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NOTES AND COMMENTS

International Sugar Agreement.

A press release from the International Sugar Council reads: "The International Sugar Council's Preparatory Committee concluded its first meeting on Thursday, 19th September. This meeting marks the first step in the preparation of a new International Sugar Agreement. The Committee's final report will enable the Council fully to consider the matter before the end of June 1964, and make appropriate recommendations to Governments, as is required by Article 2 of the Protocol extending for a further two years the Agreement of 1958.

"The Preparatory Committee conducted a constructive and useful first exchange of views on the kind of provisions which might best suit the changed and changing circumstances of the world sugar market, commissioned further studies, and arranged to meet again before the next Session of the Council to be held in November, to which a progress report will be made."

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Increase in U.K. distribution payments on sugar.

The Sugar Board's distribution payments on sugar were increased from 2s 4d to 14s 0d per cwt of refined sugar (from ¼d to 1½d per lb) from the 15th October. The sharp increase was occasioned by the need to correct the high level of ex-refinery prices resulting from high raw sugar prices.

The sharp advance from the level of £69·50 per ton on the London market quoted in our last issue to £83·00 on the day of the Board's announcement had been occasioned by two major causes: Licht's comparatively low estimate for the current European beet crop and the reported loss of about a million tons of the Cuban 1963/64 crop in the damage caused by hurricane Flora.

The Board's action would have had the effect of reducing the ex-refinery price of sugar by 11s 8d per cwt but an increase of 1s 6d per cwt in the price of raws on the day it took effect reduced the effect to just over 10s per cwt, and the price has subsequently risen to £99·per ton, only £2 below the post-war record level of May 23rd.

U.K. Sugar Board Annual Report.

The 6th Annual Report of the Sugar Board was published on the 20th September after presentation to Parliament by the Minister of Agriculture, Fisheries and Food. The Report deals with the activities of the Board from 1st July 1962 to 30th June 1963 and includes an audited statement of the Board's Accounts for that period.

During the year covered by the Report, there was an unprecedented rise in world market prices for sugar, which nearly quadrupled, and from being, at the beginning of the year, about half the price which the Board have to pay under the Commonwealth Sugar Agreement for the Commonwealth sugar which they handle, rose to a point about twice those levels by the end of the year.

The Board's trading position accordingly moved from incurring a considerable deficit at the beginning of the year to receiving a considerable surplus at the end. The Board's duty, under the Sugar Act, 1956, is to balance their revenue account, taking one year with another, by means of Surcharge in the event of trading deficits, or Distribution Payments in the event of surpluses. Accordingly, the Board started with a Surcharge of 3d a lb, reduced it by three successive steps, and, towards the end of the year, replaced it by Distribution Payments at the rate of 6d a lb. Since the end of June, with world prices falling back and then recovering, there have been three successive reductions and one increase in Distribution Payments, bringing the current rate to 1½d a lb.

By adjustments in the rates of Surcharge and Distribution Payments, the domestic price of sugar has, in spite of the abnormal behaviour of the world sugar market, kept reasonably steady except for a period in May, 1963, when the world price rocketed and domestic prices reached an abnormally high level, followed by a longer period of exceptionally low prices when Distribution Payments had come in and world prices had declined.

The Board's net loss on trading during the year amounted to £15¾ million on nearly 1·7 million tons of Commonwealth, South African and Irish sugar costing £76 million. The Board received a net pay-

ment of £500,000 from the British Sugar Corporation in respect of the production of about 700,000 tons of sugar from home grown beet. This made a total outgoing of £15¼ million. Net receipts of Surcharge collected during the year amounted to £40·2 million and net Distribution Payments to £16·1 million. After meeting the cost of interest and the expenses of the Board and of the Customs in connexion with Surcharge and Distribution Payments, there was a net surplus of £8·6 million for the year.

The Board started the year with an accumulated under-recovery of £10·8 million carried forward from the previous year to 30th June, 1962, and after recovering the £8·6 million this year, there remains an under-recovery of £2·2 million to be carried forward to the next accounting period.

During this year the Board assumed additional functions under the Irish Sugar Agreement of purchasing and re-selling 10,000 tons of Irish beet sugar and of selling Commonwealth sugar to the Irish Sugar Company. By the former transaction under the first year of that Agreement the Board received £62,000 from the Irish Sugar Company, owing to the effect on the price formula of the abnormally high world prices.

* * *

European sugar statistical situation.

Elsewhere in this issue appear estimates by F. O. Licht K.G.[1] of the 1963/64 statistical position for European sugar. Production figures are estimates made at the beginning of October while initial stocks are latest available figures, some being estimated. Final stock figures are also estimates, based on the stock-establishing policies of the contries concerned, while consumption figures are based on recent developments in sugar consumption in the appropriate countries.

Heavy crops are expected in France and Germany as a result of favourable weather conditions during August and September so that production figures are higher than was expected earlier in the growing season. C. Czarnikow Ltd. have commented[2], concening the estimates, "The biggest question mark must, as always, be placed against the forecast of the crop in the Soviet Union. It is known that climatic conditions have been very bad this year and an output well below last season's level is to be expected. The impossibility of making an accurate assessment at this stage is plain, however, and Licht has clearly followed a reasonable course in putting production at the round figure of six million tons."

The final column of the estimates—surplus or deficit—indicate either sugar available for export where positive or an import requirement where negative. Actual imports and exports cannot be assessed now, however, especially where the countries concerned, e.g. the U.K., have a refining and re-export trade.

Nevertheless it becomes evident that of Western European countries, only France, Denmark and Belgium-Luxembourg are possible exporting countries if Western Germany does not break its post-war practice of not exporting sugar. The surplus of Turkey Licht considers to be insignificant. The other countries of Western Europe will have to import sugar, a total of 4,300,500 tons being required, half of this being for Great Britain.

The corresponding net requirement figure for 1961/62 was only 2,732,199 tons; this is because in this period stocks were reduced by over 900,000 tons and a number of countries had no need of imports whereas they have in 1963/64.

The figures for the U.S.S.R. are the dominating influence in the estimates for Eastern Europe. They indicate the requirement of some three million tons of sugar, part of which may be supplied from the other East European countries with surpluses—East Germany, Czechoslovakia and Poland (provided the beet crop is harvested without losses and reported difficulties are not serious).

But with a total demand of six million tons compared with four million in 1961/62 it is evident that European sugar will bring no pressure to bear on the world market during the campaign and that cane sugar production will have decisive influence.

* * *

Japan sugar import liberalization.

Government restrictions have been removed on imports of raw sugar into Japan up to a polarization not exceeding 98. It had been anticipated that the Government, in line with its policy of permitting greater freedom in international trade, would adopt some measure for sugar which would include quotas fixed at varying rates of duty. The fact that the new regulations include no such terms and come into force from the 31st August was therefore a surprise.

Domestic production of sugar has increased rapidly of recent years but still contributes the minor part of Japanese consumption; it was feared that there might be speculative importation that might damage the domestic industry if no protection was afforded by appropriate Government measures.

However, the Goverhment is now preparing for several measures to protect the domestic sugar producers[3]. Principal measures would be as follows:

1. Special arrangements for expanding the domestic sugar and sweet resources.
2. Reduction of sugar tariffs and excise taxes.
3. Purchase of Ryukyu raw sugar.

In any case fresh purchases of raw sugar for prompt shipment are not expected, owing to adequate stock and outstanding contracts which cover the requirements of Japanese refiners up to May 1964.

[1] *International Sugar Rpt.*, 1963, **95**, (9), 125.
[2] *Sugar Review*, 1963, (631), 176.
[3] *Willett & Gray*, 1963, **87**, 405.

SUGAR CANE RESEARCH IN MAURITIUS

Mauritius Sugar Industry Research Institute Report for 1963

ACCORDING to this report active research and experimentation have been carried out on the extraction of protein from cane juice. A high protein coagulate was used in feeding trials and proved sufficiently encouraging to justify further research. Other trials were carried out to test the digestibility of rations composed of cane tops, molasses and filter muds. The results have shown that muds contain only a small percentage of digestible protein. The Research Institute has received a grant of £21,500 from the "Freedom from Hunger" Committee for the F.A.O. to further this research.

Varieties

The variety M147/44 accounted for nearly 31% of the quantity of cane milled and the variety Ebène 1/37 for 17·7%, while M134/32 and B37172 each represented 13·5%. The popularity of M147/44 is increased by its high resistance to cyclones. It yielded an average of 33·7 tons per arpent for 1962, which is 20% more than the average yield for all varieties. A four-crop trial carried out in the North showed that M147/44 yielded on average 10 tons of cane and 1 ton of sugar more than did M134/32.

Among the varieties released after 1959, M253/48 gave very high yields under irrigated conditions, and both M202/46 and M93/48 produced more than 28-ton averages. Ebène 50/47 performed best in the Centre where it outyielded Ebène 1/37 by 9 tons and has become the leading variety in the coastal plateau. It has also gained some ground in other sectors. In trials the following Mauritius varieties, not yet released for commercial cultivation, show promise—M248/48, M423/51 and M442/51.

Weed Control

It is now established beyond doubt that the use of herbicides has brought about a substantial improvement in cane agriculture in Mauritius. The sugar industry spent over Rs 4 million on herbicides in 1962, which is approximately half a million more than in 1961. The Research Institute, however, emphasizes the dangers of an indiscriminate and haphazard use of herbicides and points out that this cultural practice, in order to be really effective, requires a thorough knowledge of the products themselves, dosage, time of application, stage of growth and spraying techniques, besides other agronomic factors. Experiments are quoted in the Institute's report to show that a lack of knowledge and technique may cause severe injury to plant canes in certain cases.

Diseases

All varieties cultivated at present in Mauritius are susceptible to the two main virus diseases: ratoon stunting disease and chlorotic streak. Harvesting results in ratoon stunting trials have shown average reductions in yield, after four ratoons, varying from 9% in Ebène 1/37 to 17% in B 37161 in the sub-humid area. The trials in the super-humid zone were affected by the cyclones, and the results obtained were somewhat less reliable, although they confirmed the observations made previously on the varieties released after 1959; yield losses fluctuated from 20% in Ebène 50/47 and 16% in M 202/46 to 10% in M93/48 and 7% in M253/48. In view of the importance of using disease-free planting material, the Research Institute has now established a central nursery from which healthy plants will be available for secondary nurseries on estates.

Nurseries established on estates totalled 133 arpents in 1962, and plantations made during the year with material obtained from both the central and secondary nurseries amounted to 1410 arpents, which represents more than 10% of the 12,280 arpents planted. The nursery acreage will be progressively increased in 1963 and 1964, and by 1965 the material available will meet the total planting requirements.

Soil and Ground Water Surveys

The soil map of Mauritius appeared during the year and there is no doubt that it will prove of great value to the sugar industry. Already it has been of great help for the selection of permanent units, fully representative of climate, soil groups and past history of cane fields, from which leaf samples will henceforth be obtained to control cane nutrition by means of foliar diagnosis. Determinations of soil fertility have been made by several chemists on their respective estates, and eventually it will be possible to give basic soil data covering all the estate cane area.

The ground water survey initiated in 1958 was completed at the end of 1962, except for observations on the water level of 130 sites. From the investigations it would seem large scale exploitation of ground water could probably be made in several well defined areas in the North and in other districts. In addition a number of sites suitable for local utilization of ground water have been located, and two of those are at present being exploited by the sugar estates on which they are situated.

F.N.H.

SUGAR CANE DISEASES IN TAIWAN

Report of Taiwan Sugar Experiment Station, No. 30, Jan. 1963

THIS report deals mainly with the recent work in Taiwan on those diseases of sugar cane which are most troublesome in that country—especially Downy Mildew and White Leaf Disease.

T. L. CHU and L. S. LEU deal with "Testing the First Year Seedlings of Sugar Cane against Downy Mildew (*Sclerospora sacchari*)" They point out that the degree of resistance or susceptibility to Downy Mildew in sugar cane varieties is inherited. The breeding of sugar cane varieties resistant to the disease is one of the major objectives of the Taiwan Sugar Experiment Station. The purpose of the experiments here described (which extended over a four-year period) was to test the effect of exposure to mass infection of the first year seedlings of varying parentage and to ascertain whether such a severe test so early in the life of the plant could be used in the breeding of Downy Mildew resistant varieties. In general it was found that all varieties seemed to be highly susceptible at this early age. With some varieties it appears resistance increases with increasing age. Further work on the subject is envisaged.

Another paper, by L. S. LEU and H. C. LO deals with "Studies on the Artificial Inoculation with Sugar Cane Downy Mildew," experiments having been conducted at the Hsin-chu Downy Mildew Resistance Trial Field. Artificial inoculation with both conidia (asexual stage), from conidia-bearing leaf tissue, and with oospores (sexual stage), from splitting sugar cane, presented no difficulty. Inoculations were made on the buds of cuttings and those of standing cane. All the tillers emerging from cuttings of several varieties infected by bud inoculation with conidia bearing leaf tissue showed symptoms of infection, their growth being poor and their stalks thin. Leaf splitting and oospores were observed. In the case of inoculated leaves local lesions were easily recognised two or three days after inoculation. Photographs illustrate the nature of the disease.

There are four papers in the report on the White Leaf disease of sugar cane (a virus), all in Chinese with English summaries. Three are by K. C. LING and C. CHUANG-YANG, viz.: (i) "Leaf Recovery and Mask of Symptom," (ii) "Efficacy of Hot Water Treatment in the Disease," and (iii) "Evidence of Spreading of the Disease under Natural Conditions," while the fourth paper, by K. C. LING, deals with "Phloem Cells of the Diseased Stem." It has been established that a white leaf on a diseased stem may gradually regain chlorophyll and become normally green in appearance and be indistinguishable from normal healthy leaves. Nevertheless stem cuttings from a stem bearing such a leaf are liable to show the disease when growth commences.

Hot water treatment was not found to be effective or wholly effective in the treatment of planting setts from diseased mother plants, although it reduced the incidence of the disease. Treatment was at 54°C for 40 minutes. Healthy plants placed in diseased fields became infected but the causal agent responsible for the spread of the disease is obscure.

In his paper on phloem K. C. LING points out he wished to ascertain whether any abnormalities existed in this tissue in the cane of plants suffering from White Leaf disease. Some phloem cells in the vascular bundles (mainly sieve tubes) were found to be discoloured (slightly yellowish grey) and to react differently with certain stains as compared with normal healthy tissue.

H. T. CHU and T. K. TSAI are authors of a paper on the effect of soil fumigation on the growth of sugar cane. There are five kinds of nematode parasitic on sugar cane in Taiwan. The use of soil fumigants as nematocides ("EDC" and "DD" mixture) to control these pests has a beneficial effect on the early growth of the cane. This has also been found to apply in Queensland and Hawaii. Figures are given showing the increase in yield that may be expected.

F.N.H.

AGRICULTURAL ABSTRACTS

Translocation of ^{14}C in sugar cane. C. E. HARTT *et al.* *Plant Physiology*, 1963, **38**, (3), 305–318.—As sugar cane plants in Hawaii translocate sucrose at the rate of over one million tons per year it is contended that translocation studies have an immense economic potential. The sugar cane plant possesses advantages for studying translocation with its long symmetrical leaf blades with parallel venation and the large size of the plant. It was found that sucrose was the principal compound translocated throughout the plant; down the stalk to stubble and roots, up the feed stalk to the spindle and up other stalks in the stool. Newly formed radioactive sucrose quickly enters the veins and moves mainly downward at velocities up to 2·5 cm per minute. Factors affecting velocity of translocation are mentioned.

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Hawaiians in Puerto Rico: Efforts made to increase production. C. T. WILLETT and C. BREWER. *Sugar y Azúcar*, 1962, **57**, (12), 65–66.—In 1961 C. Brewer & Co. Ltd. of Honolulu, Hawaii, acquired the interests of Fajardo Eastern Sugar Associates (A Trust) producing 169,000 tons of sugar from 56,000 acres in 1960. A research laboratory with experience in Hawaii was quickly established paying special attention to soil deficiency problems and fertilizers. In some areas phosphatic fertilizers yielded astounding results. Mechanization in field operations receives special consideration.

Cane variety Q.57 in the far North. ANON. *Cane Grower's Quarterly Bull.*, 1963, **26**, (4), 111.—The good sugar cane crops obtained in Queensland in the year 1962 are referred to, records for many areas being broken. The fine performance of the variety Q.57 in the cane growing area from Mossman to Tully, where it constitutes 37·1% of the crop, is dealt with. The ability of this cane to synthesize sugar where there is a deficiency of sunshine, i.e. in cloudy wet-belt areas, is stressed. In one mill area it now constitutes 62% of the crop.

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Bandicoots damage cane setts. C. A. MCALEESE. *Cane Grower's Quarterly Bull.*, 1963, **26**, (4), 112. The short-nosed bandicoot (*Isoodon obesulus*), common throughout coastal Queensland, has been shown to be a pest with newly planted sugar cane in the Mirani area of the Mackay district in Queensland. It digs up the planted cane sett and eats the pith, leaving the rind. Damage was severe enough to call for replanting in some blocks.

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A useful drain cleaner. C. L. TOOHEY. *Cane Growers' Quarterly Bull.*, 1963, **26**, (4), 113–114.—An account, with photographs, is given of a new tractor-drawn or driven drain cleaner in sugar cane fields, which is claimed to be very efficient. A rotary hoe driven by the tractor is incorporated. The machine may be used to clean, or construct, a round bottomed drain to a depth of 22 inches. It is made by Byron Farm Implements Co., Dandenong, Victoria, Australia.

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Frost in the Mackay District. C. G. STORY. *Cane Growers' Quarterly Bull.*, 1963, **26**, (4), 115–118. This article constitutes a good account of the manner in which frost or too low a temperature will injure sugar cane. Injury may take place with (a) foliage, (b) eyes, (c) growing point and (d) stalk. Foliage is usually the first part to be affected and may be the only part with light frosts. With leaf damage only, the setback is only temporary. The greatest losses from frost damage follow the killing of the growing point. Planting material inadvertently exposed to frost should be examined for eye damage. The nature of the frost damage in various districts is discussed and a photograph showing "sideshooting due to frost damage" is included.

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Ploughing-in gives better distribution of insecticides. K. C. LEVERINGTON. *Cane Growers' Quarterly Bull.*, 1963, **26**, (4), 130–131.—For the control of soldier flies and some grub pests in Queensland sugar cane fields the practice is to broadcast insecticides and then incorporate them into the soil either by ploughing or heavy discing or by light discing or using a tined implement like a grubber. By an ingenious method, applying the fluorescent pigment "Saturn Yellow" to the soil, incorporating in the soil by different methods and then examining slices of the soil under ultra-violet light, it was possible to test the efficiency of the different methods of incorporation. This clearly demonstrated the value of ploughing or heavy discing.

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Forage harvesters for harvest residue disposal. G. H. WHITAKER. *Cane Growers' Quarterly Bull.*, 1963, **26**, (4), 132–133.—Early in the milling season, with poor burns, and damp conditions generally, growers in Queensland may be faced with the disposal of a large body of green leafy tops before ratooning operations can commence. This paper describes the successful employment of a forage harvester which shreds the tops or leafy material and then disposes of it through a chute at the back leaving an even blanket of residue over the field.

* * *

Q.75 performs well in ratoon trials. L. G. VALLANCE. *Cane Growers' Quarterly Bull.*, 1936, **26**, (4), 134–135. In trials conducted with this variety in three different areas in Queensland, it gave a very good performance. It was grown next to standard varieties for comparison, and a future is predicted for it in Queensland. Q.75 shows great resistance to wind damage.

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Q.68 impresses at Isis. J. ANDERSON. *Cane Growers' Quarterly Bull.*, 1963, **26**, (4), 140–142.—An account is given of the promising performance of this new variety in Queensland. It is thought it will prove valuable in many districts.

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The effect of wetting agents combined with mercurial sprays or dips on the germination of cane. D. R. L. STEINDL. *Cane Growers' Quarterly Bull.*, 1963, **26**, (4), 143–144.—Poor strikes with seed cane or setts led some Queensland cane growers to believe that the wetting agents used might be responsible. The trials disproved this.

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Field mechanization. R. J. LEFFINGWELL. *Sugar y Azúcar*, 1963, **58**, (3), 12.—A brief survey is made of recent developments in cane harvesting and handling in different parts of the world. Interest in mechanical harvesting continues to grow in Australia. At the close of last season ninety-one Massey-Ferguson harvesters were operating successfully. Two new whole-stick cane harvesters, the Maxwell Morrow

and the Cabavie, have entered the field while that developed by Toft Bros. Enterprises is reputed to have performed very well. The Thompson Machinery Co. in Thibodaux, Louisiana, have a new cane harvester operating in Costa Rica which is designed to handle 50 to 100 tons per acre cane in tropical areas.

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Early Everglades research: the need for copper and manganese for sugar cane. R. V. ALLISON. *Sugar y Azúcar*, 1963, **58,** (3), 53–54, 78.—An account is given of the early work establishing the need for copper and manganese in the sugar growing areas of the Florida Everglades.

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Sugar beet yellows and the seed crop. R. HULL. *British Sugar Beet Rev.*, 1963, **31,** (3), 125–128. Recent developments in insecticides indicate that more effective control of the insect vectors responsible for spreading this virus disease will be possible in the future.

* * *

Selection work with sugar cane in Réunion. H. MOURGUET. *Rev. Agric. Ile Réunion*, 1962, **62,** 357–368.—This article is the second and final instalment of an earlier article. It outlines the methods employed at the sugar research station in breeding and producing new varieties. The characteristics of those varieties which are, or have been, of importance in Réunion are dealt with and geneological trees, which show clearly their derivation, are included.

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Kenaf for Mozambique's grain bags. ANON. *S. African Sugar J.*, 1963, **47,** (4), 233.—As grain bags may be bracketed with sugar bags it is interesting to note that Portuguese East Africa hopes to substitute locally produced kenaf for imported jute in their manufacture. A factory near Beira makes 20,000 bags a day. Seed of kenaf (*Hibiscus cannabinus*), and advice about growing are given to farmers. The crop takes only a few months to grow and might be rotated with sugar cane[1].

* * *

Fodder cane responds to fertilizer in Gympie trials. N. W. DOHERTY. *Queensland Agric. J.*, 1963, **89,** 214–216.—Trials over two seasons showed that balanced ratoon type fertilizers plus side dressings of sulphate of ammonia gave the highest yield per acre. Less substantial but more economical increases were obtained from side dressings of sulphate of ammonia alone.

* * *

Overland on an air cushion, dbuét of the Vickers "Hovertruck". ANON. *Tropical Science*, 1963, **5,** (1), 4–5.—This is an account of the first public demonstration of a cross-country vehicle (Vickers "Hovertruck" Mk. 1) employing the revolutionary hovercraft principle. It was held on soft fen-land soils on a farm at Ely, Cambridgeshire, England. A description of the vehicle, with photographs, is given. It is based on a "Land-Rover" wheel-based chassis, with 2¼-litre engine. The truck can operate on wet or muddy soils where the ordinary tractor would get bogged. Whether such a vehicle will find a use in cane-growing areas only the future can tell.

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Sugar cane planting in Spain. E. M. HERRERA. *Boletín de Información del Sindicato Nacional del Azúcar*, 1963, (178), 21–22.—An account is given of the recommended methods of planting cane in the Malaga area, including treatment of setts with insecticides or fungicides for disease control.

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Sugar beet trials in west Kenya. J. L. ELMER, J. M. GOSNELL and R. G. SMITH. *East African Agricultural and Forestry J.*, 1963, **28,** 243–248.—As fodder beet had been successfully grown in some of the cooler parts of Kenya it was decided to test sugar beet, 18 field experiments being laid down in 1959 and 1960. By and large, results were not very favourable and the conclusion reached was that sugar beet is unlikely to compete with sugar cane as a sugar producer in Kenya. Marked response to phosphatic and nitrogenous fertilizers was obtained.

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Varieties of sugar beet. ANON. *Farmers' Leaflet* (National Inst. Agric. Botany, Cambridge, England), 1963, (5), 6 pp.—This leaflet contains a list of 15 recommended varieties of sugar beet for British farmers. Information on the main characteristics of each variety is given.

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Studies on the biology of sugar cane white fly, *Aleurolobus barodensis* Maskell. J. S. SANDHU and SARDAR SINGH. *Indian J. Sugar Cane Res. Dev.*, 1963, **7,** 83–88.—An account of detailed life history studies of this pest is given. A serious sugar cane pest in the Punjab, it sucks the sap from the leaves, causing severe losses in sucrose content.

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Distribution, seasons of occurrence and control of the early shoot borer of sugar cane—*Chilotraea infuscatellus* (Snellen), in Madras State. V. M. KALYANARAMAN, A. L. DAVID and P. S. NARAYANASWAMY. *Indian J. Sugar Cane Res. Dev.*, 1963, **7,** 89–95.—This early moth borer does much damage by killing young shoots outright. Results are given of studies relating to distribution, extent of damage, effect of weather conditions and control measures.

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Studies on the effects of application of major nutrients to sugar cane at Tanuku. K. K. P. RAO and V. L. RAO. *Indian J. Sugar Cane Res. Dev.*, 1963, **7,** 96–101. During the last three seasons investigations were carried out to ascertain the optimum requirements of

[1] See also *I.S.J.*, 1963, **65,** 99, 131.

sugar cane with regard to nitrogen, phosphate and potash. There were eight different treatments. Nitrogen resulted in marked increases in yield but potash and phosphoric acid had little effect.

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Varietal susceptibility to sugar cane rust at Padegaon. Y. V. INAMDAR and M. S. RANE. *Indian J. Sugar Cane Res. Dev.*, 1963, **7**, 102–103.—This paper gives the results of tests with numerous varieties on susceptibility to rust. Of 75 varieties tested, 33 proved susceptible while 42 remained free of the disease. In the State of Bombay the promising variety Co. 475 was given up on account of high susceptibility to rust.

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Fertilizer experiments on sugar cane in South India. II. NPK trials at Pugalur. R. D. REGE, V. R. RAJAGOPAL and V. K. BHASKER RAO. *Indian J. Sugar Cane Res. Dev.*, 1963, **7**, 104–107.—Nitrogen (150 lb or 250 lb per acre) greatly increased yield with both "special" season and "main" season crops, while P alone and K alone gave negligible responses. The highest yield ("special" season) viz. 60·67 tons of cane per acre, was obtained with N(250) + P(100) + K(100).

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Studies on time of planting and harvesting of sugar cane. II. Adsali. S. K. SASTRY, A. VENKATACHARI and Q. ZAINULABEDIN. *Indian. J Sugar Cane Res. Dev.*, 1963, **7**, 108–117.—No significant difference in cane yield or juice quality was found at the Sugar Cane Research Station, Rudrur (Andhra Pradesh), in crops planted during the four monsoon months (June–September) which are the adsali planting season. In the harvesting months juice sucrose improved from October to January. August planting and January harvest gave maximum profit.

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Study of total solids-sucrose content relationship in sugar cane with reference to varieties. D. J. DURAIRAJ. *Indian J. Sugar Cane Res. Dev.*, 1963, **7**, 118–126, 127–135.—An attempt at determining, even during the early stages of cane growth, the earliness or lateness of different cane varieties from a consideration of the total solids-sucrose relationship in the juice is described. The effect of time of planting and age of crop at harvest on the relationship is also studied.

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Factors affecting the population of sugar cane white fly (*Aleurolobus barodensis* Maskell). J. S. SANDHU. *Indian Sugar*, 1962, **12**, 581–584.—Observations on white fly populations were carried out in conjunction with fertilizer experiments. It was found that white fly decreased with the increase in the application of N, which supported the findings of earlier observers. P and K applications had no effect.

Influence of intercrops on the juice quality of sugar cane—a critical study. P. S. GILL. *Indian Sugar*, 1963, **12**, 629–633.—Tests over a period of 10 years at 7 locations, with 9 different intercrops, were carried out, intercropping with autumn planted cane being on the increase in areas of high crop density in the States of Uttar Pradesh and Bihar. The conclusion reached is that the practice is not necessarily harmful to the cane and sugar content. Reasons are given.

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A note on the effects of gibberellic acid on growth and juice quality of sugar cane. H. P. VARMA and S. A. ALI. *Indian Sugar*, 1963, **12**, 635–636.—Pot experiments with different concentrations of gibberellic acid applied to the growing points were carried out. With the highest concentration (in lanolin) average internode length increased from 7·6 cm to 10·3 cm. There was a reduction in diameter and tillering and no increase in number of internodes. Except in the highest dose juice quality was not affected. The use of the hormone on a field scale would not be economical.

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Ammonium chloride fertilizer on sugar cane crop. H. SINGH and S. C. SEN. *Allahabad Farmer*, 1962, **36**, 11–13; through *Soils & Fertilizers*, 1963, **26**, (4), 287.—Ammonium chloride should not be applied at high rates (100 lb/acre N). Even at lower rates split application is recommended, the 2nd dressing being kept slightly higher and given at the onset of rains. It is safer applied with organic manures.

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Some effects of different soils on composition and growth of sugar beet. P. J. GOODMAN. *J. Sci. Food Agric.*, 1963, **14**, 196–203; through *Soils & Fertilizers*, 1963, **26**, (4), 287.—Sugar beets grown on silty loam, shallow loam, oolitic limestone and clay with flints were harvested at 2–4 weekly intervals during 1960 and 1961 and analysed for N, P, K and Na. Yields on all soils were closely related to N supply. Details are given of findings in regard to other nutrients.

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Sugar cane diseases in Mauritius, Natal and Kenya. P. BAUDIN. *L'Agronomie Tropicale*, 1963, **18**, 227–232. The troublesome fungus, virus or bacterial diseases of sugar cane in these three countries are dealt with. General information about the diseases and the remedial measures that are being taken are included.

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The sugar beet as a producer of fodder. O. HEINISCH. *SB deutsch. Akad. Landwiss. Berl.*, 1961, **10**, (4), 35–39; through *Plant Breeding Abstracts*, 1963, **33**, (3), 439.—Improvements in yield of tops have been made and varieties expected to be of use for fodder have been developed. These include hybrids between mangels and sugar beet. The development of forms suitable for mechanical harvesting is now receiving attention.

FURTHER STUDIES IN THE DRYING OF WHITE SUGAR

By T. RODGERS, C. L. LEWIS and J. D. OSBORNE

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PART III

Theoretical considerations of forced circulation

We have seen that even by increasing the circulator speed up to 100 r.p.m. we have been unable to make any measurable improvement in No. 3 pan, but the cause of the difference could be simply in the shape of the pan, i.e. due to reduced velocity and poor circulation above the tubeplate as the result of the increased diameter at this point. On the other hand, if it is due to too little massecuite recirculation, by reason of the smaller downtake diameter, by how much should the propeller speed be increased to compensate for this reduced diameter as compared with that in pans 1 and 2 ? To attempt to answer this we had to try a theoretical approach to the problem.

The design of propellers is based as much on arbitrary constants and coefficients as it is on pure hydraulic theory. There was unfortunately no means attached to any pan for measuring the massecuite velocity in the tubes. It was possible to use theoretical calculations to determine the quantity of massecuite being pumped, but without knowing the actual velocity, we could not determine a value for propeller efficiency for the different diameter propellers used, or indeed for the different speeds and shapes of pans under which the propellers operated. We did however know the power consumed under different conditions, and felt therefore that a theoretical approach, again although not supplying absolute figures, could give relative indications of differences between the pans.

(*b*) An increase in turnover of the whole contents of the pan. It is well known that very severe differences in temperature, and therefore syrup saturation, do occur in a vacuum pan, due to hydrostatic head and boiling point elevation, and also due to the fact that the heat input is at the bottom of the pan and liberation of vapour is from the top surface. The more rapid the circulation, the better chance there is of maintaining a more even temperature throughout the pan contents, and therefore more even crystallization.

With these considerations in mind, it will be noted in columns 10 and 11 of Table VIII that the ratio of tube area:downtake area and final strike volume: downtake area is calculated for each pan. We have maintained earlier that with the same design of propeller used in all pans, the diameter (or area) of the downtake has the greatest influence on the quantity of massecuite circulated. The downtake area is therefore used as a measure of the volume circulated. Increase of speed it seems can only compensate for this diameter difference up to a point, because it seems very likely from theoretical considerations that the "slip" is greater, i.e. efficiency of the propeller is less, with increasing speed.

Again we would emphasize that any conclusions made are not absolute, but from the evidence at King's Lynn, and with the propeller design as used, the ratio of tube area:downtake area should not exceed 2·00 by any great amount, and the final strike volume:downtake area ratio gave much superior results at 60 than at 100.

Table VIII

Pan No.	Number of tubes	Dia. of tubes (in)	Area of tubes (sq.ft.)	Dia. of downtake	Area of downtake (sq.ft).	Final strike volume (cu.ft.)	Tube plate dia.	Heating surface (sq.m.)	Ratio Area of tubes: Area of downtake	Ratio Final strike Vol.: Area of downtake	Peripheral speed at tips of blades (ft./sec.) 64 r.p.m.	75 r.p.m.	80 r.p.m.	93 r.p.m.	100 r.p.m.
1	612	3½	35·9	4 ft 9 in	17·7	1100	12 ft 0 in	205	2·03	62	17·6	20·6	—	—	—
2	612	3½	35·9	4 ft 9 in	17·7	1100	12 ft 0 in	205	2·03	62	—	—	—	25·5	—
3	810	3½	45·7	4 ft 3 in	14·2	1530	12 ft 0 in	275	3·22	108	—	18·3	19·5	—	24·4
4	522	4	39·4	3 ft 11 in	12·0	1250	11 ft 0 in	220	3·28	104	—	18·3	19·5	—	—

Table VIII records, for the four pans, some of the data which we consider are significant in the matter. It seems apparent that the production of better crystals by forced circulation must be due to one, or both, of the following effects:

(*a*) An increase of massecuite velocity in the heating tubes, thus reducing the likelihood of local overheating and therefore less severe conditions of under- and over-saturation of the syrup surrounding the crystals. Increased velocity will also have the effect of minimizing variations in saturation as the result of the more rapid relative movement of crystals in mother syrup.

In Table IX are shown some calculations on the pans at the various speeds using the formula of Tromp[2],

$$Wm = \frac{\pi}{4} (d^2 - d_1^2) \times V \times w$$

where Wm = weight of massecuite in lb/sec, d = outside diameter of propeller, d_1 = diameter of propeller hub, V = speed of massecuite in ft/sec, w = density of massecuite in lb/cu.ft., and

$$V = \frac{p \times n}{60}$$

where p = propeller pitch in feet, and n = speed in r.p.m.

[2] "Machinery and Equipment of the Cane Sugar Factory". (Rodger, London). 1936, p. 451.

The calculated figures do not allow for any "slip," so the actual velocities will be lower, and the ratio of volume displaced: final strike volume will be smaller in practice. Nevertheless, the relative figures are comparable.

Again the significant differences between the two pan designs are illustrated in columns 5 and 8 of this table. The most satisfactory results are achieved with a theoretical tube velocity of about 2·5 ft/sec. It is interesting to note that to achieve this velocity in say pan No. 3, the stirrer would have to be run at a speed of approx. 145 r.p.m. This is based on theoretical considerations, but it is almost certain that the speed would have to be greater to accommodate the lower efficiency. The peripheral speed would then be so high that the sugar boiler would find it extremely difficult, to say the least, to avoid formation of false grain.

In Table X are recorded some typical readings taken during the boiling of a strike in each pan. The speed of the stirrers is also noted in each case.

These results are illustrated in Fig. 15. Pan No. 3 with a stirrer speed of 100 r.p.m. required 55 amp at graining, approximately 50 amp on continuous feed and rose to 100 amp at 5 minutes before dropping. The power in h.p. may be determined closely by multiplying amperage readings by 0·75. It can be seen that it is quite possible for the sugar boiler to operate his pan from the ammeter. The circulator is in fact a mobility meter, and is used as such by the sugar boilers at King's Lynn.

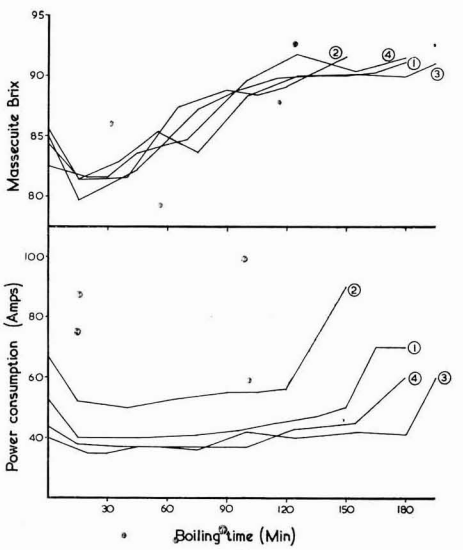

Fig. 15

It will also be noted from Table X that the power consumed at 80 r.p.m. in Nos. 3 and 4 pans is less than in No. 1 at 75 r.p.m.

Table IX

Pan No.		*Propeller speed r.p.m.*	*Wm-weight massecuite displaced (lb/sec)*	*Propeller displacement (cu.ft./sec.)*	*Velocity through tubes (ft/sec).*	*Velocity through downtake (ft/sec.)*	*Massecuite volume displaced (cu.ft./min.)*	*Ratio of massecuite volume displaced to final strike volume*
1	.....	64	6988	75·1	2·09	4·24	4506	4·10
		75	8163	88·0	2·45	4·97	5280	4·80
2	.....	93	10103	108·9	3·03	6·15	6534	5·94
3	.....	75	5940	64·0	1·40	4·50	3840	2·51
		80	6340	68·3	1·49	4·80	4086	2·67
		100	7920	85·4	1·86	6·00	5105	3·33
4	.....	75	5390	58·1	1·47	4·84	3476	2·78
		80	5760	62·0	1·57	5·16	3710	2·96

Table X

Pan 1 (75 r.p.m.)				*Pan 2 (93 r.p.m.)*				*Pan 3 (80 r.p.m.)*				*Pan 4 (80 r.p.m.)*			
Time (min)	*Power (amp)*	*Brix*	*Volume (cu.ft.)*	*Time (min)*	*Power (amp)*	*Brix*	*Volume (cu.ft.)*	*Time (min)*	*Power (amp)*	*Brix*	*Volume (cu.ft.)*	*Time (min)*	*Power (amp)*	*Brix*	*Volume (cu.ft.)*
At grain	53	85·0	425	Grain	67	85·6	425	Grain	44	84·4	400	Grain	40	82·5	400
15	40	79·6	460	15	52	81·4	530	15	38	81·4	550	20	35	81·6	550
45	40	82·2	530	40	50	81·6	670	35	37	82·8	650	30	35	81·6	630
75	41	87·2	600	65	53	87·4	700	55	37	85·4	740	45	37	83·6	630
95	42½	88·8	810	90	55	88·8	880	75	36	83·6	850	70	37	84·8	710
115	45	89·8	850	105	55	88·4	990	100	42	88·4	850	100	37	89·6	850
135	47	90·0	880	120	56	89·2	1090	125	40	90·0	1000	125	43	91·8	970
150	50	90·0	1025	150	90	91·6	1130	155	42	90·2	1150	155	45	90·4	1150
165	70	90·4	1160	—	—	—	—	180	41	90·0	1350	180	60	91·6	1250
180	70	91·2	1160	—	—	—	—	195	60	91·2	1450	—	—	—	—

Sugar Moisture Analysis

There is no doubt that the main cause of difficulties which can arise when handling white sugar in bulk is excessive moisture in the sugar. Tests have confirmed the presence of Bound Moisture and it is very often this form that can be most dangerous, because it is so difficult to measure by the standard gravimetric method. To use a standard 3 hr drying test on sugar just produced in the factory really does not tell us very much about the moisture present in the sugar, and therefore how it is going to handle in bulk form. It is essential to know the total moisture present, and this we know we can do by letting crystallization continue until no more moisture is released, and then drying the sample in the oven. But this takes time—in the opinion of the authors at least two or three days to get a reasonably accurate result—and as all factory operators know, the earlier any analysis is available, the more useful it is to the production staff.

It was in thinking along these lines that the authors felt that it would be most useful to have a relatively rapid method of measuring the total moisture in a sample of sugar, and at the same time a method which is simple enough to perform for routine factory control. On this basis it was decided to investigate the method of KARL FISCHER which is quite widely used for moisture analysis on a number of products. This analysis does not require too complicated apparatus but, as we were to find, it requires rather an exact technique. However, it gives a relatively quick result and we wished to ascertain whether it would measure some or all of the Bound Moisture in this short time.

Tests were started during last campaign on samples of sugar being produced, using a Karl Fischer apparatus obtained from Baird and Tatlock Ltd. Details of the procedure are as follows :—

Under sealed conditions, 10 ml of Karl Fischer reagent (containing the equivalent of approx. 5 mg of water per ml) was titrated against methanol of known water content (2·5 mg/c.c.), from which the exact strength of the Karl Fischer reagent was obtained. Thirty grams of sugar were immediately added to the titration vessel as rapidly as possible, to avoid absorption of moisture from the atmosphere, followed by agitation for 25 minutes by means of a magnetic stirrer. Excess Karl Fischer reagent was added and retitrated with the methanol. From the latter titration the moisture content of the sugar is obtained.

Over twenty analyses were carried out using this method and on each sample a check was made with a portion of the same sugar by treating in the humidity oven, followed by a 3 hr drying test. In each case the samples were left in the oven for 24 days so that most of the Bound Moisture was by then released. An initial 3 hr drying test was also carried out in each case.

The average results of the tests were as follows:—

Original Moisture (Gravimetric method, 3 hr at 105°C)	= 0·0192%
Moisture by Karl Fischer analysis	= 0·0261%
Final Moisture (Humidity oven and 3 hr at 105°C)	= 0·0339%

The analysis by KARL FISCHER took about 40 minutes to perform. It can be seen that the results hold some promise, but they are not yet satisfactory, individual results varying quite appreciably.

The average of the Karl Fischer results was approximately midway between the initial moisture and the total moisture; therefore, on average, the results achieved gave a more true indication with a 40 minutes' analysis time than did the old method requiring about 5 hours for the gravimetric test (allowing for cooling the sample).

This was felt to be sufficiently encouraging to carry on using the apparatus this off-season to perfect the technique, and it is proposed to carry out a further series of analysis in the 1963/64 campaign when fresh sugar is again available.

Conclusions

From the results of the 1962/63 trials at King's Lynn, the authors are confident that by using a circulator of the present design and with pans proportioned to suit the figures quoted in Tables VIII and IX, satisfactory crystals can be produced. It is important not to have the peripheral speed of the stirrer too high, say not exceeding 20 ft/sec, otherwise there are difficulties with formation of false grain.

The shape of the shell of the pan is a problem on which a definite conclusion cannot be drawn. With the proportions of tube area, downtake area and final volume, which seem to be necessary, and with the propeller design which we have, the low head pan does not seem either necessary or suitable for the work. Indeed provided one can achieve the desired grain size in white sugar (which one can with a parallel-sided pan) there seems no advantage to be gained in the low head design.

The information so far obtained might be used, however, in suggesting a design for a pan. It must be understood that the following design is one which would suit the propeller in use, and furthermore is one which the authors are quite confident would give good crystal shape—certainly better than could be obtained with natural circulation.

It is based on the two ratios referred to earlier. We have considered a 1250 cu.ft. pan (50 tons massecuite) which is a standard size frequently used in the British Sugar Corporation. Furthermore we have used the same heating surface (220 sq.m.) as used in the standard pan, as this is known to be suitable for boiling white sugar on 2nd effect evaporator steam. As a point of interest this is the capacity and heating surface of Pan No. 4 illustrated in Fig. 1.

The calculation is as follows:—

$$\text{If ratio } \frac{\text{Final strike vol (cu.ft.)}}{\text{Area of downtake (ft.)}} = 60$$

then area of downtake = 20·8 sq.ft.; so diameter of downtake = 5·08 ft or say 5 ft downtake diameter.

$$\text{Now using ratio } \frac{\text{Tube cross section area}}{\text{Area of downtake}} = 2{\cdot}0$$

Tube area = 2 × 20·8 = 41·6 sq.ft.

With tubes of 3½ in diameter, therefore, the number of tubes required is 625 and, therefore,

$$625 \times \pi \times \frac{3{\cdot}5}{12} \times L = 2360 \text{ sq.ft. } (=220 \text{ sq.m.})$$

$$\therefore L = 4{\cdot}11 \text{ ft}$$

i.e. length of tube = 4 ft 1½ in.

To determine the diameter of the pan, a tubeplate was drawn to accommodate a 5 ft dia. downtake and 625 × 3½ in dia. tubes. This gave a tubeplate (or pan) diameter of 11 ft 6 in.

Likewise for a pan of 1530 cu.ft. (60 tons massecuite) the downtake should be 5 ft 9 in diameter, the number of tubes of 3½ in dia. is 760, the length of tubes 4 ft 3 in for a heating surface of 275 sq.m., and the pan diameter 12 ft 6 in. This is equivalent to the low head pan No. 3 in the tests.

From the practical point of view, it was quite certainly much easier to dry the sugar in the 1962/63 campaign than ever before (despite the fact that we were not entirely satisfied with the grain from pans 3 and 4). Referring now to an initial moisture determination and with results strictly comparable with the previous campaign (when only one pan was fitted with a circulator), the moisture last campaign was 0·018% against 0·035% in 1961/62.

Another effect was a decrease in % ash between the two years, amounting to 0·002%, and at the same time there was an increased yield of white sugar primarily due to using less water on the white centrifugals. The 1961/62 yield for the whole campaign was 5·620 tons/100 hl (one circulator in use) while for 1962/63 the average yield was 6·153 tons/100 hl. This represents an increase of over 9% on white sugar.

A further advantage is the possibility of using the circulator for controlling automatically the liquor feed to the pan. Other variables would, of course, have to be controlled, but the mobility of the massecuite would be the hub around which the control system would be built. At King's Lynn the most desirable concentration while running up the strike was about 60% of the final amperage. When the massecuite volume reached a certain quantity, the amperage was allowed to increase for 15–20 minutes. This brought the strike to its final concentration, the circulator being stopped when full load current of the motor was reached (depending on stirrer speed used).

Finally, the improvement of the crystal form, with the consequent reduction of syrup left on the crystal surface after centrifuging, can materially reduce the Bound Moisture which is normally slowly released from all freshly produced sugar. The reduction of this Bound Moisture is the most important feature in the quality of sugar which has to be stored or transported in bulk.

Acknowledgments

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CANE JUICE DELIMING

Results with Soda Ash at Crescent Sugar Mills & Distillery Limited

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with the collaboration of

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CRESCENT is a double carbonatation factory designed for a capacity of 1500 long tons of cane per day but actually crushing over 1650 tons while at the same time melting from 25 to 35 tons per day of gur at 74–82 purity or khandsari sugar of 95 purity in the weighed mixed juice, the purity of which has varied between 78 and 82 during the past season.

At Crescent, and also at the two other factories in the same region of West Pakistan, the lime salts in the clarified juice are found, in general, to be between 225 and 250 mg CaO per litre of juice of 15–17° Brix, when cane alone is being processed. This applies even when using over 3% on cane of very good quality limestone. When melting gur, the CaO content rises to around 275 mg per litre and even to more than 300 mg when stale, acidic gur or very stale cane is being processed. In this connexion, the senior author, while recently in Bihar, India, was shown figures of over 600 mg CaO per litre of clarified juice in a factory having to crush very stale cane.

The usual method of carbonatation, i.e. adding milk-of-lime and carbonatating in five to six steps, including a moderate pre-liming stage with a little gassing, is practised, the juice from the heater being maintained between 52 and 55°C and the juice from the first filter-presses between 56 and 59°C.

*, †, ‡ General Manager, Chief Chemist and Chemists, respectively, of Crescent Sugar Mills & Distillery Ltd., Lyallpur, West Pakistan.

There were definite signs at Crescent, however, of a certain shortage of CO_2 at the carbonatation station in spite of the fact that 10% of coke of good quality was being used on limestone. The very peculiar design of the tanks for first carbonatation is illustrated in Fig. 1; this includes an inner circulation

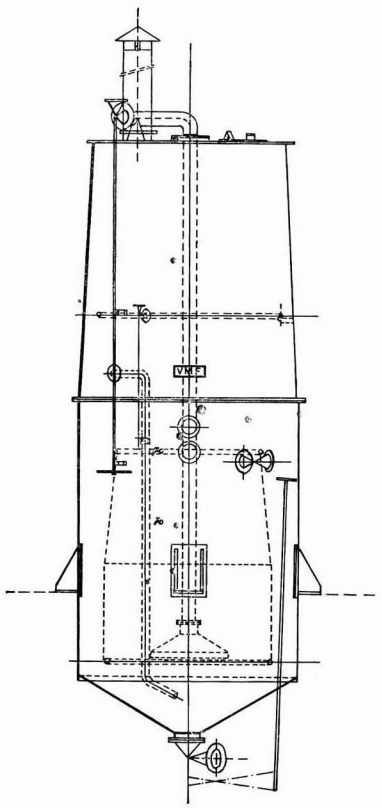

Fig. 1.

1. Overall height = 21 ft 11 in
2. Diameter at top = 7 ft 4 in
3. Diameter at bottom = 8 ft 4 in
4. Height of cylindrical portion = 10 ft 5 in
5. Height of conical portion = 9 ft 8 in

tank with the gas distributor at the bottom of this. It was suspected that the tanks were not providing adequate absorption, and to check this the CO_2 content of the exhaust gases from the four tanks was determined. This analysis is rarely carried out in most sugar factories, yet its usefulness may be judged from the fact that it clearly confirmed the suspicion that the tanks were not operating efficiently.

The exhaust gas had a CO_2 content which fluctuated between 18 and 24%, compared with the kiln gas CO_2 content which varied from 36 to 39%. Assuming average figures of 21% and 38%, adsorption can be seen to be less than 50%, and this explains the shortage of CO_2 at the first and second carbonatation stations with resulting irregular work and high CaO content in the clarified juice. P. HONIG[1] mentions that the CO_2 content of the exhaust gases from the first carbonatation tanks is usually below 10%.

The stand-by CO_2 pump was brought into operation, regulating by means of a recycling pipe, and this expedient, although wasteful, was successful in overcoming the shortage of CO_2. Better results ensued at both first and second carbonatation stations, together with a lower CaO content in the clarified juice. This was still over 200 mg per litre, however, so it was decided to investigate the homogenity of the mass of juice in the first carbonatation tank.

At Crescent there already existed the usual two sampling cocks on the tank, the upper cock also serving as an indicator for the highest level to be reached by juice when filling (about 520 cu.ft.). The distance between these two cocks is 31 inches; 58 inches below the lower one was installed a third cock, and a fourth was fitted to the conical bottom about 18 inches from the discharge pipe. The additional cocks are not in line with one another or with the two original upper cocks.

After completion of liming and gassing, during a period of 14–16 minutes, the end-point being controlled using Dupont paper, samples were taken from the four cocks just before emptying the tank. The samples were filtered and the CaO content determined in the usual way by titrating with N/28 sulphuric acid to pH 8·0, using neutral phenolphthalein as indicator. It was immediately evident that the degree of heterogeneity in the mass of juice in the tank was rather marked, as is indicated by the data recorded in Table 1, for five tests.

Table 1

Cock No.	*a*	*b*	*c*	*d*	*e*
1 (topmost)	250	310	320	390	470
2	280	340	430	440	540
3	270	—	430	460	540
4	600	1900	1480	720	920

It is consequently easy to understand the difficulties experienced by the operators who, however, manage to give, most of the time, a filtered first carbonatation juice containing 400–600 mg CaO per litre, as required of them.

On the other hand, the receiving tank for unfiltered first carbonatation juice is rather large (700 cu.ft.) and is provided with a stirring device, so that some measure of correction of the juice heterogeneity takes place in this tank. But this is clearly not exactly what is required, and it has been decided to instal a 2000 g.p.m. recirculation pump of the correct design, when the juice in the tank should be homogeneous at all times and permit far greater absorption of CO_2 from the kiln gas. The eventual transformation into a continuous first carbonatation system is also being envisaged.

[1] Principles of Sugar Technology. Vol. I. (Elsevier, Amsterdam). 1953. pp. 667–668.

In the meantime, the use of light soda ash of fairly good quality, (94% and sometimes up to 96–99% purity) manufactured in Pakistan, was investigated for reduction of lime salts. The use of soda ash for deliming is general in beet sugar manufacture. McGINNIS[2] states that the control of natural alkalinity, and from this the amount of soda ash to be added to the juice to obtain minimum residual lime salts, is regularly effected in the U.S.A.

P. HONIG[3] concludes that, for cane sugar manufacture, the use of soda ash is not a practice to be recommended since the amount required is too large if substantial effects are to be achieved. On the other hand, J. RAULT[4] of Natal, in a fairly recent paper on his long experience with the carbonatation process, states that the use of soda ash for deliming at second carbonatation has helped to reduce by 25–30% the level of soluble lime salts which, in turn, has definitely lowered the ash content of the refined sugar.

But what, above all, prompted the writers to apply soda ash at Crescent was its rather low price as compared with the price of refined sugar (Rs 0·18 per lb *vs.* Rs. 0·65 per lb), coupled with the fact that more cane is being produced by the growers than the factory can take owing to restricted evaporator capacity which is the limiting factor. Under present conditions it is found that losses by entrainment appear and become progressively more important as the evaporator becomes scaled—with the result that the grinding rate has to be progressively reduced. Factory runs in Pakistan are usually a month in duration.

It was decided, therefore, to apply about 350 mg of soda ash per litre of filtered first carbonatation juice, corresponding to about 330 mg of anhydrous Na_2CO_3. This is added to the juice at pH 10–10·5 and 56–59°C in the receiving tank just before pumping to the second carbonatation tank. The reaction time of the soda and juice is therefore generally a matter of seconds rather than minutes.

The soda is applied as a continuous stream of 15°Baumé solution. Precipitation of calcium carbonate is instantaneous and intense, while the mixing of the small amount of soda solution in the large volume of juice is rendered nearly perfect in the centrifugal pump, and this also stimulates precipitation. The juice which arrives in the second carbonatation tank therefore contains an abundance of active calcium carbonate nuclei which strongly induce further precipitation of the excess soluble lime salts during the continuous second carbonatation to pH 8·3–8·7. This range the operator is able to maintain most of the time, even with the present equipment, although this too is to be considerably improved.

The intensity of instantaneous precipitation of calcium carbonate by the soda ash is, naturally, quite apparent and is further demonstrated by the heavy scaling of the lower portion of the receiving tank for the filtered first carbonatation juice, the centrifugal pump and the piping. This, in fact, constitutes a disadvantage which, however, will be overcome easily by the installation on the delivery line of the pump of one or two small reaction tanks of proper design with a quick-acting stirring device.

For the moment two pumps with separate lines are being used at Crescent. It is firmly believed that the addition of soda either to the weighed mixed juice or to the juice in the second carbonatation tank would not be as effective as application to the fairly hot and strongly alkaline filtered first carbonatation juice.

The results for the major part of the last run which lasted 34 days, finishing on the 25th February, were more than satisfactory. Even though the addition of soda was not started until a few days from the start of the run, the evaporator, for the first time in the history of the factory, was found to be only slightly scaled. This is to be expected, however, since it has been established by a large number of measurements that the 330 mg of Na_2CO_3 added per litre of filtered first carbonatation juice can reduce the CaO content of the clarified juice even to less than 25 mg per litre when fresh cane is being crushed in winter without remelting of gur or khandsari in the juice. Melting khandsari of good quality will raise this figure to around 75 mg, while gur or inferior khandsari will raise it to 100–150 mg. Thus the addition of 330 mg of anhydrous Na_2CO_3 per litre of juice has eliminated and is eliminating 125–175 mg of CaO. In other words, the level of soluble lime salts in the clarified juice is reduced by some 50% or more using the dosage of soda ash adopted.

When crushing cane alone—unfortunately, only from time to time and for limited periods—the CaO content does not fluctuate very much; when melting gur and/or khandsari, the position is different because variations in their quality are so marked that a large number of analyses are required in order to draw sound conclusions. In fact, the variability in the non-sugars composition and behaviour of the gur and khandsari has made it impossible to draw definite conclusions as to the effect of the rather intensive deliming on the final molasses purity. As small a drop as 0·2 in the purity of the final molasses gives sufficient extra sugar in bags to pay for the soda ash being used, however.

But certainly the main gain, it should be repeated and emphasized, lies in the control of scaling of the evaporator. It is hardly necessary to elaborate on the importance of such an advantage except to mention that longer factory runs at appreciably higher crushing rates will now be the rule. In addition, the usual haze in the sulphited syrup has almost entirely disappeared by reducing the CaO content of the clarified juice, and the resulting sugar is thus more lustrous and brilliant. Economy has resulted in the labour needed

[2] Beet Sugar Technology. (Reinhold, New York). 1951. Chapter 9.

[3] Principles of Sugar Technology, Vol. I. (Elsevier, Amsterdam). 1953. p. 676.

[4] *Proc. 34th Congr. S. African Sugar Tech. Assoc.*, 1960, 120–127.

for cleaning the evaporator, and there is improved steam economy and an increase in the capacity of the low-grade boiling house. And, last but not least, the life of the expensive evaporator tubes will be materially extended.

In brief, the benefits of intensive deliming have proved numerous and important. It is difficult to work out accurately the profit gained by using soda ash, but there is no doubt that it is paying large dividends in Crescent's conditions.

ACKNOWLDGEMENTS

The writers wish to thank MIAN BUKHASH ILLAHI, Owner and Managing Director of Crescent Sugar Mills & Distillery Ltd., for the encouragement and assistance given in the investigation and for permission to publish these results.

We wish also to thank ABDUL KARIM of the Laboratory staff who carried out a large number of CaO determinations each day, sometimes at 15-minute intervals with frequent checking and re-checking.

CHROMOGENIC REDUCING SUBSTANCES IN MOLASSES

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PART II

COLOUR PRODUCTION IN SYNTHETIC SYSTEMS

DUBOURG and DEVILLERS[9] found that concentrated solutions of glycine deoxyfructose only slowly became coloured on heating, but when glycine was also present during the heat treatment the concentrated solutions became coloured much more quickly.

SCHNEIDER[14] detected the formation of a ninhydrin-reacting reducing compound on heating mixtures of glucose and glutamic acid at concentrations of 40–50% solids, and from chromatographic evidence it was deduced that the optimum yield of this substance was obtained when the reaction mixture was heated at 60°C and pH 7 for 16 hours.

HENRY and PIECK[15] have studied the influence of sodium glutamate on the rate of colour formation from hexoses in 15% sugar solution and concluded that at 80°C only about one third of the colour production was attributable to the Maillard reaction.

The results recorded in the preceding section demonstrate that significant amounts of the amino acid deoxyfructoses only accumulate in the high Brix sugar end liquors in the beet factory process and even in molasses the concentration of these compounds is low, generally of the order of 0·25% (1 m.mole/100 g). These conditions are very different from those outlined above and a series of model experiments was therefore conducted to assess the influence of hexose-amino acid reactions in colour formation under the prevailing conditions of high Brix and low amino acid deoxyfructose concentrations.

All the experiments were conducted at 90°C in 70°Bx sucrose solutions and, except where otherwise stated, amino acids and/or reducing sugars were added at concentrations of 5 m.moles/100 g syrup. The syrups were buffered with mixtures of disodium hydrogen phosphate and potassium dihydrogen phosphate totalling 7·5 m.moles/100 g syrup. Normal sugar end syrups are buffered by traces of bicarbonate and by amino acids and polyvalent acids. Bicarbonate is not a particularly suitable buffer for use at low pH because extreme precautions are necessary to prevent changes in pH due to loss of carbon dioxide, while the remaining buffers could not be used owing to interference in the colour reaction. Phosphate buffer was therefore used for convenience and it was established in a preliminary experiment that the rates of colour formation in phosphate buffer at the above concentration very closely paralleled the rates in bicarbonate buffer.

Effect of pH and of Amino Acid Species

The influence of pH is illustrated by the results obtained on heating glucose with glycine in the 70°Bx syrup. The initial solutions ranged from pH 6·5 to 8·2 and the changes in pH and apparent invert concentration are reported in Table VI, while the colour production is recorded in Fig. 2.

At the lower pH levels, the invert concentration increased throughout the experiment but despite this increase, the colour production was progressively lower at lower pH values. Increasing colour production is of course obtained with increasing pH from the degradation of invert sugar in the absence of amino acids, but the attenuation index of the above reaction mixture without glycine, maintained for 7½ hours at a pH higher than sample 1, pH 8·01 falling to pH 7·71, was only 0·06. The low colour production from alkaline degradation of glucose, at a pH higher

[14] *Compte-rendu Xe Assemblée C.I.T.S.*, 1957, 32.
[15] *ibid.*, 129.

Table VI

Interaction of glucose and glycine at 90°C

Amino acid concentration 5 millimoles per 100 g in 70°Bx sucrose

Heating time (*hr*)	0	2	4	6	7½	0	2	4	6	7½
			pH			(*Invert millimoles*/100*g*)				
Sample 1	8·17	7·69	7·41	7·24	7·21	5·2	4·7	4·5	4·4	4·3
Sample 2	7·51	7·36	7·28	7·02	7·00	5·0	5·0	5·0	5·1	5·3
Sample 3	7·02	6·92	6·82	6·71	6·70	5·1	5·6	6·1	6·4	7·1
Sample 4	6·53	6·53	6·49	6·39	6·30	5·3	6·4	7·8	9·9	11·0

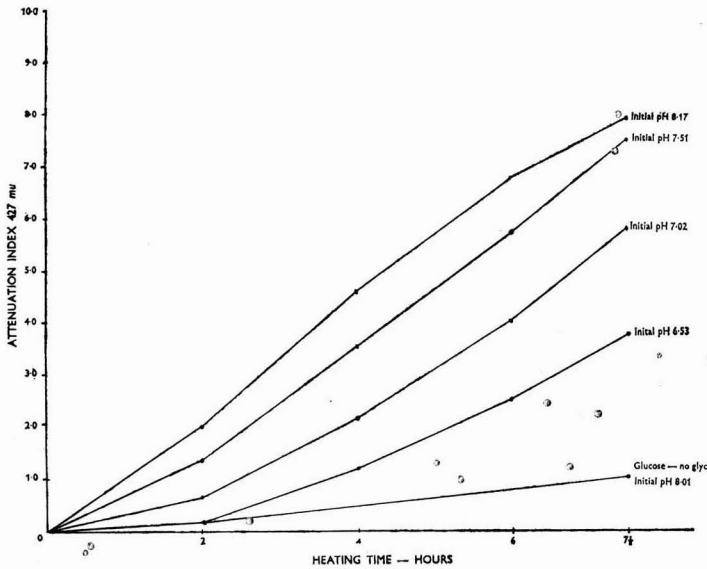


Fig. 2. Interaction of glucose and glycine at 90°C

than that prevailing in any of the glucose: glycine interactions demonstrates that the majority of the colour formation recorded in Fig. 2 and the pH-colour relationship can be attributed to the Maillard reaction.

The same association between high pH and high colour production was found for the interaction of glucose with any of the principal amino acids in juice but the rate of colour formation at any one pH differed appreciably for different amino acids.

The relative rates of colour formation for 5 different amino acids are recorded in Fig. 3. The phosphate buffers were adjusted initially to approximately pH 7 and the changes in pH and apparent invert concentrations during the 7½-hour heating are recorded in Table VII.

Since neither the reaction rates nor the buffer contributions of the amino acids themselves were the same in the 5 samples, the pH values and the apparent invert concentrations differed slightly as the heat treatment continued. The measured values in Table VII are recorded because they demonstrate that pH and invert variations were not responsible for

Table VII

Interaction of glucose with different amino acids at 90°C

Amino acid concentration 5 millimoles per 100 g in 70°Bx sucrose

Heating time (*hr*)	0	2½	5	7½	0	2½	5	7½
		pH			*Invert* (*millimoles*/100*g*)			
γ-aminobutyric	7·02	7·00	6·82	6·78	5·4	5·7	6·0	6·6
Glycine	6·95	6·88	6·78	6·74	5·4	5·9	6·5	7·2
Leucine	7·00	6·99	6·81	6·79	5·4	5·6	6·3	6·7
Asparagine	6·99	6·78	6·77	6·72	5·4	5·9	6·6	7·4
Glutamic acid	7·00	7·08	6·99	7·00	5·4	5·9	6·5	7·0

the differences in colour formation between the different amino acids. Indeed the pH and invert variations tended to minimize the differences in colour production since the glutamate sample gave the lowest colour although having an above average pH and invert concentration, while very high colours were produced with γ-aminobutyric acid despite the relatively low residual invert levels.

Effect of Glycine Deoxyfructose and Difructose Glycine

The double Amadori product difructose glycine, systematic name 1,1′—(Carboxymethylamino) bis—[1-deoxy-D-fructose], has been shown by ANET[12] to be a probable intermediate in browning reactions in dried fruit. This product was therefore synthesized by the method of ANET[16]. Although the double Amadori product is readily obtained by reaction of concentrated solutions of glycine and glucose under alkaline conditions, compounds of this nature were not detected in the chromatographic examination of ion exchange fractions from molasses. The possible significance of difructose amino acids under sugar end conditions was examined by addition of difructose glycine to the synthetic syrups.

To compare the effect of glycine deoxyfructose and difructose glycine on colour formation, low concentrations (0·75 m.moles/100 g) of each compound were heated in the 70°Bx syrups at pH 7·0. The rate of colour formation is recorded in Fig. 4.

Considerable colour formation occurred on heating either of the Amadori products even in the absence of added glucose or glycine. There was almost no difference between the colour yields from the two compounds and it is probable that, under these conditions, colour formation from either product occurs by a similar pathway.

On the other hand, in the presence of added glycine, or glycine plus glucose, the intial rate of colour formation from difructose glycine was markedly

[16] *Australian J. Chem.*, 1960, **13**, 396.

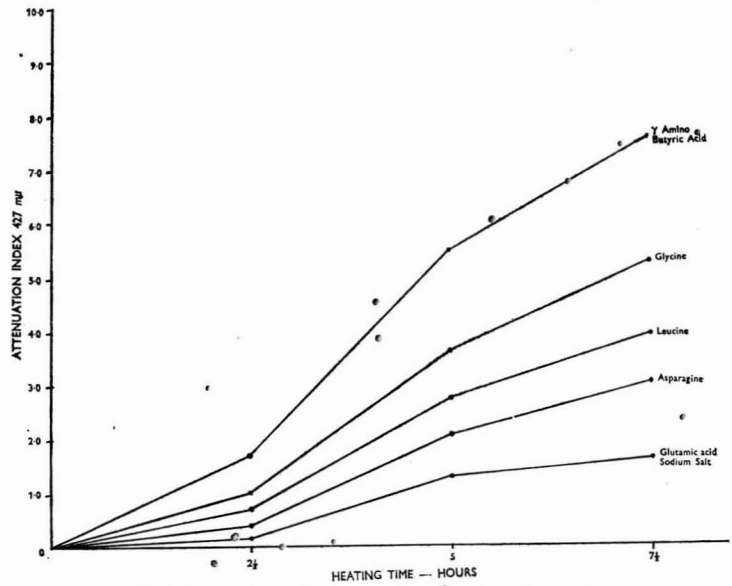


Fig. 3. Interaction of glucose with different amino acids at 90°C

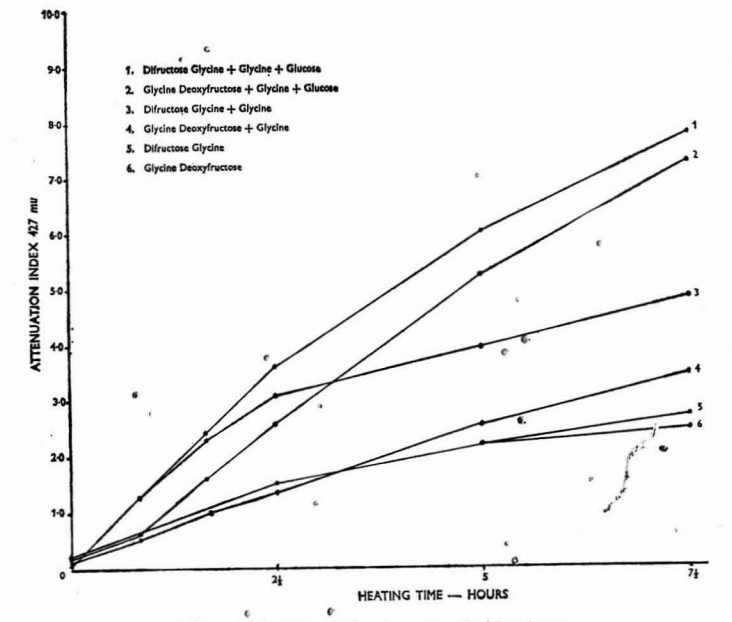


Fig. 4. Colour Formation from Amadori Products

greater than from glycine deoxyfructose but this difference only persisted up to 100 minutes with glycine alone, and up to 50 minutes when glucose was also present, after which the rates of colour formation were almost identical. Examination of solutions 1 and 2 by electrophoresis showed that after 20 minutes heating approximately 75% of the difructose glycine had been converted to glycine deoxyfructose, while after 35 minutes difructose glycine was barely detectable. In digest 2, it was not possible to detect difructose glycine at any stage up to 50 minutes, but the concentration of glycine deoxyfructose in both digests was identical in the period 50 to 150 minutes.

It is concluded that in the presence of added amino acid, cleavage of one carbohydrate unit from difructose glycine in digest 1 led to the rapid initial formation of colour, after which colour was produced from the residual glycine deoxyfructose at the same rate as in digest 2. In the later stages of the reaction, the simultaneous production of glycine deoxyfructose from glucose and glycine maintained this somewhat reduced rate of colour formation in digests 1 and 2, whereas in the absence of added glucose, colour production further diminished in digests 3 and 4.

If difructose glycine is an intermediate in colour formation under the conditions employed, the double Amadori product must occur only in catalytic amounts and consequently it would not be expected that readily detectable amounts of difructose amino acids would be present in molasses.

Thermal Degradation of Amino Acid Deoxyfructoses in Solution

The synthetic deoxyfructose derivatives of aspartic acid, glutamic acid, serine, γ-amino butyric acid and glycine were heated separately, at concentrations of 10 m.moles/100 g, in 1% sodium bicarbonate solution for 2 hours at 90°C. The product solutions were examined by electrophoresis in 3M formic acid. Although the amino acid deoxyfructoses are relatively insensitive to ninhydrin spray reagent, in the absence of sucrose it was possible to load the electropherogram to such an extent that both the initial compounds and some of the degradation products could be detected with the spray reagent.

Each deoxyfructose compound was partially decomposed by the heat treatment to liberate some of the constituent amino acid together with up to eleven other ninhydrin reacting products. From each solution, except that containing γ-amino butyric acid deoxyfructose, one component migrated towards the anode while the remaining reacting bands were cationic. As the bands were revealed by ninhydrin, it is probable that at least part of the constituent amino acid molecule was incorporated into each product. Some of the products were more mobile than the residual deoxyfructose compounds and these materials were not strongly coloured but the less mobile components nearer the start line were associated with pale yellow bands before ninhydrin treatment. The majority of the coloured material however remained on the start line; this region was insensitive to ninhydrin but some of the parent amino acid was liberated when the immobile coloured band was eluted and treated with N hydrochloric acid, or sodium hydroxide, at 100°C for 18 hours.

Even in the absence of other reacting chemicals, these 5 separate amino acid deoxyfructoses yielded about 50 degradation products, or groups of products, which could be detected with a single spray reagent. A vast number of degradation products must therefore be possible in sugar end syrups, containing at least 10 amino acid deoxyfructoses, particularly since, as shown below, foreign amino acids can be incorporated in the products.

As free amino acid was liberated on heating amino acid deoxyfructoses, the amino acid component of the degradation products could have arisen from two possible sources; either the amino acid had remained linked to a carbohydrate residue during conversion to the products, or recombination between the free amino acid and a carbohydrate residue had occurred.

These possibilities were investigated by heating glycine deoxyfructose (10 millimoles/100 g) and glycine (30 millimoles/100 g) at 90°C in 1% sodium bicarbonate solution. To differentiate between the two possible sources of glycine, two such digests, were prepared, one containing radioactive glycine and inactive glycine deoxyfructose, and the other containing inactive glycine and radioactive glycine deoxyfructose. (This latter compound, labelled only on the amino acid moiety, was synthesized from glucose [720 mg] and glycine-C14 [300 mg = 100 μc] by the procedure employed for the larger quantities of inactive derivatives. After the ion exchange separation, the product in 21% yield was obtained radiochemically pure in 2 ml of solution.)

The total activity in each digest was 2·5 μc/ml, and after heating the solutions were examined by electrophoresis and the products were detected by autoradiography and with ninhydrin spray. A series of ninhydrin positive bands, similar to those produced on heating glycine deoxyfructose alone, was detected in both digests. Regardless of the source of radioactivity, all of the ninhydrin positive bands were radioactive, but the most strongly radioactive band, other than free glycine, was the immobile region at the start line. As radioactive products were formed from radioactive free glycine, the free amino acid must have been incorporated in the products. On the other hand, the product bands were slightly more radioactive from the digest containing radioactive glycine deoxyfructose, even though partial liberation of the active glycine could never have yielded a total glycine activity as high as in the digest initially containing radioactive glycine. Combination of free amino acid was therefore not the sole source of amino acid in the products and it appears that the products contain amino acid units, some of which originated as free amino acid and some of which have remained attached to a carbohydrate residue.

In similar experiments, radioactive glutamic acid was heated with inactive glycine deoxyfructose and the products were compared with those obtained by heating radioactive glycine with inactive glutamic acid deoxyfructose. With the exception of the free amino acids liberated from the inactive deoxyfructose compounds, all the ninhydrin positive spots were radioactive although the mobilities of the bands in the two digests were not identical. Both digests showed a coloured immobile band at the start which was strongly radioactive. On elution and treatment with N hydrochloric acid at 90°C, each immobile band yielded both glycine and glutamic acid, and radiochemical assay showed that approximately 40% of the total activity in the immobile band could be recovered as free amino acid.

It is therefore concluded that complete amino acid units, originating both from the free amino acids and from the amino acid deoxyfructoses, are incorporated in the coloured complexes.

Formation and Degradation of Amino Acid Deoxyfructose in Beet Process Syrups

The relative extent of formation and degradation of amino acid deoxyfructose was investigated by heating a sample from a white sugar factory of low green syrup, pH 7·26, in which glycine-C-14 had been dissolved to give an activity of 30 μc per g of syrup. The weight of added glycine was 0·4 mg/g, which is rather higher than the amount normally present in low green syrup.

The syrup was heated for 16 hours at 90°C and then diluted to about 2° Bx for electrophoresis. The electropherogram was exposed for autoradiography for 10 hours and the radioactivity was found to be distributed in bands similar to those obtained on heating glycine deoxyfructose in aqueous solution except that the glycine deoxyfructose band itself was less intense while, instead of the single band migrating towards the anode, a weakly active continuum was revealed extending over one third of the electropherogram towards the anode. Within this continuum zones were more intense than the remainder.

The most active single band on the electropherogram, other than the added glycine, was the immobile region near the start line.

On the basis of the distribution of activity the electropherogram was cut into strips and the material from each strip was eluted and counted to determine the relative activities of the constituents. The results are recorded in Table VIII.

Table VIII

Relative activities of products obtained on heating glycine-C14 in low green syrup, after electrophoresis in 1·5M formic acid: 2M acetic acid, 1:1

Position on electropherogram	*Activity c.p.m.*	*Relative activity*
Migrating towards cathode:		
Glycine	1233	62%
Between glycine and glycine deoxyfructose	48	2%
Glycine deoxyfructose	91	5%
Between glycine deoxyfructose and immobile band	75	4%
Immobile band at start line	195	10%
Continuum migrating towards anode	340	17%

Under the experimental conditions 38% of the glycine in the low green syrup was incorporated into other products, 5% of the glycine was accountable as glycine deoxyfructose while a higher proportion, 16%, was found in products whose electrophoretic behaviour was similar to the immobile complex and the intermediates which were formed on degradation of glycine deoxyfructose in artificial media. A further 17% of the glycine was found in acidic components for which no corresponding continuum was found in artificial experiments.

It is therefore quite possible that the total quantity of amino acid incorporated in the coloured complexes in molasses is greater than the amount remaining as amino acid deoxyfructose.

From tracer experiments to simulate conditions in multiple effect evaporators, it was found that, although about 2·5% of the labelled amino acid was incorporated in a band remaining near the start line of the electropherogram, less than 0·7% was present as amino acid deoxyfructose. In consequence, it appears that similar amino acid: glucose reactions occur during evaporation, though to a smaller extent than in sugar end syrups, and that the conditions only permit the accumulation of the relatively small amounts of ionic reducing material found on analysis of thick juice and standard liquor.

Summary

The composition of the reducing material in molasses and sugar-end syrups has been examined critically and rearranged condensation products of amino acids and glucose, the amino acid deoxyfructoses, have been shown to be present.

The amino acid deoxyfructoses reduce both tetrazolium and Fehling's solutions. It has been found that approximately 30% of the reducing material in molasses is ionic; the majority of the ionic fraction could be absorbed on strong cation exchangers and this cationic material consisted predominantly of amino acid deoxyfructoses. The remaining anionic fraction contained aspartic acid deoxyfructose, and traces of some of the more acidic amino acid deoxyfructoses which were incompletely absorbed on the cation exchanger; together these were responsible for about one quarter of the reducing properties of this fraction. The amino acid deoxyfructoses represented about 60% of the reducing material in the combined ionic fractions. In contrast, this ionic component is negligible in thin juice; small amounts are produced during evaporation but these products accumulate principally in high Brix syrups and particularly in molasses.

The deoxyfructose compounds of ten amino acids have been identified in molasses samples and the concentrations of the individual compounds were found to differ from the relative concentrations of the free amino acids in beet process liquors.

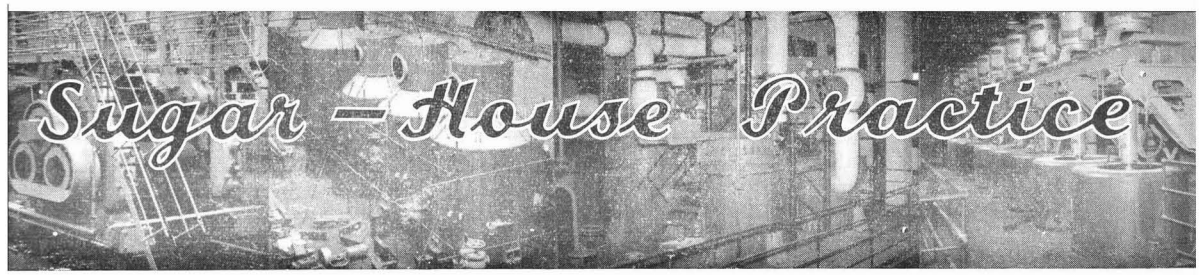
The amino acid deoxyfructoses have been shown to be intermediates in the colour-forming Maillard reaction in beet process liquors, and radioactive tracers have been used to establish that the amino acid deoxyfructoses degrade both spontaneously, and in reaction with other amino acids, to form coloured complexes. A comparison has been made of the rate of colour formation from glycine deoxyfructose, and from the condensation product with a second glucose molecule, difructose glycine. Model experiments have also been conducted to assess the influence of pH and of the particular amino acid species on the colour forming reaction between amino acids and glucose under the conditions prevailing in the beet sugar process.

Acknowledgment

The authors wish to acknowledge the invaluable contributions of their colleagues, R. E. Atkin, R. W. Murdin and M. Shore, in work associated with this paper.

Sugar factory for Syria[1].—A/S. De danske Sukkerfabrikker is carrying out studies in Syria for the setting up of a sugar industry in the Ghab region. An agreement is expected to be signed in the near future between the Company and the Syrian Government, and work should then start on the factory towards the beginning of next year.

[1] *Public Ledger*, 17th August 1963.



Sugar manufacture—past and present. G. H. JENKINS. *Sharkara*, 1962, **5,** 96–104.—A general historical survey is presented of cane sugar manufacturing techniques with diagrams and sketches of the equipment used.

* * *

The sugar refining industry in Japan. T. YAMANE. *Sugar J.* (La.), 1963, **25,** (10), 24–28.—The refining methods used by Japanese refineries are discussed and information is given on the scheme at Shibaura refinery where the raw sugar is mingled with affination syrup before purging. The affined sugar is melted and the resultant 63°Bx liquor is carbonatated, passed through Sweetland filters and active carbon slurry is added to the filtrate before re-filtering through two "Autofilters." The filtrate is then treated with "Amberlite IRA 401" in Cl^- form and passed through two ceramic candle filters before transferring to the pans. The colour is reduced from 9°St to 0·2–0·3°St after the ion exchanger. *A* and *B* soft sugar is produced with yellow hard and soft sugar being boiled on the 3rd and 4th syrups.

* * *

Some results of investigations into refined sugar pressing. M. U. KATSNEL'SON and M. A. PAVLOVSKII. *Sakhar. Prom.*, 1963, (4), 22–27.—Details are given of a rotary press for refined sugar, a test model of which has been installed at Krasnopresnensk refinery. This comprises a rotary drum housing matrices and two punches on each of a number of cross arms; the movement of the cross arms is determined by a master key. On the outside of the drum are an upper and lower rocker plate. Three pressings take place on the upper plate and a fourth pressing and sizing of the tablets on the lower one. Each block of sugar consists of 64 tablets each measuring 23 × 24 × 11·75 mm and with a density of 1·2–1·3 g/c.c. Each block should weigh 500 ± 10 g at a moisture content of 0·2%, thus giving tablets each weighing 7·66–7·97 g. The sugar paste used for pressing should have a moisture content of no less than 1·7%. Tests were carried out using strain gauges to determine the working stresses and pressures and to determine the optimum distribution of cycles that would permit regular loading of the press. The results are expressed in a graph of pressure *vs.* movement of the punch and in the form of an oscillogram. It was found that dividing the total pressing into four cycles reduces the maximum pressure applied, and that with the first movement of the punch the sugar is not so much pressed as merely condensed by free tamping, the pressure being zero. Alterations to the master patterns are suggested in order to obtain optimum pressing.

Tests with a new continuous centrifugal. M. ATHENSTEDT. *Zeitsch. Zuckerind.*, 1963, **88,** 199–202.—Tests on affination of *C*-sugar in a BMA K 1000 continuous centrifugal are discussed. This conical centrifugal operates at 1200–2000 r.p.m. and the 2-stage basket has a maximum diameter of 1000 mm. The screen for the 2nd stage is of 0·06 mm perforations, while the screen for the 1st stage is finer. The results showed that one centrifugal could affine all the low-grade sugar produced by a 1700 ton beet factory at the rate of 4–4·5 tons/hr, an excellent refined sugar resulting from the affined *C*-sugar and middle product. The proportion of very fine crystal in the sugar was relatively high, but since there was little crystal damage in the K 1000 centrifugals, this is attributed to the high speed continuous low-grade centrifugals before affination. Apart from details of affination tests, results are also given of middle and low-grade massecuite spinning, which was carried out for only a 2 hour period. For middle product massecuite, the throughput rose to above 6 tons/hr, whereas for *C* massecuite it fell to 2·5–3·0 tons/hr; however, this was still some 30% higher than with the smaller 2650 r.p.m. continuous centrifugal. The lower throughputs are ascribed to the lower spinning temperature of 35°C. The proportion of damaged crystal was lower with the larger centrifugal.

* * *

Application of the polymeric electrolyte for improving the basic clarification mechanism in the defecation of cane juice. W. CHEN and C. H. CHEN. *Rpt. Taiwan Sugar Expt. Sta.*, 1963, (30), 103–118.—The factors affecting clarification of cane juice are discussed. Conventional clarification methods are considered to have very little effect on the surface activity of the colloids and cause only partial coagulation in limed juice, particularly when this is of a refractory nature. The use of polymeric electrolytes such as "Separan AP-30" and "Krilium" as coagulants for refractory juices is suggested and tests carried out on *A* and *B* mill juice are described in which 0·5–1·0 p.p.m. of "Separan AP-30" was added. The muds obtained were denser and more compact, and faster settling rates were achieved. The results are tabulated and given in graph form.

* * *

A study on the crystal sugar from palm juice. N. GOPINATHAN. *Indian Sugar*, 1963, **12,** 681–685.—The physical and chemical properties of crystal sugar and sucrose obtained from four types of palm[1] were investigated and compared with those of cane sugar. The tabulated data reveal no essential differences

[1] *See also I.S.J.*, 1962, **64,** 9–11.

between palm and cane sugar; any special characteristics attributed to palm sugar are felt to be due to impurities in the white sugar.

* * *

Bagasse burning in multi-cells. I. E. LEGENDRE. *Proc. Amer. Soc. Sugar Cane Tech.*, 1963, **9**, 62–65.—A description is given of the Bigelow boiler and Detrick-Dennis multi-cell furnace, two of which burnt 76% of the total bagasse produced in 1961 at the Lafourche Sugar Co. The two boilers consistently burnt 95,000 lb of bagasse/hr with peaks above 100,000 lb; the 1325 h.p. boiler produced an average of 93,000 lb of steam/hr, while the 1500 h.p. boiler averaged 110,000 lb of steam/hr. In the event of reduced crushing, the steam supply can be maintained by supplementing with gas fuel, the gas burners automatically cutting in with a fall in steam output below a required level and producing steam until the flow reaches the desired level again. Mention is made of the ash removal procedure and of the practices in the event of mill stoppages in order to maintain bagasse supplies to the boilers.

* * *

Burning bagasse in a stoker furnace. P. CANCIENNE. *Proc. Amer. Soc. Sugar Cane Tech.*, 1962, **9**, 66–67. Details are given of the Riley spreader stoker-type furnace at Lula factory. Natural gas firing is used during mill stoppages. Steam production is 70,000 lb/hr from 15 tons of bagasse of 52% moisture content per hr. Using natural gas, 91,000 lb of steam is produced per hr.

* * *

Present-day milling practice at Glenwood. L. SUAREZ. *Proc. Amer. Soc. Sugar Cane Tech.*, 1962, **9**, 68–70. See *I.S.J.*, 1962, **64**, 240.

* * *

Silver continuous centrifugal. C. R. STEELE. *Proc. Amer. Soc. Sugar Cane Tech.*, 1962, **9**, 71–81.—See *I.S.J.*, 1962, **64**, 268.

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Experiences with continuous centrifugals at Valentine. H. ELIZONDO. *Proc. Amer. Soc. Sugar Cane Tech.*, 1962, **9**, 82–87.—See *I.S.J.*, 1963, **65**, 20.

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The Bach "Poly-cell" subsider. W. M. GRAYSON. *Proc. Amer. Soc. Sugar Cane Tech.*, 1962, **9**, 88–92. Details are given of the Bach "Poly-cell" subsider, manufactured by The Mirrlees Watson Co. Ltd.

* * *

A sugarcane carrier control system. S. J. LEVET. *Proc. Amer. Soc. Sugar Cane Tech.*, 1962, **9**, 93–97. See *I.S.J.*, 1963, **65**, 50.

* * *

The "Autocane" carrier drive at Okeelanta. A. TELLECHEA. *Sugar J.* (La.), 1963, **25**, (11), 30.—Details are given of the Edwards Engineering Corporation "Autocane" carrier drive which is an automatic system maintaining a constant cane delivery to the crusher by regulating the carrier speed inversely to the cane level on the carrier near the point of discharge. One of these systems installed at Okeelanta has resulted in increased grinding rates and steadier, choke-free mill operation as well as reduced labour requirements.

* * *

The continuous centrifugal for processing low and high grade massecuites. B. SILVER. *Sugar J.* (La.), 1963, **25**, (11), 49–55.—Data supplied by a number of sugar factories are tabulated comparing massecuite and molasses Brix and purity, sugar purity and massecuite throughput using batch centrifugals and Hein, Lehmann continuous centrifugals as manufactured by Silver Engineering Works Inc. The results are discussed, as are the advantages of the continuous machine.

* * *

Control of massecuite boiling by measuring the vapour consumption. M. S. ZHIGALOV. *Sakhar. Prom.*, 1963, (5), 10–14.—Tests were carried out to determine the vapour consumption in boiling *A* massecuite with a view to controlling the boiling process. Carbon tetrachloride was used as working fluid with a differential manometer in the vapour feed line. Graphs are reproduced of manometer readings, massecuite temperature, vacuum, vapour pressure and temperature *vs.* time from the start of boiling. It was found that variations in vapour consumption between syrup drinks may be expressed by a complex curve with a minimum lower than the value at the start of the subsequent drink, a rise in vapour consumption accompanying a rise in massecuite temperature. At the same time, there is a fall in the effective temperature difference between the massecuite and vapour, causing retarding of the water evaporation and resulting in a drop in vapour consumption. After the first two or three drinks, the vapour consumption was found to increase for 1 min instead of droppping. This is attributed to a fall in viscosity caused by vigorous mixing of the syrup and massecuite. In the final boiling stages, during the addition of syrup drinks, the vapour consumption varies only very slightly, since the mother liquor Brix approaches that of the molasses at the end of boiling and, the crystals being sufficiently large, the syrup does not alter the massecuite viscosity appreciably. The vapour consumption is then 20–33⅓% of that in the initial period. Thus, boiling control by means of vapour consumption determinations can only be effective in the final stages of the process.

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Fluctuations in massecuite temperature and concentration in a vacuum pan. D. V. GORBAN'. *Sakhar. Prom.*, 1963, (5), 14–17.—Data are tabulated for *A* and *B* massecuites boiled in various types of vacuum pans; these show the massecuite Brix and temperatures at the start, halfway through, and at the end of dropping. An empirical formula is presented for calculating the rate at which crystals grow in the

massecuite. It is pointed out that the value will be much lower for a *B*-massecuite because of the considerably higher viscosity of the molasses, so that large crystals found in a *A*-massecuite will be almost completely absent in a *B*-massecuite. It was found that in the pans studied the Brix tended to rise with depth of massecuite, the highest Brix generally occurring in the apex of the conical bottom. This is attributed to packing of the crystals thrown out of the circulation stream and to the squeezing of the molasses between them. The lowest massecuite temperature was found at the very top and bottom of the pans, and the highest temperature around the calandrias. The theoretical difference in crystallization velocity resulting from this temperature distribution may be as much as 3%, and even greater if the difference in sucrose solubility as a function of temperature is considered. These findings were confirmed by sieve analyses of *A* massecuite crystals. It was found that where syrup drinks were frequently added, the differences in crystal sizes were lowest as a result of the reduced massecuite viscosity, although the results are still far from satisfactory. Improvements are possible where the circulation is improved and the boiling thus shortened by various means briefly described.

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Introduction of new techniques in refineries. E. A. GUSEV. *Sakhar. Prom.*, 1963, (5), 17–21.—Details are given of the latest acquisitions by various Soviet refineries, including Soviet push-type centrifugals, and a list is given of equipment needed (in the author's opinion) but at present not produced by Soviet factories. The list includes automatic scales, automatic continuous remelters, automatic mechanical filters for syrups, continuous syrup decolorizing equipment, continuous centrifugals, and an automatic line for pressing, drying and packaging refined sugar.

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Design defects in NGP-4k-860 push-type centrifugals. E. M. KARNASEVICH. *Sakhar. Prom.*, 1963, (5), 42–43.—Among the defects discussed are: inefficient separation of runoffs; inadequate sealing between screens, allowing molasses to seep into the sugar crystals; excessive screen mesh, allowing fine crystals to pass into the molasses tank and reducing the crystal yield by 2–3% on massecuite. Fitting the molasses tank with a mixer is recommended, as is the installation of three nozzles for washing massecuite of colour greater than 1·35°St. Other purely structural defects are mentioned.

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Sudan cane sugar factories. H. KAMPF. *Sugar y Azúcar*, 1963, **58**, (5), 30–32.—Details are given of Guneid factory which has been designed to crush 4000 tons of cane per day to give an annual output of 50,000–60,000 tons of plantation white sugar (approximately half of the domestic sugar consumption). A second factory is being constructed at Khashm-el-Girba and sugar production is planned for December 1964. The factory will be of the same design and capacity as the Guneid factory. The Khashm-el-Girba factory, near the Eritrean border, is planned as part of a resettlement scheme for the people living in Wadi Halfa which will be submerged when the Aswan High Dam reservoir is filled.

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Combinations of quadruple effect evaporators. A. L. WEBRE. *Sugar y Azúcar*, 1963, **58**, (5), 33–35. 45.—A number of evaporation schemes for quadruple-effect evaporators are summarized, with the steam usage of evaporator, juice heaters, vacuum pans, evaporation per lb of steam and vapour sent to the condensers worked out. The most suitable system is considered to be one in which the juice is heated in two stages using 3rd and 1st vapours for 1st and 2nd stage respectively. Although not the most economical of the schemes surveyed, it is nevertheless simpler than the most economical, in which the juice is heated in four stages, the 1st heater using 4th vapour, the 2nd heater using 3rd vapour, the 3rd using 2nd vapour and the last using 1st vapour. Flow sheets are presented for these two systems.

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Suggested improvements to clarifier designs. J. R. GUNN. *Proc. 35th Congr. S. African Sugar Tech. Assoc.*, 1961, 47–50.—The improvements proposed include: installing a screw-type pump at the bottom of a clarifier to replace a diaphragm- or plunger-type pump at the top of the clarifier and so eliminate pulsations in the suction line whereby heavier mud portions remain at the bottom of the pipe and are not pumped away; replacing the muddy juice inlet downtakes in an inverted-conical clarifier with a ring feed round the clarifier circumference to avoid turbluence and enable lighter mud fractions to settle; fitting a ring main in a conical clarifier with small-bore standpipes connected to it for decanting of the clear juice (this avoids channelling and a 143% increase in throughput has been claimed as a result of such an installation).

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The double magma boiling system at Umzimkulu. A. E. RABE. *Proc. 35th Congr. S. African Sugar Tech. Assoc.*, 1961, 51–53.—While introduction of the double magma system has resulted in an increasing volume of massecuite, large-grained *B*-sugar has been eliminated (this is difficult to boil and cure), and consistently good quality raw sugar has resulted. In the scheme used, *C*-massecuite is grained on 70 purity *A*-molasses using a fondant slurry and is run up on *B*-molasses. After approximately 48 hours' crystallization, re-heating and curing, the resultant sugar is mingled with *A*-molasses and used as footing for *B*-massecuite, which is run up on *A*-molasses, cooled for 12–14 hr, cured and the sugar mingled with syrup, to be used as footing for *A*-massecuite which is run up on syrup and is cured hot. Each footing is prepared in a mingler and not in the pans.

Defeco-saturation and 2nd carbonatation applied to purification of juices from deteriorated beets. S. GAWRYCH and T. PIETRZYKOWSKI. *Gaz. Cukr.*, 1963, **65**, 74–76.—See *I.S.J.*, 1963, **65**, 24.

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Tests on the determination of optimum conditions for thin juice sulphitation. Z. NITSCHKE. *Gaz. Cukr.*, 1963, **65**, 77–80.—See *I.S.J.*, 1963, **65**, 52.

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The effect of repeated recycling of burnt carbonatation mud on beet juice purification efficiency. S. ZAGRODZKI and W. FORNALEK. *Gaz. Cukr.*, 1963, **65**, 80–82.—See *I.S.J.*, 1963, **65**, 25.

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Experiments with hydrocyclones at Tirgu-Mures sugar factory (Roumania). S. HARTWIG. *Ind. Alim. Prod. Veg.*, 1961, **12**, 279–283; through *S.I.A.*, 1963, **25**, Abs. 117.—Experiments were carried out in 1958 with hydrocyclones of 80 mm dia. for the clarification of 2nd carbonatation juice. The flow characteristics were varied by changing the underflow and top flow outlet diameters and the length h of the central top flow outlet tube within the hydrocyclone. The best separation effect (~99% removal of suspended matter from the top flow) was obtained with an underflow volume equal to 10% of the inflow volume; the underflow was returned to pre-defecation. The optimum value of h was 40–80% of the hydrocyclone dia. The hydrocyclone gave a flow of ~70 litres of clear juice per min under 4 atm pressure. A battery of 18 hydrocyclones was operated satisfactorily in the 1959 and 1960 campaigns in place of two filter-presses. An improved hydrodynamic design is shown; this is to be further studied.

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Storage of sugar in silos. T. DINESCU and I. PATRASCU. *Ind. Alim. Prod. Veg.*, 1961, **12**, 298–308; through *S.I.A.*, 1963, **25**, Abs. 134.—The construction and operation of a Weibull silo of 20,000 tons capacity, of which two have been built at Ludus and Bucecea factories, Roumania, are described in some detail, with diagrams.

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Calculation of the crystal content by weight in massecuite. I. S. SKRIPKO and V. D. POPOV. *Sakhar. Prom.*, 1963, (4), 18–21.—Equations are developed for calculating the massecuite crystal content (by weight), the crystal content normally attainable in practice and the maximum possible obtainable crystal content for given conditions. The actual crystal content (Kr) is given by $\frac{P_s}{100} + NP.Bx_s - 100\ NP$, where P_s and Bx_s are respectively massecuite purity and Brix, N = sucrose solubility and P = supersaturation. The crystal content normally obtainable (Kr_p) is given by $100\ NP \dfrac{(1 - P'_m)(P_s + NP)}{P'_m(1 - P'_s) + NP(1 - P'_m)} - 1$, where $P'_m = \dfrac{\text{mother liquor purity}}{100}$ and $P'_s = \dfrac{\text{massecuite purity}}{100}$. The maximum crystal content possible (Kr_{max}) is given by the same equation as Kr_p but P is assumed to be 1·0. Worked examples are presented as is a graph of calculated values of crystal sugar yield *vs.* test results obtained by various authors using massecuites of various purities. The close agreement between the values is demonstrated by the fact that most of the points are distributed along the diagonal of the graph.

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Control and regulation of the withdrawal of thickened suspension from clarifiers to vacuum filters. S. T. KOZHEMYAKIN. *Sakhar. Prom.*, 1963, (4), 21–22.—The density and flow of clarifier muds to vacuum filters may be regulated by means of a control tank located on the servicing platform of the clarifier at a height determined by the specific gravity of the 1st carbonatation juice entering the clarifier and by the s.g. of the muds. The muds pass from the 3rd and 4th compartments to the tank, the pipes being fitted with valves at the tank end.

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Experiment in purifying flume-wash waters in hydrocyclone stations. S. M. SHAKHNOVICH and O. L. PASTUKHOV. *Sakhar. Prom.*, 1963, (4), 27–29.—At Khmel'nitsk sugar factory the flume and wash waters, after screening to trap large foreign bodies and tails, are clarified in hydrocyclones, and the water then returned to the beet flumes while the muds and residual water (73% on weight of beet) are discharged to a waste water tank.

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Automation of pulp drying plants. S. N. PODOL'SKII. *Sakhar. Prom.*, 1963, (4), 29–31.—At Dondyushansk sugar factory, an automatic control system for the solid fuel pulp drier has ensured maintenance of the dried pulp moisture content within permissible limits (approximately 10–12%) provided that the temperature of the furnace waste gases is kept at 110°C. Details are given of the controls and of the regulations of waste gas flow to prevent any rise in losses of dried pulp that occur when there are sharp fluctuations in the weight on discharge from the drier. A similar control scheme for a liquid fuel drier is also described.

Automatic photo-electric counter of sugar bags on a conveyor. A. M. CHERNYI. *Sakhar. Prom.*, 1963, (4), 32–34.—Details are given of a photo-electric system for counting sugar bags as they pass along a conveyor. Two relays are provided so that the bags may be of any length and allowance made for the occasional tipping over of a bag.

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Rationalization at Kshensk sugar factory. A. F. YAKIMOV. *Sakhar. Prom.*, 1963, (4), 45–49.—A closed circuit for cooling water used in low-grade crystallizers has resulted in a lower molasses purity while maintaining the heat transfer efficiency in the crystallizers. The water passes through the cooling tubes of the crystallizers, being thus heated from 18–22°C to 48–55°C, and is then pumped via a collecting tank to a single-pass heat exchanger where it is cooled by fresh water en route from the water tower to a water tank. The fresh water temperature is raised by only 1·5–3°C. The pH is maintained at above 10 by adding soda ash. During three months only one leakage occurred through flashing. Details are given of the results with 2nd product massecuite. Also described is a foam filter for recovery of sugar dust from air fed from the drier. This is based on the foam method of gas purifying. The vertical vessel contains a horizontal perforated screen over which is fed water or juice. When the air is blown up through the screen by a fan, the sugar dust coming into contact with the liquid layer forms a foam which is then discharged. The larger dust particles are caught by the falling liquid before they reach the screen. The water or juice can be replaced when the density reaches a certain value or may be replaced continuously. The apparatus has worked satisfactorily throughout one campaign.

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Experience in the use of an electro-separator for classifying granulated sugar. A. I. KATANA. *Sakhar. Prom.*, 1963, (4), 49–50.—A simple experimental 40 V electro-separator is described which was used for sizing a 6·8 kg sample of sugar. The first fraction (1·5%) contained 84% dust and small particles, the second fraction (11·5%) contained 99% small and medium crystals, while fraction three (87%) contained 97% large crystals. Other applications are suggested.

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Sugar storage in silos. E. WERNER. *Zeitsch. Zuckerind.*, 1963, **88**, 193–199.—A general discussion of sugar storage and the effect of moisture is followed by a more detailed study of the factors affecting the hygroscopicity of the sugar (crystal size, purity, sugar temperature and the atmospheric humidity). Sorption isotherms are presented showing the moisture content of the sugar *vs.* relative humidity for sugar at various temperatures and of various grain sizes. The fluidity of sugar stored under normal conditions remains unchanged up to about 60% R.H., but above this value there may be a risk of caking. Over the range 20–60% R.H., the equilibrium humidity between the sugar and the atmosphere alters only very slightly. Air conditioning methods for silos are described, including ventilation of the sugar with hot air, subject to limiting values determined from an i-x Mollier diagram for wet air; drying of the air in the silo with silica gel; a combination of these two methods for fine sugar stored under particularly adverse climatic conditions; and a specially constructed silo with wall heating, as at Northeim[1].

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Prefabricated concrete unit method—even in the sugar industry. H. MATHEIS and P. BERGER. *Zucker*, 1963 **16**, 222–229.—The use of prefabricated reinforced concrete components in the construction of sugar factory buildings is discussed with the aid of illustrations showing various stages in the erection of beet reception yards and silos, etc. at a number of sugar factories in Germany and elsewhere. The basic advantages include reductions in time and in labour requirements.

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Lagooning and treatment of waste water. W. W. BARR. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 181–191.—Information is given on the disposal of waste water at the sugar factories of the American Crystal Sugar Co. The problem of feeding effluent to rivers is discussed. Tests conducted on water lagooned at Moorhead showed that 53% of the BOD_5, 87% of the total solids and 97% of the suspended solids were removed during a campaign by lagooning. To obtain a high degree of biological activity during the warmer months of a campaign and in the spring months, a commercial enzyme material has been tested and found in a large number of experiments to reduce the BOD considerably and eliminate the odour.

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Affination of low raw beet sugar. P. H. LOTT and H. L. MEMMOTT. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 216–224.—Details are given of a scheme for raising the purity of low-grade sugar by affination at the Moses Lake factory of the Utah-Idaho Sugar Co. Low-grade massecuite is cooled in crystallizers, spun and the sugar discharged either to a mingler or to the affination tank, which consists of a 12 foot long scroll with a set of spiral paddles. Here the sugar is mixed with green syrup and is then pumped to the high-grade raw sugar mixer for spinning in continuous centrifugals or for mingling with the high-grade raw massecuite before spinning in high-grade raw centrifugals. The sugar from these centrifugals is melted in the high-grade raw sugar mingler. Results of tests over 35 days showed that the low-grade sugar purity can be increased to at least 99 provided that the mean aperture of the sugar is above 0·01 and the coefficient of variation is below 30. The amount of high-grade raw massecuite boiled can be cut by 32% and the loading at the sugar end reduced.

[1] *I.S.J.*, 1962, **64**, 138–141.

Salt elimination during diffusion of sugar beets. A. E. GOODBAN and J. B. STARK. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 238–244.—A laboratory-scale DdS continuous diffuser was used in experiments to determine the changes in sodium and chloride contents of the cossettes. Two runs were made in the diffuser, the first to determine the distribution of salt from the supply water between pulp and juice, and the second to determine the effect of changes in the supply water management on this distribution. The draught was 146%, the diffusion temperature 70°C and the retention time 57 min for beet and 27 min for juice. Distilled water was used in the first run, then water with 5% NaCl added. It was found that about 48% of the added chloride was carried over into the juice. Introducing the water in two streams, one at the tail with 5% NaCl added and the other through a hole about 1 foot from the tail gave a much more favourable distribution of salt between the pulp and the juice. The chloride exceeded the sodium in the juice in a ratio of 2·34:1. The large amount of sodium in the pulp is attributed to the presence of uronic acid polymers which impart an exchange capacity to the pulp. This was confirmed by further cation exchange tests. Splitting the supply water into two streams increases the pulp sugar only very slightly. The results of the tests agree well with the theory of STITT[1].

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Dual laboratory continuous Dorr system first carbonatation apparatus. F. G. FIS. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 249–251.—Tests carried out with a twin version of a Dorr carbonatation vessel, with the units operating in parallel and with separate control of any operating variable, showed that the point at which lime is added has a major effect on 1st carbonatation. Carbonatation was carried out at 80°C at an alkalinity of 0·085% CaO with an equivalent of 2% CaO in the 1st carbonatation effluent and at a recirculation ratio of 8:1. Saccharate milk was fed into the secondary carbonatation tank of one unit and into the primary tank of the other unit. Adding lime to the primary rather than the secondary tank decreased the settling rate of the 1st carbonatation sludge and increased the lime salts content while decreasing the thin juice colour; it also reduced the 1st and 2nd carbonatation filtration. The unit has operated very satisfactorily.

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Beet sugar factories combined with cane sugar refineries. J. HARTL. *Czechoslovak Heavy Ind.*, 1963, (5), 6–13. Information is provided on the combined processing of beet and cane raw sugar with a mention of the equipment used and flow-sheets of the carbonatation and phosphatation processes. A sample balance sheet is also reproduced, together with a refinery steam diagram showing the steam consumed % refined sugar. The advantages and disadvantages of candle filters and the use of ion-exchange resins for liquor decolorizing are discussed.

Automation of the juice tank before an evaporator. A. L. ANTONOVICH. *Sakhar. Prom.*, 1963, (5), 28–30. The juice level in the tank is indicated by signal lamps which flash on and off according to the height of the juice relative to two coppered pipes acting as electrodes. Whenever the juice level in the 1st evaporator effect and in the tank falls too low, a relay and valve system controls the feed of ammoniacal water to the tank until the level has reached a sufficient height. A pressure-reducing valve on a by-pass remote control panel is used to reduce the flow when ammoniacal water is fed to the tank. Circuit diagrams for both systems are presented.

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Modernization of a sloping-type twin-scroll diffuser. A. A. SOLLOGUB. *Sakhar. Prom.*, 1963, (5), 37–40. Fresh cossettes fed to the two DdS diffusers at Ust'-Labinsk were found to pass through gaps in the scroll blades and flow back along the diffuser, while continuing to be squeezed; this resulted in interference with the normal circulation and drop in throughput, with consequent increased sugar losses, lower juice purity and a sharp rise in the loading. Cossettes from dried beet offered no difficulties, however, and diffusion was satisfactory. It was decided, because of the simplicity of construction, ease of maintenance and other properties of these diffusers, not to replace them with other types of diffuser but to modify them. The gaps between the bands on each scroll blade were covered with perforated metal strips, leaving very small gaps on each side. The fresh water feed was altered, so that 30% was fed below the wheel hoist and the rest at the point where the press-water was previously fed, the press-water feed point then being lowered by some 1·5 metres. The steel filter screens were replaced with brass screens. As a result of these modifications, the throughput was increased by 122·2% and the losses reduced to 0·39% on beet at a draught of 114·4%. The cossette length was 11 m/100 g compared with 3·5–4 m/100 g previously. The loading on the electric motors has been reduced to 20 from 35 kW, whereas an increase in the loading was anticipated. It was also planned to increase the angle of slope by 2–3°, but this was omitted. Other advantages of the DdS diffuser are mentioned, including the low maintenance costs compared with those of an RT diffuser.

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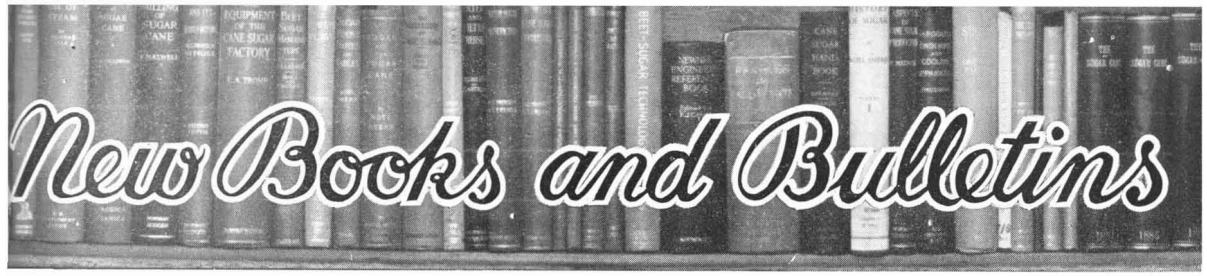
Scale removal in 2nd carbonatation (juice) heaters. G. T. RYBKA. *Sakhar. Prom.*, 1963, (5), 40–41.—To prevent scaling of the juice heater, this and the press-water heater were used each in turn to heat the 2nd carbonatation juice and the press-water for 20 day periods. During 147 days, there was no need to clean either heater, the temperature being maintained at a required level. At the end of the campaign, the last heater used for the water was free of scale, while the other had a small amount of scale which was easily removed by scrubbing.

[1] *I.S.J.*, 1959, **61**, 145.



Principles of Sugar Technology. Volume III. Ed. P. HONIG. 711 pp; 6 × 9¼ in. (Elsevier Publishing Co., P.O. Box 211, Amsterdam, Holland.) 1963. Price: 120s 0d.

Volume III of Honig's "Principles" is uniform with the first two volumes of the series and like them includes contributions by a number of technologists, divided into four parts covering, respectively, evaporation, centrifugation, microbiology of the sugar industry, and grading and classification of sugars and molasses.

Dr. HONIG himself contributes two chapters, on the chemistry of the evaporation process and the cleaning of evaporators, which are models of the type necessary to present "in a constructive form" subjects "of direct interest to most sugar technologists" as he puts it in his preface. They give a wealth of information in clear and concise manner which should enable many, if not most, sugar technologists to find in them much of interest concerning the problems they have to deal with in the course of their usual work, be it as operators or designers of plant. More specific views would have been welcome, however, concerning "modern evaporators which show less scaling" and especially those "with guided circulation" as mentioned on page 125.

The high standard set by Dr. HONIG is not, unfortunately, maintained throughout the book, R. C. L. BOSWORTH's chapter on heat transfer making this treatment more difficult to follow than necessary by the use of both metric and British units and by the simultaneous dealing with quite distinct problems of heat transmission. The chapter of principles of steam economy in evaporation by S. STAUD and M. PATURAU deals with the problem on the basis of conditions in Mauritius which appear to be rather out of date; the combination of these two chapters might give the novice the false impression that the design of practical heat transfer plant is amenable to scientific and accurate calculation; that this is not so is admitted on page 57—"the resulting evaporator is a compromise based on the designer's previous experience."

Valuable points deserving the full attention of both designers and operators are included in the chapters on the theory of the centrifugal process by F. M. CHAPMAN and the engineering principles of sugar centrifugals and the centrifugal process by E. KRIEG, although the second of these is marred by the English which is less than perfect.

It is strange that the only chapter on continuous centrifugation should have been devoted only to the push-type centrifuge, described and discussed by E. RUEGG whose chapter is naturally devoted almost entirely to the machines of Escher Wyss A.G. of which company he is Chief Engineer.

R. MOROZ contributes the chapter on methods and procedures for the analysis of microorganisms in sugar, while D. BECKER gives an account of the grading of commercial raw beet sugars. T. YAMANE describes the various types of soft sugars, brown non-centrifugal sugars and re-processed sugars of Asia together with their manufacture, and H. OLBRICH reviews the formation of molasses, its constituents and utilization of molasses for production of citric acid, butanol and acetone, animal fodder, etc. In all four chapters will be found a great deal of information of great interest to specialists in the fields concerned; none could really be described as being "of direct interest to most technologists", however.

The book is very well printed with clear illustrations, although some spelling mistakes have intruded and, as can be expected in the case of a book in a language foreign to the publishers, a few oddities such as breaking of the word "swinging" after the letter n at the end of a line. Each chapter is provided with a bibliography and the volume closes with author and subject indexes.

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Proceedings of the 11th Congress of the International Society of Sugar Cane Technologists, Mauritius, 1962. Ed. J. R. WILLIAMS. 1250 pp; 6¾ × 10¼ in. (Elsevier Publishing Co., P.O. Box 211, Amsterdam-C, Holland.) 1963. Price: £10. 0s.

This very handsome volume contains the texts of the papers read at the 11th Congress of the I.S.S.C.T. held from 24th September until 5th October in Mauritius. It has been prepared by the Executive Committee of the I.S.S.C.T., Réduit, and also contains an author index, lists of members and regional vice-chairmen, reports of the opening, general and plenary sessions, reports of officers and committees, resolutions and election of officers for the next Congress to be held in Puerto Rico. Also included are photographs of the individual delegations and of all members who attended the Congress. The only criticism the reviewer has to make is that the volume is perhaps somewhat unwieldy (it weighs about 6 lb) and two separate volumes might be easier to handle. Abstracts of the papers will appear in this Journal in due course.

LABORATORY METHODS AND CHEMICAL REPORTS

New express method of determining molasses standard purity. P. M. SILIN and I. S. CHEN'. *Sakhar. Prom.*, 1963, (3), 17–21.—The device suggested by ZAKHAROV[1] for saturating molasses by agitating a molasses-white sugar mixture at 2000-3000 vibrations/min is criticized because the vibrator is a mechanical one using a piston rod and is very noisy and because of difficulties in freeing the sample for testing. An electromagnetic vibrator is recommended instead, with vibration of the vessel containing the sample and not just of the sample itself. The version described contains 8–10 small tubes vertically mounted between two horizontal discs with a central oscillating shaft, the system being housed in an ultrathermostat. After agitating, drops of the molasses sample are withdrawn for refractometric analysis by admitting air under pressure through a hole in the top bung of each tube so that the sample is discharged through a corresponding hole in the bottom. Complete saturation requires 2 hr and the standard purity values as calculated by means of Zakharov's nomogram[2] agree very closely with those obtained by prolonged crystallization.

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Rapid method of determining the reducing substances in Cuban raw sugar. N. A. ARKHIPOVICH and G. P. VOLOSHANENKO. *Sakhar. Prom.*, 1963, (3), 21–23.—Since the OFNER and MÜLLER methods of determining reducing sugar are too time-consuming, a method for Cuban raw sugar is suggested using methylene blue. The sample (20 g) is dissolved in 1 litre of distilled water and 50 ml of this solution (or a dilution of 20–25 ml with water to 50 ml if decolorization takes less than 1 min) heated to boiling in a 300 ml Ehrlenmeyer in a hot water bath. One ml of 0·1% methylene blue solution is added together with 1 ml of Fehling's solution, followed by 2 ml of distilled water. The time between addition of the Fehling's solution and the complete decolorizing of the solution is measured and the reducing substances content is read from a table of decolorization times for contents of 0·0010–0·0074 g. The values in the table were determined for raw sugar solutions of concentrations from 0·2 to 1 g/50 ml water. The difference between the values given by this method and OFNER's method was 0·002–0·06%, giving a relative error of 10–12%. To prevent inversion if the sample has an acid reaction, $CaCO_3$ or $NaHCO_3$ should be added before heating. While clarification would not, it is felt, increase the accuracy, it is pointed out that the invert sugar content in a non-clarified solution is exaggerated since fructose decomposes more rapidly than glucose and the methylene blue may be reduced by other non-sugars such as glyoxalic acid. While the method gives only approximate values, it is recommended for routine use because of its rapidity.

Microbiological standards for sugar. M. P. SCARR. *J. Sci. Food Agric.*, 1963, **14**, 220–223.—The types and numbers of micro-organisms in dry and especially liquid sugar are discussed with particular reference to the soft drinks industry, commercial and canners' sugar. When *Aspergillus glaucus* was inoculated into liquid sugar treated with de-ionizing resin and containing less than 0·0001% ash, no mould formed after 3 weeks' incubation at 27°F, whereas mould did form on un-treated liquid sugar containing about 0·05% ash. *Saccharomyces rouxii* was inoculated into sugar to which 0, 0·04% and 0·1% wort was added. After 28 days at 27°F, only occasional moulds had formed. Strains of this yeast were also inoculated into 40% w/v sucrose solutions containing wort broth and 0, 50, 100, 200, 300 and 500 p.p.m. of benzoic acid per ml. After 10 days' incubation at 27°F, the counts ranged from 0 with the highest benzoic acid content to 8×10^6 per ml with no benzoic acid. The original count was 19,800 per ml. The use of filtered air and U.V. lamps for sterilization of commercial liquid sugar is discussed and is recommended particularly where the syrup is loaded into a tanker when hot. The question of heating in the procedure for sampling canners' sugar for spores is also discussed.

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Sugar beet quality for processing. A. C. CARRUTHERS. *British Sugar Beet Review*, 1963, **31**, 129–132.—On the basis of the equivalent weight of the acids with which potassium and sodium are associated in clarified beet juice, an expression was obtained for calculation of the impurity value; this is given by 2·5K + 3·5 Na + 10 amino-N + betaine, each non-sugar being expressed as mg/100 sugar. Beet macerates were clarified with lime and phosphoric acid and a relationship obtained: purity = 98·5 — (8·31 × 10^{-4} × impurity value). The correlation coefficient was —0·95 and 90% of the beet samples showed a maximum difference between the measured purity and that calculated from the impurity value of 0·23 units. Analyses of factory juices from British Sugar Corporation factories and 5 factories outside the U.K. gave a regression equation of purity = 98·77 — (9·76 × 10^{-4} × impurity value), with a correlation coefficient of —0·94. In a graph of purity *vs.* impurity factor, the highest British levels are shown to be below the best in many of the factories outside the U.K. and it is pointed out that very few of these factories would operate at such low juice quality as in some U.K. factories. Two anomalous values are attributed to excess use of soda ash to avoid low pH values and consequent sucrose decomposition.

[1] *I.S.J.*, 1963, **65**, 123.
[2] *I.S.J.*, 1960, **62**, 258.

Development of a method for rapid determination of sucrose in beet by means of mechanical comminuting devices. A. DRABIKOWSKA. *Prace Inst. Lab. Badawczych Przemyslu Spozywczego*, 1962, **12**, (2), 15–29; through *S.I.A.*, 1963, **35**, Abs. 168.—Four types of apparatus (a lens-shaped rasp, a saw grater with a rotating saw, a "segmented grater" with a hollow rotating toothed cone, and a hammer mill) were tested in order to obtain a pulp fine enough for cold digestion. The results were compared with the results of hot digestion by the Herzfeld methods. All the results of cold digestion for 5 min were significantly lower than those of hot digestion for 30 min; the best results were obtained with the hammer mill at 1520 r.p.m. Cold digestion with an alcohol-water mixture was then tested on pulp from the rasp; 10 ml of 96% ethanol were added to the normal weight of pulp for 10 min and the mixture was then diluted with 168·2 ml of water. The method gave reliable results which differed only insignificantly from those of the Herzfeld method.

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Ultraspectroscopic estimation of coloured substances in sugar products. A. R. SAPRONOV. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1962, (6), 132–136; through *S.I.A.*, 1963, **25**, Abs. 171.—The ultraviolet absorption spectra of beet molasses and of prepared samples of alkaline degradation products of invert sugar, melanoidins (prepared from glucose and asparagine), and caramelan were determined in the range 205–400 mμ. A graph and table of the results are given. Absorption peaks were found as follows: melanoidins, 300 mμ; degradation products, 250 mμ; caramelan, 282 mμ and 225 mμ. The optical density of mixtures of the three groups was additive. A method is described for analysing the absorption spectrum of a coloured product by making three measurements corresponding to the main peaks, and calculating the amounts from linear simultaneous equations. The proportions of each group in thin juice, standard liquor and molasses are tabulated. The degradation products were the largest group of coloured substances but decreased relative to melanoidins and caramelan during processing. Caramelan was formed mainly in the evaporator. Melanoidins, owing to their strong visible absorption, are of equal importance to the degradation products as sources of colour in sugar products; caramelan has practically no visible absorption and may be neglected.

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Saponin floc in mineral waters. H. ROTHER. *Riechstoffe u. Aromen*, 1962, **12**, 289–290, 293–294, 296–300; through *S.I.A.*, 1963, **25**, Abs. 172.—The conditions determining the rate of appearance of visible floc in carbonated or acidified sugar solutions were studied experimentally and a practical floc test suitable for users of sugar was developed from the results. Beet saponin (2–50 p.p.m.) was added to double-refined sugar from which dilute sugar solutions were prepared and bottled in the normal manner. The number of days before the appearance of floc was then plotted against the saponin content of the sugar. The appearance of floc was accelerated at higher saponin concentrations, at higher temperatures (reaching a limit at 40°C) and at lower pH values (reaching a limit at pH 3·0 and below). A colloidal silver preparation (e.g. "Cumasina EFB/3"), used as a disinfectant, strongly accelerated floc formation. The rate of appearance of floc at a given pH was independent of the acid anion. The proposed test is as follows: 100 g of sugar are dissolved in 200-300 ml of water and filtered through sintered glass. To the filtrate in a 1000 ml cylinder are added ~5 ml of 50% citric acid, 1 ml of colloidal silver, and water up to 1 litre. The cylinder is kept at 50°C for two days, at the end of which no yellow or brown sediment should be visible. The test limit corresponds to ~5 p.p.m. of saponin. Out of 10 samples of refined sugar and 10 of beet white sugar which were tested, three white sugars were unsatisfactory, two of which showed high Braunschweig points ratings. Existing commercial and analytical tests are reviewed: three of the latter methods (Johnson & Diehl, Walker, and West & Gaddie) were tested and found to be unreliable.

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The osmotic properties of sucrose solutions. I-V. G. D'ALTON. *Confect. Manufacture*, 1962, **7**, 624–626, 690–691, 693; **8**, 20–21, 75–76, 78, 130–132; through *S.I.A.*, 1963, **25**, Abs. 180.—The concept of equilibrium relative humidity (E.R.H.) of sugar solutions, fondants and confectionery is explained with a graph showing the fall in the E.R.H. of sucrose, invert sugar or glucose syrup solutions with increasing concentration. The effects of fluctuations in temperature and/or relative humidity on the quality of fondants in storage is described. The calculation of the E.R.H. of mixtures in solution is explained, with numerical examples from confectionery, according to two different methods: the method of GROVER[1] in which the percentages of the various sugars are multiplied by conversion factors to give the equivalent sucrose (*Es*) in solution; and the method of MONEY & BORN[2].

* * *

Sugar cane phospholipides. The isolation, separation, and identification of the principal phospholipides of sugar cane juice. J. J. FRILOUX and N. A. CASHEN. *J. Agric. Food Chem.*, 1962, **10**, 509–511.—A mixed phospholipide preparation was isolated from freeze-dried fresh juice by solvent fractionation; the solvents used were a 2:1 ethanol-ethyl ether mixture, ethyl ether, chloroform and acetone. A 60 g column of a 2:1 silicic acid-"Hyflo Super-Cel" mixture was used for the initial separation and was eluted with chloroform-methanol mixtures. The lipids in the fractions were digested with sulphuric acid and 50% hydrogen peroxide, and the residue was analysed for phosphorus by the method of KING[3]. The two major phospholipide components obtained were analysed chromatographically on silicated glass-fibre paper, using a

[1] *J. Soc. Chem. Ind.*, 1947, **66**, 201–205.
[2] *I.S.J.*, 1951, **53**, 264.
[3] *Biochem J.*, 1932, **26**, 292.

procedure described previously[1]. Comparison was made with reference compounds and it was found that the two principal phospholipides corresponded chromatographically to phosphatidyl ethanolamine and lecithin. Column and paper chromatograms are presented. Paper chromatography of a hydrolysate of the original preparation was indecisive, but the hydrolysate gave a positive choline reaction with Reinecke acid.

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Determination of amino nitrogen, pyrrolidone carboxylic acid nitrogen, and total nitrogen with ninhydrin. W. A. HARRIS. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 200–209.—To determine total amino nitrogen, a ninhydrin-KCN solution is added to the beet juice samples which then react in a methyl cellosolve (ethylene glycol monomethyl ether) solution buffered with a 2-component solution (20% NaOH with 20% acetic acid, 1:2). After 15 min in a boiling water bath, the transmittance is measured colorimetrically at 570 mμ and the reading converted to amino nitrogen using a calibration curve of mg N *vs.* % transmittance prepared with a series of diluted glutamic acid standards. The pyrrolidone carboxylic acid component of the total amino N is determined by hydrolysing to glutamic acid with the NaOH fraction of the buffer solution, adding the acetic acid fraction, making up to volume, and carrying out the ninhydrin reaction as above. Total nitrogen is determined by boiling the test sample, containing 1 mg N or less, with Na_2SO_4 and H_2SO_4. After cooling and diluting with water, methyl red is added and then NaOH until the red colour is eliminated. Dilute H_2SO_4 is added until the solution is just acid to methyl red. After cooling and making up to volume, an aliquot of the neutralized digest is reacted with the ninhydrin-KCN solution and the transmittance measured.

* * *

Simplicity in analytical methods. W. A. HARRIS and L. W. NORMAN. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 245–249.—A study has been made of the possibility of using chromatography for betaine determination, although difficulties have occurred regarding suitable reagents. The determination of floc in bottlers' sugar may be simplified by extracting the filtered floc from an acidified sugar solution with 80–85% H_2SO_4, giving colour gradations according to the saponin content, instead of adding H_2SO_4 to a methanol solution, cooling and making up to volume. Heating this acid extract for 10 min, adding a few drops of potassium chromate or dichromate, heating for a further 10 min, then adding chromotropic acid gives a much more intense colour and enables clear differentiation to be made between samples of different saponin contents with only 10 g of sugar in solution. The use of the reducing properties of saponin for determination of saponin is also suggested.

* * *

Wet screening of sugar crystals from low purity massecuites and sugars. R. R. WEST and R. S. GADDIE. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 251–253. The method devised by SAINT & TROTT[2] for determining crystal size and uniformity has been modified for application to low purity beet products containing very small crystals. Details of the procedures for high-grade raw sugar, high-grade raw massecuite and low-grade raw sugar and massecuite are given.

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Insecticide residue in sugar beet by-products. J. R. JOHNSON and S. E. BICHSEL. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 255–258.—Some aspects of methods that may be used to determine the level of DDT in dried beet pulp are noted. The three methods mentioned include colorimetry, paper chromatography, and gas chromatography.

* * *

The determination of colour and turbidity of white sugar solutions. J. BUREŠ and M. FRIML. *Listy Cukr.*, 1963, **79**, 85–93.—Sugar solutions treated with active carbon and "Hyflo Super-Cel" were filtered and the attenuation index, measured spectrophotometrically at 400–800mμ. It was found that adding 2 g of the "Hyflo Super-Cel" per 100 ml of solution at filtration caused a reduction in the attenuation index at all wavelengths, although greater amounts than this had no increasing effect on the index reduction. An unfiltered solution of dissolved crystal was also tested spectrophotometrically at 400-800 mμ in cells measuring 1, 2 and 3 cm. No essential difference was found in the attenuation index values for the different cell lengths. A series of solutions of graduated colour contents and dissolved crystal contents and some containing turbidity also were prepared and part of each standard filtered. The attenuation index was then measured. It was found that the index increased with crystal content (33·3–100%) in the unfiltered samples, although the value depended considerably on the wavelength, the highest value occurring at the blue end of the visible spectrum, the effect of added crystal being less marked in the red spectrum. The attenuation index did not change regularly according to turbidity and colour content. The effect of wavelength was greater with filtered samples than with the unfiltered solutions, and the absorption index at wavelengths above 620 mμ was only a fraction of that at 420 mμ. Light was absorbed at all wavelengths, however. Equations are presented for computing the colour and turbidity based on the measurements of the attenuation index at 420 and 720 mμ. The calibration of photocolorimeters and their application for measuring the colour of white sugar are also discussed.

* * *

Dry substance content of sugar products. L. CAVALLARO. *Ind. Saccar. Ital.*, 1963, **56**, 1–10.—This is the Referee's Report on Subject 15 of ICUMSA, presented at the 13th Session in Hamburg, 1962. Research reported during the previous four years on various methods of determining moisture is reviewed, with 40 references, and recommendations are made as reported earlier[3].

[1] MULDREY: *Lipid Res.*, 1959, **1**, 48.
[2] *I.S.J.*, 1961, **63**, 249.
[3] *I.S.J.*, 1962, **64**, 325.

BY-PRODUCTS

Technico-economic factors which influence the production of newsprint from cane bagasse. D. S. CUSI. *Bol. Azuc. Mex.*, 1963, (163), 22–30, 32.—An account is given of unsuccessful methods intended for the economical production of newsprint from bagasse, and the development of a new method from theoretical examination of the problems involved in the operation of the San Cristóbal plant for bagasse pulp and newsprint production.

* * *

Cane in the feeding of animals. A. C. DUARTE. *Brasil Açuc.*, 1962, **60,** 219–220.—The usefulness of growing fodder cane for animals is presented; numerous advantages include low cost per unit of nutrition and harvest time when other forage is becoming scarcer. The ensilage of cane alone or with other forage crops is also described and recommended.

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Changhwa bagasse board factory of today. H. C. TAO. *Taiwan Sugar Quarterly*, 1963, **10,** (1), 25–33.—An illustrated description is given of the processes and equipment used at Changhwa which produces bagasse hardboard, insulation board and acoustic tiles. One-third of the board produced is exported.

* * *

Two years of PM (preventive maintenance) in Changhwa bagasse board factory. T. M. MA. *Taiwan Sugar Quarterly*, 1963, **10,** (1), 34–43.—Details are given of the preventive maintenance system at Changhwa, which after two years has led to increased productivity, higher quality products, and reduced costs as well as increased equipment life.

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Preparation and properties of linoleate esters of sucrose. E. G. BOBALEK, A. P. DE MENDOZA, A. G. CAUSE, W. J. COLLINGS and G. KAPO. *Ind. Eng. Chem., Prod. Res. & Dev.*, 1963, **2,** 9–16.—Details are given of a pilot-plant process in which sucrose esters are produced by catalytic trans-esterification between methyl esters of fatty acids (methyl linoleate) and sucrose in dimethylformamide with K_2CO_3 as catalyst. High drying oil properties develop at a degree of esterification above 4 if the iodine value of the fatty acids is greater than about 140 and all the unreacted methyl esters are removed by solvent extraction or adsorption on silica gel. Further modifications of the finished product to form emulsions, styrenated oils, urethane polymers and polyurethane foams are noted and their possible applications discussed.

* * *

Studies on chromatography of sucrose esters. T. OTAKE. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12,** 25–34.—Sucrose mono-, di- and polyesters (25–50 mg) were separated by column chromatography on silica gel (1·6 g) using the following solvents: 100 ml of chloroform eluted the methyl esters and dimethylformamide, 150 ml of methanol-chloroform mixture (5:95 v/v) eluted the tri-esters and higher polyesters; 200 ml of methanol-chloroform mixture (8:92 v/v) eluted the di-esters; 200 ml of methanol-chloroform mixture (20:80 v/v) eluted the mono-esters; and dimethylformamide the free sucrose. No great difference was observed in the elution pattern with different types of fatty acid combined with sucrose.

* * *

Studies on submerged citric acid fermentation from cane molasses. S. F. LIN. *Rpt. Taiwan Sugar Expt. Sta.*, 1963, (31), 155–165.—A citric acid yield of up to 60% on total sugar was obtained by using a newly isolated *Aspergillus* strain, M.L.516, in a submerged fermentation technique. The optimum conditions are as follows: the molasses, containing 13–14% sugar, is diluted to 20°Bx with water, and 0·0005% phosphoric acid and either 0·25% ammonium sulphate or 0·075% urea added as nutrient. After sterilization, the medium is adjusted to pH 6 and 3% of methanol added before treating with 2% of the *Aspergillus* inoculum. During fermentation, the medium is aerated and agitated at 29°C. The time at which methanol is added relative to the inoculation is decisive.

* * *

Feeding cattle with beet leaves. A. ORTH and W. KAUFMANN. *Zucker*, 1963, **16,** 360–362.—The correct amount of beet leaves (fresh and ensilaged) to add to cattle fodder is discussed on the basis of the nutritive composition. If too high a daily ration is fed, a crude fibre deficiency will result and interfere with the microbial digestion processes in the rumen. The consequent mal-fermentation will lead to a reduced milk yield and will impair the health of the cattle. The daily leaf intake should be limited to 40 kg with supplementary hay, straw or silage to increase the crude fibre content. The effect of specially prepared fodder on the quality of milk fat, which is often of too hard a consistency, is also discussed.

* * *

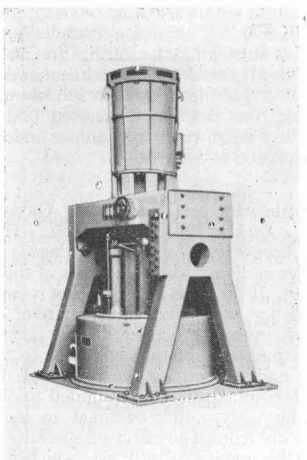
Possibility of creating a paper industry, based on cane bagasse, in the state of Tamaulipas. L. LÓPEZ C. *Bol. Azuc. Mex.*, 1963, (167), 28–32.—The use of bagasse for preparation of paper pulp is discussed briefly and the quantity of cane required to produce 100 tons/day of bleached pulp calculated as 2160 tons/day. Double this should be milled, half of the bagasse being stored for processing in the off-season. The bagacillo and pith may be used either as boiler fuel, or, as at El Mante, for incorporation in animal fodder. In Tamaulipas there are two factories—El Mante and Río Guayalejo—each with a capacity of 5000 tons of cane per day. These would provide surplus bagasse by attention to heat conservation, or could have all the bagasse replaced by petroleum products from a nearby source. They are located near a port and could therefore supply raw material for a local paper plant. The various factors affecting choice of pulping process are listed and discussed and it is suggested that an expert study be made of such a project.

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.

Automatic high-speed sugar centrifugal. CEKOP, Box 112, Warsaw, Poland.

The centrifugal illustrated has been developed for curing 2nd and 3rd product sugar. The controller is adjusted to the appropriate programme, after which no further attendance is necessary after starting up. The motor is switched to the required speed for charging (200 r.p.m.), acceleration in two stages (to 750 and 1500 r.p.m.), running at full speed, and deceleration to ploughing speed (60 r.p.m.). Electro-pneumatic valves actuate the charging and washing



devices, plough, etc., the time intervals between them being variable according to a series of control dials in the console. A manual overriding control is provided. The 4-speed motor is provided with regenerative braking and is self-cooling and designed for operation in high ambient temperatures and humidities. A charge indicator/controller governs the feeding of massecuite—about 500 kg—into the basket.

* * *

The "CycloBlower". Gardner-Denver Company, Gardner Expressway, Quincy, Illinois, U.S.A.

The Gardner-Denver "CycloBlower" is a rotary lobe-type, axial flow, positive displacement blower/compressor for pressure, vacuum or combination service. It features a one-piece high strength housing, anti-friction bearings, helical timing gears, dynamically balanced four-flute gate rotor and a two-lobe main rotor milled from high tensile strength cast iron, labyrinth type shaft air seals, and splash lubrication, and is adaptable to V-belt drive, direct drive, or variable speed drives. It is available in 13 sizes ranging from 17 to 3350 c.f.m. with pressures ranging up to 18 p.s.i.g. and vacuum capacities down to 16 in Hg. It can be truck-mounted and is widely used in the dry bulk transport industry.

* * *

Dewrance-Yarway impulse steam trap. Dewrance & Co. Ltd., Great Dover St., London S.E.1.

Steam trap No. 991 is a light-weight, space-saving unit designed for service in systems where only small amounts of condensate are formed. It has only three parts: stainless steel body, bonnet and disc, the seat being integral, and it is suitable for pressures from 4 to 600 p.s.i. and up to 750°F.

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PUBLICATIONS RECEIVED

SERVO-OPERATED INDICATORS. Evershed & Vignoles Ltd., Devonshire Works, Dukes Ave., London W.4.

A new leaflet, SS 61, describes a series of servo-operated indicators used as remote indicators and repeaters, mainly for weight and batch-weight measurements. The large-diameter dials—up to 28 inches—provide scale lengths of up to 7 feet, so that increments of 1 lb are easily readable in a scale calibrated up to a ton. The instruments can be fitted with micro-switches, counters and printers to facilitate the control of batch weights and to provide printed records of weights and total weighings.

* * *

INDUSTRIAL WATER TREATMENT. Houseman & Thompson Ltd., The Priory, Burnham, Bucks.

A new leaflet describes the filming amine treatments for recirculating cooling water for condensers, heat exchangers, etc., which prevent scale formation, corrosion, algal growth and slime formation. The amines are cationic surface-active materials which penetrate the oil, scale and corrosion deposits and bring them away from the base metal, while killing organisms such as algae and slime. Initially a dose of 1 lb of amine per 1000 gallons is required, the make-up dose being $\frac{1}{4}$ lb per 1000 gallons.

* * *

NEW BEET PULP PRESS. Rose, Downs & Thompson Ltd., Hull.

A new leaflet, 6–100863, illustrates and describes the new Rose, Downs & Thompson pulp press which is of high capacity, handling wet pulp from 1000 tons of beet per day, gives a high dry substance—22%—with resulting economy in the subsequent drying, and is of high efficiency, having minimum compression rate with co-rotating shafts, totally enclosed gearbox, friction-less bearings and low power consumption. It has a high degree of accessibility, the drainage cage being in 12 sections, each fully accessible for minimum maintenance.

* * *

SEPARATION EQUIPMENT. Sharples Centrifuges Ltd., Tower Works, Doman Rd., Camberley, Surrey.

A new Bulletin "Sharples span the whole spectrum of separation" describes the full range of Sharples separation equipment which, including the well-known centrifugal machines, now also features new machines to fulfil a variety of separation requirements.

SUGAR STATISTICAL SITUATION IN EUROPE 1963/64[1]

(*metric tons, raw value*)

	Production	*Initial Stocks*	*Final Stocks*	*Consumption*	*Surplus or Deficit*
WESTERN EUROPE					
Western Germany	2,000,000	150,000	150,000	1,925,000	+ 75,000
Austria	290,000	22,000	30,000	330,000	— 48,000
France	1,980,000	300,000	250,000	1,625,000	+ 405,000
Belgium-Luxembourg	400,000	50,000	50,000	350,000	+ 50,000
Netherlands	420,000	105,000	80,000	710,000	— 265,000
Denmark	368,000	50,000	50,000	280,000	+ 88,000
Iceland	—	1,000	1,000	11,500	— 11,500
Sweden	230,000	160,000	170,000	365,000	— 145,000
Norway	—	15,000	15,000	142,000	— 142,000
Italy	852,000	110,000	175,000	1,320,000	— 533,000
Spain	322,000	50,000	75,000	585,000	— 288,000
Portugal	—	42,000	42,000	173,000	— 173,000
Yugoslavia	340,000	60,000	60,000	390,000	— 50,000
Greece	44,000	25,000	25,000	125,000	— 81,000
Switzerland	40,000	140,000	145,000	280,000	— 245,000
Great Britain	775,000	550,000	600,000	2,875,000	—2,150,000
Ireland	138,000	11,000	15,000	165,000	— 31,000
Finland	54,000	63,000	60,000	195,000	— 138,000
Turkey	500,000	20,000	60,000	445,000	+ 15,000
1963/64 Total	8,753,000	1,924,000	2,053,000	12,291,500	—3,667,500
1961/62 Total	*8,354,279*	*4,209,944*	*3,284,565*	*12,011,857*	*—2,732,199*
EASTERN EUROPE					
Eastern Germany	825,000	100,000	90,000	665,000	+ 170,000
Czechoslovakia	950,000	60,000	75,000	600,000	+ 335,000
Hungary	425,000	46,000	45,000	330,000	+ 96,000
Poland	1,180,000	120,000	180,000	1,100,000	+ 20,000
Albania	13,000	2,000	2,000	17,000	— 4,000
Roumania	355,000	75,000	50,000	345,000	+ 35,000
Bulgaria	180,000	65,000	50,000	205,000	— 10,000
U.S.S.R.	6,000,000	720,000	750,000	9,000,000	—3,030,000
1963/64 Total	9,928,000	1,188,000	1,242,000	12,262,000	—2,388,000
1961/62 Total	*10,922,388*	*2,174,805*	*2,712,333*	*11,709,281*	*—1,324,421*
ALL-EUROPE					
1963/64 Total	18,681,000	3,112,000	3,295,000	24,553,500	—6,055,500
1961/62 Total	*19,276,667*	*6,384,749*	*5,996,898*	*23,721,138*	*—4,056,620*

BREVITIES

New sugar refineries for the U.S.—The Pepsi-Cola Company has announced its plans to build a $22 million beet and cane sugar refinery in Auburn, N.Y., provided Cayuga County's request for a 50,000 tons beet acreage allotment is granted[2]. The Dept. of Agriculture is scheduled to make the decision in November and, if it approves, the refinery will be operating by Autumn 1966. Savannah Sugar Refining Corporation has also announced plans to build a refinery in the Florida Everglades to serve buyers in the South Florida marketing area[3]. The new refinery will operate on a year-round basis with an initial production forecast at approximately 50,000 tons.

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Colombian sugar development[4].—A Philippine investor has announced that he intends to invest 100 million pesos in the installation of several sugar mills in the region between Calipuerto and Candelaria, in the Valle del Cauca.

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Queensland Agent-General in London. SIR DAVID MUIR, C.M.G., who has been Agent-General for Queensland in London for the past 12 years, is to return to Australia at the end of the year to take up an appointment as Director-General of Industry, a post newly-created by the Queensland Government. SIR DAVID has been Australian representative on the International Sugar Council since 1952 and served as Chairman in 1958. He was knighted in June 1961 for "outstanding services to Australia and to the sugar industry". In succession to SIR DAVID, the Queensland Government has appointed Dr. W. A. T. SUMMERVILLE, at present head of the Dept. of Agriculture and Stock, who is also a member and Deputy-Chairman of the Queensland Sugar Experiment Stations Board.

Bagasse paper for Nigeria[5].—An agreement has been signed in Nigeria to establish a £3,000,000 paper mill sponsored by the Nigerian federal government and the government of West Germany. To be known as the Nigerian Paper Mill, the factory will be located at Jebba, on the River Niger in the Northern Region, and will utilize bagasse from the new sugar factory sited at Bacita.

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Filtration exhibition. The 1st International Filtration Exhibition is to be held at Seymour Hall in London during the 11th–14th February, 1964. Exhibitors from Britain, the U.S., France, Germany, Holland and Switzerland will present their equipment which will range from coarse wire grids to filtering media retaining particles down to fractions of a micron. During the exhibition, a symposium of experts in the field will give papers on various aspects of filtration.

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Venezuelan sugar mill finance[6].—A committee of the Junta Promotora del Central Azucarera de Portuguesa was due to travel to Europe in August to negotiate financial assistance for the installation of a sugar mill at Agua Blanca in the State of Portuguesa. Offers are reported to have been received from Western Germany, the U.K. and the Netherlands. The mill would cost about 40 million bolivares.

[1] Estimates published in F. O. Licht, *International Sugar Rpt.*, 1963, **95**, (9), 125.
[2] F. O. Licht, *International Sugar Rpt.*, 1963, **95**, (Supp. 15), 206.
[3] *Lamborn*, 1963, **41**, 183.
[4] *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 782.
[5] *The Times*, 15th October 1963.
[6] *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 787.

Indian Sugar Exports 1960-1962[1]

Destination:	1962	1961	1960
	(*metric tons, raw value*)		
Aden	6,610	9,346	1,575
Bahrein Islands	0	2,557	325
Burma	0	6,988	0
Canada	142,371	7,495	0
Ceylon	0	0	3,311
French Somaliland	4,293	0	0
Hong Kong	13,840	0	0
Iraq	4,783	0	0
Malaya	61,702*	81,598	10,652
Muscat & Oman	1,740	2,610	462
Netherlands	4,670	0	0
Pakistan	17,477	0	0
Saudi Arabia	0	0	815
Singapore	0	16,986	1,195
United States	138,277	160,392	0
Viet-Nam	5,380	0	0
Yemen	400	0	0
Zanzibar	1,601	0	0
Other Countries	2,696	2,758	1,005
Total	405,840	290,730	19,340

* *Includes Singapore.*

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 17th October* 1963)	s d
Anglo-Ceylon (5s)	20/3
Antigua Sugar Factory (£1)	8/9
Booker Bros. (10s)	20/6
British Sugar Corp. Ltd. (£1)	35/6
Caroni Ord. (2s)	5/7½
Caroni 6% Cum. Pref. (£1)	15/9
Demerara Co. (Holdings) Ltd.	8/9
Distillers Co. Ltd. (10s units)	37/3
Gledhow Chaka's Kraal (R1)	21/6
Hulett & Sons (R1)	57/–
Jamaica Sugar Estates Ltd. (5s units)	4/11¼
Leach's Argentine (10s units)*	19/–
Manbré & Garton Ltd. (10s)	50/6
Reynolds Bros. (R1)	21/6
St. Kitts (London) Ltd. (£1)	15/6
Sena Sugar Estates Ltd. (10s)	9/4½
Tate & Lyle Ltd. (£1)	57/6
Trinidad Sugar (5s stock units)	3/8¼
United Molasses (10s stock units)	41/6
West Indies Sugar Co. Ltd. (£1)	22/9

CLOSING MIDDLE

New York Stocks (*at 16th October* 1963)	$
American Crystal ($10)	94⅝
Amer. Sugar Ref. Co. ($12.50)	26
Central Aguirre ($5)	34⅝
North American Ind. ($10)	22
Great Western Sugar Co.	50⅝
South P.R. Sugar Co.	42¼
United Fruit Co.	21¾

* Ex-dividend.

BREVITIES

Sugar factory tender for Syria[2].—An international tender is to be called for erection of a sugar factory in Jisr-el-Chughour, Syria.

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Moroccan sugar expansion[3].—Bids for the construction of a second beet sugar factory in Morocco have been called for by the Moroccan authorities, according to the Export Services Branch of the Board of Trade. The factory, which will be situated in the Tadla region, must be completed by 15th March 1966, and be capable of processing some 3500 tons of roots per day with provision for extending the daily beet capacity by a further 1500 tons at a later date. In June last the first beet sugar factory in Morocco, built with Polish aid, commenced operations. It is the Government's intention that by the early 1970's a beet sugar industry will be fully established, satisfying Morocco's needs in respect of sugar.

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French sugar factories for Mexico[4].—French interests are to erect three new sugar factories in Mexico, as well as 9 petrochemical factories, under the terms of an agreement made last June.

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New sugar mill in Paraguay[5].—A new sugar mill in the Guairá region, with a planned output of 1000 tons of refined sugar per year, began production at the end of July.

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Guatemala sugar production 1962/63[6].—According to the U.S. Dept. of Commerce, sugar production in 1962/63 was reported by the Sugar Association of Guatemala at 140,500 short tons, of which 50,000 tons, or 36%, was exported. This represents an increase of 22% from the 1961/62 crop year. The value of sugar and by-products from the 1962/63 crop was placed at $17·6 million and exports at $5·4 million.

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Barbados sugar production, 1962/63[7].—The final figure for total production for the 1962/63 crop is 190,697 tons (comprising 182,859 tons of sugar and the equivalent of 7838 tons of fancy molasses), compared with 158,458 tons for the 1961/62 crop.

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Antigua sugar crop, 1963[8].—The sugar factory ceased grinding operations on 10th July having produced a total of 26,958 tons of 96° sugar from 255,354 tons of cane, making an average of 9·13 tons of cane per ton of sugar.

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St. Kitts 1963 sugar production[9].—Grinding was completed on 26th July and the total of cane ground was 350,657 tons, yielding 39,924 tons of sugar at 8·78 tons cane per ton of sugar. With the crop finishing two months earlier this year, it is expected that the 1964 crop should benefit and be much larger provided weather conditions are not unfavourable.

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British Honduras sugar production, 1963[10].—The Corozal sugar factory closed on the 24th July with total production of 27,840 tons, the highest in the history of the industry in the country. Of this, 25,412 tons was export sugar and 2428 tons is to be used for local consumption.

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Japanese beet area[11].—The area sown to beets in Japan is estimated at 42,620 hectares for the coming season. From this area it is hoped to produce 1,047,044 tons of roots which compares with last year's output of 1,082,715 tons, a reduction of some 35,671 tons.

[1] Lamborn, 1963, **41**, 205.
[2] *Zeitsch. Zuckerind.*, 1963, **88**, 471.
[3] C. Czarnikow Ltd., *Sugar Review*, 1963, (624), 148.
[4] *Zeitsch. Zuckerind.*, 1963, **88**, 471.
[5] *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 722.
[6] *Willett & Gray*, 1963, **87**, 374.
[7] *Overseas Review* (Barclays D.C.O.), September 1963, p. 71.
[8] *Overseas Review* (Barclays D.C.O.), September 1963, p. 72.
[9] *Overseas Review* (Barclays D.C.O.), September 1963, p. 73.
[10] *Overseas Review* (Barclays D.C.O.), September 1963, p. 78.
[11] C. Czarnikow Ltd., *Sugar Review*, 1963, (626), 156.