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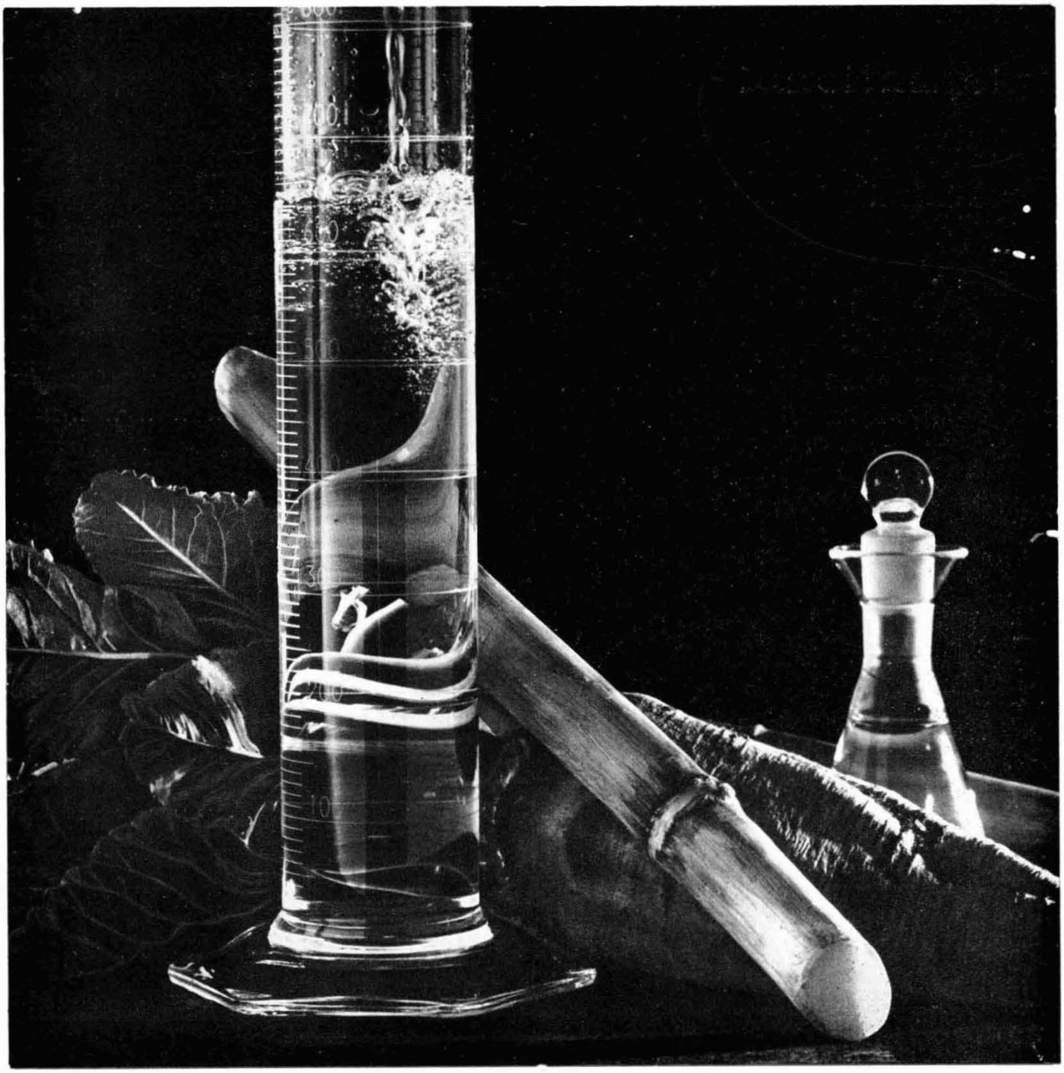

THE

INTERNATIONAL SUGAR JOURNAL

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NOTES AND COMMENTS

World sugar production 1964/65[1].

A revised estimate of world sugar production shows a substantial increase on the figures published in the first estimate, the total now being estimated at 63,7000,368 metric tons, raw value, compared with 55,063,012 and 51,423,723 tons in 1963/64 and 1962/63, respectively. The increases have resulted in an addition of nearly 600,000 tons to the overall assessment of European beet sugar production, only Spain showing any great reduction on the original estimate. The total beet sugar production in all countries is now put at about 5 million tons more than in 1963/64. As regards cane sugar production, the Cuban figure has been increased to 4¾ million tons (compared with 3·8 million tons estimated in December 1964), while Brazil's production is estimated at a little over 3·5 million tons. Other upward revisions have been made in the cases of Bolivia, where over-production is now causing some concern, and Colombia. The cane sugar estimate is now about 1,200,000 tons up on the December 1964 estimate and the total estimated at 35,157,000 metric tons compared with 31,482,000 tons in 1963/64.

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West Germany beet sugar campaign, 1964/65[2].

The 1964/65 beet campaign in West Germany has been completed with a record slice and a record sugar production. According to the final campaign report of the sugar factories, 13,534,026 metric tons were sliced, as compared with 12,988,273 tons in the previous campaign, an increase of 546,000 tons. Included in the 1964/65 figure is 271,296 tons of imported beets from Denmark, France, Belgium and Austria, while 270,993 tons of beets were imported in 1963/64 from Denmark, France and Belgium. Beet yields per hectare did not come up to those of 1963/64, however, since the sugar beet acreage had been increased by 28,000 hectares to 330,231 ha. Sugar production reached 1,947,009 metric tons, white value. After deduction of losses when reworking raw sugar, total production was 1,945,052 metric tons, white value, or 2,161,169 tons, raw value. To this figure must be added about 20,500 tons of sugar obtained by desugaring of molasses, so that total production will reach about 2,182,000 metric tons, raw value. Sugar content at the slicer, at 16·83%, was somewhat higher than last year, at 16·68%. Extraction did not reach the same level as in the 1963/64 campaign, however, amounting to 14·39%, refined value, compared with 14·48%.

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U.S. sugar consumption.

On the basis of the consumption figure for 1964 of 8,056,241 long tons, raw value, per caput offtake amounted to 93·26 lb, compared with 96·69 lb in 1963[3]. A well-known New York house has pointed out, however, that owing to the arrangements concerning constructive deliveries, whereby certain quotas can be fulfilled during the two months following the year to which they apply, actual consumption during 1964 was in the region of 8,250,000 long tons, which works out at 95·5 lb per caput as compared with some 8,050,000 tons or 94·7 lb per head the previous year.

The differences between these respective figures may seem small, but they are not unimportant, and it is interesting to note that the rate of consumption continues on an upward course, notwithstanding the inroads being made by synthetics in the United States market for sweeteners.

For the second year in succession the tonnage of beet sugar consumed reached record proportions. There was also a recovery in the offtake of direct consumption sugar, although it still remained far behind the levels established from 1950 to 1960. On the other hand consumption of sugar produced by refiners was lower than during the past few years; this incidentally is reflected by the import figures which in 1964 were more than 600,000 tons below entries during any of the previous four years.

[1] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (8), 1–6.
[2] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (3), 6–7.
[3] *Willett & Gray*; through C. Czarnikow Ltd., *Sugar Review*, 1965, (701), 41–42.

West Indies Sugar Co. Ltd. 1964 report.

It was not to be expected that 1964 would be as good a year as 1963 and in the event, profits fell by 25% from £1,629,054 to £1,204,762. This compares, however, with the 5-year average for 1959/63 of £490,186, there being a net trading loss in one of these years. Sugar production was almost as high, at 175,461 tons for both Frome and Monymusk, compared with 179,877 tons in 1963. Of the 1964 crop 15% was sold locally and the remainder to the U.K., Canada and the U.S.A. Just under half the export sugar was sold at prices influenced by the world price, the remainder being sold at the Negotiated Price under the Commonwealth Sugar Agreement.

In his statement, the Chairman, SIR PETER RUNGE, said: "It is surprising that there is so little confidence among sellers when world stocks are so low. It seems likely that this lack of confidence stems from uncertainty about how new producers are going to behave and how the increased output of established producers will be marketed. I still consider that there is little prospect of over-production in the long term and that sellers should be more robust in their attitudes. Everything, however, points to the need for a new International Agreement. The recent appointment of an Executive Director of the International Sugar Council after the post has been vacant for nearly a year is a welcome indication that international sugar circles are moving towards the resuscitation of such an Agreement. When this takes place I hope that the Agreement will contain workable provisions to assure a price range more in keeping with present costs of production (based on reasonable wage levels) and that the allocation of production quotas will be based not solely on historical performance but taking account also of commitments for future expansion".

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Tate & Lyle Ltd. 1964 report.

There have been several changes during the year in the Company's subsidiary interests. In the United Kingdom the business of the manufacture of industrial sugars carried on by Brown & Polson Ltd. at their Millwall refinery was purchased, together with the assets employed therein, in June 1964. A new subsidiary company, Millwall Sugars Ltd., was formed to operate the business.

A further United Kingdom subsidiary, Tate & Lyle Farms Ltd., was formed during the year, following the acquisition of Coxford Abbey Farm, an estate of about 1200 acres, near King's Lynn. The purpose of this new investment is to enable the Company to identify itself with the home grown sugar industry and to gain experience in the growing of beet sugar.

A further extension of the Group's overseas interests in sugar production was effected by the purchase in December 1963 of practically the whole of the issued capital of The Corozal Sugar Factory Ltd., British Honduras, and its associated companies, Plantations Ltd., Implements & Finance Ltd., Storage Ltd. and Estrella Ltd. This tightly knit group, which is now being re-organized, operates a sugar estate producing 27,000 tons of raw sugar. It has a quota under the Commonwealth Sugar Agreement of 25,000 tons, but also owns a considerable acreage of land not under cane, which is available for development.

The interest in Ndola Sugar Company Ltd. has arisen through the business and assets of the Ndola sugar refinery being "hived-off" by Rhodesia Sugar Refineries Ltd. to a separate new company incorporated in Zambia, the shares in which were distributed to the members of Rhodesia Sugar Refineries Ltd. by way of reduction of the Share Premium Account of that Company.

Tate & Lyle Ltd. took up 1,100,000 shares of 5s. each (equivalent to 10% of the issued capital), at a price of 8s per share in Hippo Valley Estates Ltd., who are carrying out a major development in raw sugar production in the Rhodesia Lowveldt.

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U.S. Sugar Act

It has been announced that agreement has been reached between the U.S. domestic beet sugar industry, the mainland cane sugar industry, Hawaiian sugar industry, Puerto Rican sugar industry and the U.S. Cane Sugar Refiners' Association regarding recommendations for a new Sugar Act. These include extension of the Sugar Act to 31st December 1971, i.e. covering a five-year period from 1967, with new domestic quotas and, where practical, new foreign quotas and other such amendments effective from 1st January 1965. New import fees are proposed, to take effect from 1st January 1966 and applying to all foreign sugar imports with the exception of Philippines sugar. This import fee would be 50% of the amount by which the U.S. target price (the level around which the U.S. administration aims to keep the domestic spot value) exceeds the world price, but would not be greater than 1 cent per lb. An increase in the quota for mainland cane and beet sugar is proposed. Quotas allocated to foreign countries, other than the Philippines, would be prorated on the basis of an objective formula to be agreed upon. The quota of any country with which the U.S. severs diplomatic relations would be prorated promptly to specific countries on a temporary basis. According to C. Czarnikow Ltd.[1] Latin American suppliers to the U.S. market are understood to have expressed concern at the prospect of having reduced quotas, and meetings to consider the situation are expected to be held shortly. "Any measures designed to limit the access of (foreign sugar producers) to the U.S. market is likely to lead them to investigate export possibilities elsewhere, which could well have unfortunate repercussions on prevailing price levels".

[1] *Sugar Review*, 1965, (706), 63–64.

SUGAR CANE CULTIVATION IN QUEENSLAND

Proceedings of the 31st Conference, Queensland Society of Sugar Cane Technologists, 1964.

ABOUT a dozen papers in these proceedings are concerned with matters relating to sugar cane cultivation.

Green Manuring

A paper by G. C. BIESKE reviews the results of green manuring trials in the Mackay area since 1956. It is pointed out that, although there are abundant data on the amount of nitrogen returned to the soil in legume residues from green manures, there is a poverty of information as to the value of this nitrogen in subsequent cane crop behaviour. The views of another observer in Queensland are quoted who considers that although legumes fix nitrogen this can be readily lost and is usually more easily applied as a fertilizer, and that the main benefits of green manuring appear to be the control of erosion and weeds and the prevention of nutrient losses through leaching. It is also argued that a legume fallow can have a deleterious effect on cane, a likely reason being the fact that the cover provided by the legume prevents a beneficial soil weathering action normally obtained in a bare fallow.

In the trials here reviewed, on old alluvial soils with a silty loam top-soil overlying a fairly impermeable clay loam sub-soil, there was no instance of a decline in cane yield following a legume. The variable results obtained illustrated the difficulty in predicting plant cane response to nitrogen supplied by green manuring. It is considered that even where yield increases occur the economics of green manuring solely for the purpose of supplying plant cane nitrogen requirements are questionable. However, in the case of fields infested wth nutgrass (*Cyperus rotundus*) it was found the legume fallow decreased the nutgrass population in the subsequent cane crop.

Urea versus Sulphate of Ammonia

In 1955 when it seemed that urea would become available as a cane fertilizer in Queensland at an advantageous price a series of trials were carried out in major sugar growing districts. These indicated that there appeared to be no significant differences in yield when urea and sulphate of ammonia were used at equivalent rates. By 1960 there were reports that some cane farmers were not satisfied with the results obtained from the use of urea as a top dressing. As a result further trials were carried out and these are reported in a paper by K. C. LEVERINGTON. Results indicated that in general there is no significant difference in yield of cane from these two sources of nitrogen when they are covered with soil immediately after application, but that urea was less efficient if left to remain on the surface of the soil.

Germination

A study of some factors which affect the germination potential of sugar cane is tho subject of a paper by R. A. YATES. It is pointed out that various factors inherent in the cane at the time of cutting may affect the ability of the cane to germinate. These are: (1) varietal effects, (2) the physiological age of the cane and eyes (buds), (3) the nutritional status of the cane, and (4) the concentration of physiologically active materials (e.g. auxins) in the cane. Of these factors the nutrients can be corrected by the grower. The work described in this paper was designed to assess the effect of nutritional status and also to check previous results on diameter and length of internode and on physiological age.

Results indicated that good nutritional status is important, also that phosphate increased germination even though it did not increase yields. A strong nitrogen × phosphate interaction occurred in most trials, making it essential to apply both together. Potash must not be in excess. Germination potential increased as the diameter of the cane increased. The youngest eyes germinated best, while old eyes (hard, with bud scales cracked) were not suitable for planting under any but ideal conditions. Owing to the danger of mechanical damage to very young eyes the use of eyes of medium age is recommended. It was found that length of internode did not affect germination, except where mechanical planters plant setts of constant length. Three-eye setts germinated better than two-eye setts, so that cane with short internodes was preferable for use with mechanical planters. Germination potential was found to increase as the diameter of the cane increased.

Irrigation

The advantages to be derived from irrigation in the drier areas of the Central district are emphasized in a paper by C. G. STORY, especially overhead or spray irrigation with its adaptability and effective use of limited water supplies. Changed economic conditions should increase the incentive to irrigate, especially on second class and marginal lands. However it must not be undertaken lightly and is not a substitute for poor farming. Results from irrigation suggest that it would often be better to invest capital in this asset than to purchase extra land. The main benefits in the area in question are the prevention of ratoon failures, production of better ratoons and extension of the ratooning cycle.

Evapotranspiration of sugar cane in southern Queensland related to grass evapotranspiration, water evaporation and meteorological data is the subject of a second paper by R. A. YATES. As part of a programme for studying various aspects of irrigation control, the Fairymead Sugar Company installed a large concrete cane lysimeter lined with heavy gauge polyethylene in 1960-61. This paper details the results obtained.

Mechanical Harvesting

An interesting historical account of the development of the Massey-Ferguson system of mechanically harvesting sugar cane is given by J. K. GAUNT. The various prototypes of the now well-known 515 cane harvester are described or illustrated. In 1963 about 140 of these harvesters operated in Queensland. In 1964 the number is expected to be nearly doubled, with a significant number exported.

The problem of deterioration of chopped cane from the chopper-type harvester in storage, i.e. over weekends, is dealt with in a paper by B. T. EGAN, who has investigated the problem. It would seem no easy solution is likely to be found if chopped cane is to be held over weekends. The souring of the cane, caused by bacterial infection (*Leuconostoc*), lowers the sucrose content of the cane. The miller has to process deteriorated cane. Infection develops rapidly. A disturbing feature has been the isolation of the bacterium from whole cane stalks. It is recommended that harvesters be washed down after use and blades kept sharp and well adjusted, and also that cane held over weekends should have been freshly burnt.

Nutgrass

Nutgrass (*Cyperus rotundus*) is a major weed pest on most cane farms in the Mackay area—as it is in many other cane growing countries. It is most troublesome in young plant cane from planting to the "cover in" stage. A paper by L. S. CHAPMAN summarizes the results of 6 herbicide trials against the weed using 14 chemicals at different concentrations, with and without a wetting agent. It is concluded that at present the chemical control of nutgrass cannot be considered a substitute for cultivation in young plant cane. It is too slow in acting in the winter months.

It is considered that the only circumstance in which spraying of nutgrass could be recommended is when cultivation is impossible. In plant cane there is a period after the drill has been filled in, when nutgrass grows in the cane row and cannot be worked. Spraying of this growth would be worthwhile. The butoxyethanol ester and the amine of 2,4-D at 2 lb per acre are recommended. Four pounds per acre will give better control but the difference is slight.

Pests and Diseases

Investigations on "wart eye" affecting germination of plant cane are described by B. E. HITCHCOCK. This malady has been responsible for poor germination for several years, the affected eyes never forming shoots. It is believed it may be due to a small soil insect or mite attacking the eyes after planting. Some varieties of cane are severely affected, others less so, while some seem to be immune. The results of preliminary tests in dipping the setts before planting in various chemicals or "dips" are given. Some give encouraging results.

An account of trials to test the efficiency of 5 different insecticides on soldier fly (*Altermetoponia rubiceps*) in different areas is given by A. A. MATTHEWS. This Australian pest, was first recorded on sugar cane in 1925 but it was not until the early 1960's that serious losses over large areas took place. It can cause loss in both plant and ratoon cane. Crude BHC (disced under), "Heptachlor" and "Dieldrin", all at 8 lb per acre, gave good control. "Aldrin" at the same rate gave good control in plant cane but some ratoon plots showed variable vigour. "Lindane" failed to control soldier fly.

Frost Injury

An account of frost injury to cane in some parts of the Central district in July 1963 is given by C. M. MCALEESE. Records show that during the last 17 years frost injury has occurred in 5 winters. The 1963 frost was unusually severe. Crops estimated to cut 35–50 tons of cane per acre generally maintained a reasonable internal condition. Stem tissue was discoloured but deterioration was slow. In some of the lighter crops damage was more severe. When sliced, stalks of Q50, Q58 and N:Co 310 were foul smelling and very watery, also discoloured and with pockets of red rot. It is concluded that well-grown crops of the varieties at present grown have the ability to maintain condition with very little financial loss to the grower.

F.N.H.

Agricultural Abstracts

Aphid sampling in sugar beet. W. J. S. KERSHAW. *Plant Pathology*, 1964, **13**, 101–106.—This paper records the difficulties met with when sampling green aphids (*Myzus persicae*) on sugar beet and suggests how, with regard to virus yellows control, these difficulties may be avoided. A simple method for separating the various instars from a mixed collection of *Myzus persicae* is described.

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Studies on sugar cane smut (*Ustilago scitaminea*) **in Kenya.** K. R. BOCK. *British Mycological Soc. Trans.*, 1964, **47**, 403–417.—This disease, first recorded in Kenya in 1958, is now regarded as responsible for a reduction of 10–15% of Kenya's sugar crop. It attacks cane in both inland and coastal areas. Observations on the biology of the fungus in Kenya are recorded. A reliable method for the laboratory screening of cane varieties for susceptibility is described and analysed.

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Translocation in sugar beet. I. Assimilation of $^{14}CO_2$ and distribution of materials from leaves. K. W. JOY. *J. Experimental Botany*, 1964, **15**, 485–494.—In experiments $^{14}CO_2$ was supplied to the leaves and the movement of labelled carbon to other parts of the plant assessed. Some very interesting results are recorded, e.g. young growing leaves assimilated carbon for their own growth and did not "export" it, while older leaves "exported" much of the carbon to younger leaves or roots.

MAURITIUS SUGAR CONGRESS[1]

THE whole of the July–September 1964 issue of the Mauritius *Revue* is devoted to an account of the 4th congress of the Mauritius Society of Agricultural and Sugar Technology, held at the Research Institute at Réduit during 18th–21st May, 1964. In addition to the Mauritius delegates there were some from neighbouring territories—18 from Réunion and 5 from Madagascar.

Historical

Several of the papers presented were of a historical nature or had a historical background. The Sugar Industry Research Institute of Mauritius completed the first 10 years of its existence in 1963 and a paper by P. O. WIEHE summarized the Institute's work during this time. He emphasized the fact that the Institute was primarily concerned with applied research, although a certain amount of long-range or fundamental research had to be carried out. The main trends in the evolution of the sugar industry in Mauritius during recent decades were discussed by C. NOËL. The evolution or changes that have taken place in the transportation of cane from field to factory was the subject of a paper by P. E. BOUVET, photographs of some of the most up-to-date loading and hauling equipment now in use in Mauritius being included. Changes or improvements that have occurred in the cane factories since the war were the subject of an article by L. LINCOLN. Figures for 1963 compared with 1948 afford interesting comparisons. Cane tonnage handled per hour at the factory had increased from 50·6 to 97·8 and sucrose content of the juice from 88 to 90·2%. The evolution of industrial relations in the sugar industry of Mauritius was discussed by J. P. DUCLER DES RAUCHES and of Réunion, during the last 10 years, by E. HUGOT.

Cane Breeding

Development in cane breeding in Mauritius over the last 10 years was the subject of a paper by E. F. GEORGE, geneticist at the Mauritius Sugar Research Institute. He pointed out that cane breeding is a slow process and that it takes 10–12 years from the time of making the original cross to the release of an interesting new variety. The more important varieties cultivated in Mauritius during the last decade were referred to, but it was pointed out the initial hybridization that brought them into being was carried out before the Research Station was established. The most recent Mauritius variety is M 442/51. Hybridization and selection work and the nursery techniques were described. A paper on cane varieties in Réunion was given by D. D'EMMEREZ DE CHARMOY (Directeur, Station Agronomique de la Bretagne, La Réunion).

Fertilizers

A review of work on cane nutrition in Mauritius was presented by D. H. PARISH, chemist at the Research Institute. He pointed out that in Mauritius more money is spent on nitrogen than on phosphate and potash together, and that with nitrogen, placement studies have indicated a higher efficiency with buried or watered-in ammonium sulphate than with surface-applied ammonium sulphate. Ammonium sulphate, irrespective of placement, is superior to urea. It is considered that as the efficiency of nitrogen utilization by cane is less than 50% it is important the mechanisms of nitrogen loss be actively studied. With phosphates it is stated "there can be no doubt that the best placement for phosphate is deep in the soil or mixed thoroughly with the soil at planting, and annual application of phosphate on the surface is an emergency approach only." The use of coral sand to maintain the calcium status, where necessary, is recommended. Organic manures for cane in Mauritius were discussed by G. ROUILLARD.

Pests and Diseases

Insect pests in Mauritius were discussed by J. R. WILLIAMS who stated: "The outstanding insect pest of cane in Mauritius is, of course, the spotted or stalk borer (*Proceras sacchariphagus*). If we consider the damage caused by this insect over the years, the landing of that particular consignment of cane which brought the pest from Java in the middle of the 18th Century must be regarded as one of the biggest catastrophies that this island has suffered." Control of the insect has proved difficult so far for various reasons. As a contrast the success achieved in controlling *Clemora smithi*, accidentally introduced from Barbados many years ago, is pointed out, this having been done before World War II. The status of the sugar cane leaf hopper (*Perkinsiella saccharicida*) in Mauritius is discussed, high populations being not at all common. Other pests dealt with are the scale insect (*Aulacaspis tegalensis*), which occurs only in the more humid regions of the island, and the army worm (*Leucania loreyi*) whose attacks on cane are now well understood.

A brief discussion of the 6 main sugar cane diseases of Mauritius is given by R. ANTOINE, 2 being bacterial, 2 fungal and 2 due to virus. G. LAUFFENBERGER of Madagascar gave a progress report of the campaign against Fiji disease (also due to a virus) in that country.

Weed Control and Irrigation

An account of the work carried out on chemical weed control has been given by E. ROCHECOUSTE, Botanist at the Research Institute, who has himself made detailed botanical studies of many Mauritius weeds. Special reference is made to the grass weeds *Cynodon dactylon* and *Paspalum paniculatum*.

Two papers dealt with overhead irrigation, tested or tried out on sugar cane in Mauritius initially in 1954. The results obtained with both mobile and semi-permanent equipment on different soil types were presented.

F.N.H.

[1] *Rev. Agric. Suc.* (Mauritius), 1964, **43**, 141–344.

Studies in the germination and moisture relationships of sugar cane setts. R. R. Panje and T. Raja Rao. *New Phytologist*, 1964, **63,** (2), 140–152.—Bud and root primordia have to attain a certain critical water content before they can begin to sprout. Addition of water to the internode may accelerate germination. Bud and root primordia appear to compete for water in the sett. At 96% humidity both bud and root primordia sprouted and grew out, but at 85% moisture only buds sprouted. The disparity may be due to the action of the bud scales.

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Leaf scald of sugar cane in Ceylon. S. N. de S. Seneviratne. *Tropical Agriculturalist*, 1962, **118,** 109–116.—It is pointed out that 3 potentially dangerous diseases of sugar cane are present in Ceylon—ratoon stunting disease, smut and leaf scald (*Xanthomonas albilineans*). A general account of leaf scald (a bacterial disease) and its symptoms in Ceylon is given, also preliminary observations on susceptibility of some imported sugar cane varieties.

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Agriculture moisture studies in Barbados using two types of lysimeters. J. C. Hudson. *Ministry of Agriculture, Lands and Fisheries (Barbados) Bull.*, 1963, (34), 25 pp.—Results are given from the first 8 months of operation of some simple field lysimeters at Waterford, Barbados, and a description of a large lysimeter which appears to be free from most of the usual defects of drainage lysimeters. Much of the work concerns the crop of most interest to Barbados, viz. sugar cane.

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The ecological control of the moth borer, ***Diatraea saccharalis*****, with special reference to** ***Lixophaga diatraeae*****: a preliminary report.** L. W. van Whervin. *Ministry of Agriculture, Lands and Fisheries (Barbados) Bull.*, 1963, (35), 22 pp.—Details are given of attempts to establish *Lixophaga* on a firm basis in the various ecological zones of the island during the period 1960-63, various strains being used. It is concluded that Barbados is environmentally resistant to *Lixophaga*, some areas being more resistant than others. Intermediate and high rainfall areas seem more favourable than the dry areas. Investigations to determine the feeding habits of the adults in nature and the effects of seasonal factors are being continued.

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Sucrose-enzyme relationships in immature sugar cane as affected by varying levels of nitrate and potassium supplied in sand culture. A. G. Alexander. *J. Agric.* (Univ. Puerto Rico), 1964, **48,** 165–231.—Young sugar cane plants grown in sand culture were subjected to potassium and nitrate stress to induce abnormal carbohydrate levels. These experiments are discussed in detail. The basic objective of the experiment was to ascertain what areas of sugar metabolism are involved in the degradation of sucrose. A list is given of the leaf enzymes concerned.

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Effect of soil pH on sugar content and yield of sugar beet. P. McEnrose and B. Coulter. *Irish J. Agric. Res.*, 1964, **3,** 63–69; through *Soils and Fertilizers*, 1964, **27,** 443.—Farms surveyed numbered 3020. As soil pH increased the sugar content of beet rose from 15·2 to 15·8% and sugar yield from 34·2 to 39·3 cwt/acre. Optimum pH was above 7 but only 34% of the farms had soils in that category.

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Phytopathological observations on nine sugar cane varieties introduced from Hawaii. M. V. A. Revilla. *Agronomía* (Lima), 1963, **30,** (2), 12–23; through *Plant Breeding Abs.*, 1964, **34,** 751.—The reactions to each of 6 diseases are tabulated. In dealing with mosaic virus, regarded as the most serious of the diseases, ancestries are given for the 5 varieties showing susceptibility. Information is also given on the distribution of the diseases at 7 localities in two departments of Peru.

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A morphological description of the sugar cane variety Co 547. M. S. Choudhary and A. Mustafa Khan. *W. Pak. J. Agric. Res.*, 1963, **1,** (2), 157–162; through *Plant Breeding Abs.*, 1964, **34,** 751.—Recommended for the Hyderabad region, this is a tall, erect cane of late maturity. It germinates and grows well and produces high average yields.

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A decade of research progress 1950-1959. L. D. Baver. *Hawaiian Planters' Record*, 1963, **57,** 118 pp; through *Plant Breeding Abs.*, 1964, **34,** 750.—A general outline is included of the sugar cane breeding and varietal testing programmes. Varieties are being bred for increased yield and quality, better adaptation and resistance to diseases. Cytogenetic studies are being made as well as an investigation of the physiology of flowering.

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Sugar cane variety outfield experiments in Louisiana during 1963. H. P. Fanguy, T. J. Stafford and R. J. Matherne. *Sugar Bull.*, 1964, **42,** 293–300. During 1963, 28 varieties were compared in outfield experiments on major soil sypes, 8 being commercial varieties and 20 unreleased varieties. C.P. 52-68 continued to yield well in all experiments but was outyielded by C.P. 55-30, especially on heavy soils.

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More about planting. L. L. LAUDEN. *Sugar Bull.* 1964, **42,** 306.—The 3 major varieties C.P.52-68, C.P.44-101 and N:Co 310 all respond well to September planting, which is preferable to August planting because of mosaic. Emphasis is placed on the need for a well pulverised seed bed, a planting furrow of uniform depth and not more than a 4-inch soil cover over the setts, well compacted.

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Recent achievements in controlling red rot in Uttar Pradesh. KIRTI KAR and D. K. SINGH. *Indian Sugar*, 1964, **14,** 223–238.—The history of this cane disease (*Physalospora tucumanensis*) in India and the severe outbreaks in the past are referred to. Details are given, with a map, of a scheme for the eradication of the disease from a part of Uttar Pradesh where it has caused heavy losses in the past. An account is given of the roguing operations so far carried out.

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Field experiments with insecticides for control of insect vectors and sugar cane mosaic spread. L. J. CHARPENTIER. *Sugar J.* (La.), 1964, **27,** (3), 17–19.—In areas of high mosaic spread, roguing of fields to be used for seed cane may be ineffective because insect vectors spread the disease into the rogued cane so rapidly. The results of experiments with insecticides to reduce aphid populations are given. Although a high level of insect control was obtained, mosaic spread was not effectively controlled. At present prices commercial application of the insecticides used ("Malathion", "Demeton") would not be economical.

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New stalk cutting device tested. ANON. *Sugar J.* (La.), 1964, **27,** (3), 44.—A sugar cane stalk cutting machine, under test by the United States Sugar Corporation, is described. It will cut stalks into 22-inch lengths regardless of the direction that the stalks enter the machine. Basically it consists of two oppositely rotating drums (8 feet long by 16 in diameter) each with two sharp blades. Further experimenting is planned.

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The economic development of the Mauritius sugar industry. R. LAMUSSE. *Rev. Agric. Sucr.* (Mauritius), 1964, **43,** 113–127.—This is the second of a series of articles and is concerned with "labour problems" from the slave days to the present time.

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The selection of seed cane for new areas. G. M. THOMPSON. *South African Sugar J.*, 1964, **48,** 539. Advice to growers on the selection of seed cane is given, with planting material likely to be in short supply. The establishment of nurseries for seed cane production is strongly recommended, with regular and frequent inspections and roguing. Notes on the important diseases and their recognition are included, viz. smut, mosaic, chlorotic streak, ratoon stunting disease and gummosis.

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A visit to the mechanization demonstration. ANON. *South African Sugar J.*, 1964, **48,** 629–635.—A description is given, with numerous photographs, of the 1964 field mechanization demonstration held near Empangeni in Zululand. A number of new tractors and implements were demonstrated. More than 900 cane growers attended during the two days.

* * *

Sugar cane pests of Bihar and methods of control. Z. A. SIDDIQI. *Indian Sugar*, 1964, **14,** 289–295. Insect pests are considered to be responsible, on an average, for a loss of 25% in the sugar crop. A brief account is given of the biology of these pests and of methods of control. Major insect pests listed include various borers, termites, pyrilla or leaf-hopper (*Pyrilla perpusilla*) and white fly (*Aleurolobus barodensis*). Minor pests include scale insects, mites, mealy bugs, cutworms and grasshoppers. Several pests are illustrated.

* * *

Soil fatigue versus root excretion. T. S. C. WANG. *Taiwan Sugar Quarterly*, 1964, **11,** (2), 17–21.—A useful summary is given of present knowledge regarding root secretions. It is pointed out how the use of radioactive organic compounds is likely to promote knowledge in this field. Soil fatigue with sugar cane is widespread, especially in Taiwan with the interplanting system intensively practised. Some crops and some weeds suppress cane growth very much while others do so to a lesser extent.

* * *

New cane varieties released in Taiwan. B. C. MOK *et al. Taiwan Sugar Quarterly*, 1964, **11,** (2), 22–25. Descriptions and agronomic characteristics of three new varieties of cane are given. These now account for 40% of the island's cane crop. They are F146, F148 (both released in 1959) and F152 (released 1961). F146 was bred from the Natal variety N:Co 310, so prominent in Taiwan.

* * *

Cane field operations advance. R. P. HUMBERT. *Sugar y Azúcar*, 1964, **59,** (9), 79–81.—The whole field of recent developments in sugar cane cultivation and production is reviewed. It is thought that the changes now taking place, particularly with mechanization and harvesting, will ensure adequate sugar for the world's expanding population. Planting, cultivation, weed control, irrigation, ripening control, harvesting and transport of cane are all discussed.

* * *

Sugar beet field mechanization. A. ARMER. *Sugar y Azúcar*, 1964, **59,** (9), 82–84.—The evolution of mechanization in the sugar beet fields of the United States during the last half century is discussed. Today harvesting is virtually a completely mechanized operation in the U.S.A., as it is in other beet growing countries. Besides harvesting, mechanization of spring season work, notably thinning and the use of processed or monogerm seed, is discussed.

* * *

Thoughts on early start. D. RACKHAM. *British Sugar Beet Rev.*, 1964, **33**, (1), 20.—The pros and cons of early harvesting of the beet crop in Britain while the weather remains open and mild (as in 1964) are discussed.

* * *

Seed—the basic factor: a survey of the position. R. A. BOND. *British Sugar Beet Rev.*, 1964, **33**, (1), 21–24. More than 64% of the present British sugar beet crop was sown with precision drills using processed seed, compared with only 4% in 1954. Whatever the ultimate solution of spring mechanization problems (which are discussed) the essential requirement of graded seed of high germination will remain a first class seed-bed.

* * *

Machinery for spring work shown in Yorkshire. D. TIDY. *British Sugar Beet Rev.*, 1964, **33**, (1), 25–26, 32.—A report is given of the 15th national sugar beet spring demonstration (at Messrs. John Ramsden & Sons, Myton Home Farm, near Boroughbridge) attended by 4500 visitors. Eleven precision drills, 16 down-the-row thinners and gappers, 14 tractor hoes and 5 band sprayers and granule applicators were demonstrated.

* * *

On-farm clamping of beet: value of ventilation. G. H. BATTLE. *British Sugar Beet Rev.*, 1964, **33**, (1), 45–46, 48.—A description is given of the method of providing ventilation channels in the concrete base of a clamp to avoid heating of the beet, with consequent sprouting and loss of sugar.

* * *

Sugar cane cultivation and production in South Africa. J. A. LÓPEZ HERNÁNDEZ. *La Ind. Azuc.*, 1964, **70**, 275.—A sugar cane expert from Tucumán (Argentina) gives his impressions of a visit to the sugar cane areas of South Africa.

* * *

Soil sampling. ANON. *Sugarland* (Philippines), 1964, **1**, (5), 10–12.—Recommendations and advice are given (by the Philippine Sugar Institute) on the correct method of taking soil samples.

* * *

Mexican cane production in the year 2000? A. G. GALLARDO and J. R. ARANDA. *Bol. Azuc. Mex.*, 1964, (181), 18–22.—The authors make interesting speculations on the possible or probable future sugar cane production of Mexico. At the close of this century it is thought that production of cane could be 5½ million tons, with a population of 117 million. This compares with 56,000 tons in 1911 when the population was 11 million and 1½ million tons in 1960 with the population nearly 34 million. Notes on the early history of sugar cane cultivation in Mexico and adjoining countries are given.

* * *

Harvester edition. ANON. *Up and Down the Rows*, 1964, (135), 4 pp.—This special issue is devoted to the more than 200 sugar beet growers of Ontario who have harvested their crop mechanically during the last decade. About half a dozen different sugar beet harvesters of various sizes are described and illustrated.

* * *

New nitrogen fertilizer plant. ANON. *Producers' Rev.*, 1964, **54**, (8), 25.—The official opening of a new nitrogen fertilizer plant near Sydney is recorded. It cost £A6,000,000 and will produce ammonia, ammonium nitrate and urea.

* * *

Transload cane station. ANON. *Producers' Rev.*, 1964, **54**, (8), 37.—One of the newer pieces of Hawaiian field mechanization is described and illustrated. It transfers cane from in-field transport vehicles to rail cars, at the same time cleaning and chopping the cane to provide higher density hauling.

* * *

Phosphorus fixation by soil. C. R. VON STIEGLITZ. *Producers' Rev.*, 1964, **54**, (8), 45.—Most of what is known of this subject is from research work carried out in the last 25 years. The importance of the nature of the soil is stressed and of placing phosphate dressings near the roots, as is in fact generally done with sugar cane.

* * *

Drainage vital in cane growing. ANON. *Producers' Rev.*, 1964, **54**, (8), 67–73.—A general discussion on the merits of land drainage precedes an account of the methods and machinery employed in large scale drainage of swampy land in Queensland that later became good cane land.

* * *

A journey to the sugar cane areas of Hawaii, Louisiana, Mexico, Peru and Puerto Rico. LUIS GARCIA LOZADA. *Bol. Instituto para el Fomento de la Productividad Azucarera* (Barquisimeto, Venezuela), 1964 **1**, (4), 102 pp.—This is a detailed account of a visit by a sugar cane agronomist from Venezuela to various sugar cane growing countries of the World and of the impressions he formed. It is divided into three parts, the first giving an overall picture of sugar cane cultivation in each of the countries concerned. The second part describes the nature of the experimental and research agronomy in the broad sense. Fertilizing, planting, varieties grown, herbicides, pests and diseases, irrigation, harvesting and flowering are all dealt with. An index on the title page renders the booklet easy to use.

THE USE OF A GRANULAR MINERAL DECOLORIZING CARBON IN A BEET SUGAR FACTORY

by R. M. J. WITHERS and G. CRANE

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

PART III

The Herreshoff furnace

Fig. 7 is a simplified section of this plant, consisting of ten circular hearths, placed one above the other and enclosed in a refractory-lined steel shell. A vertical rotary shaft (air-cooled) through the centre of the furnace carries arms with rabble blades which stir the charge and move it in a spiral path across each hearth. Material is fed to the top hearth (No. 1), and rabbled across it to pass through dropholes to the hearth below (No. 2). Finally the material drops out of the bottom hearth (No. 10).

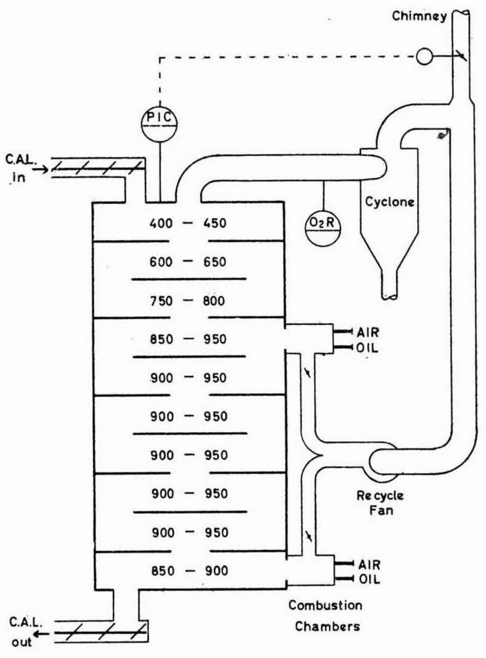

Fig. 7

In our first plant the material from the bottom hearth fell into a sealed quench tank which ensured that no excess air could find its way into the furnace and so prevented consequent loss of carbon by combustion in excess air at elevated temperatures.

Heated gases flow counter-currently to heat the CAL carbon to such a temperature that the impurities ignite. Control of the oxygen content of these gases is intended to preserve a wide margin between the combustion temperature of the impurities and of the CAL itself. These impurities are themselves a source of heat, and automatic temperature control is provided so as to ensure that only sufficient fuel is injected to maintain the necessary reaction temperatures.

Part of the total heat input is used merely to evaporate the water brought in with the sweetened-off carbon. It is therefore necessary to remove as much water as possible so as to reduce fuel consumption to a minimum. In our final plant system an average moisture of 36% was achieved. The furnace is supposed to deal with 700 lb per hour of CAL carbon at 40% moisture content.

The heated gases originate from separate combustion chambers burning fuel oil. One of these chambers is associated with hearth No. 10, and one with hearth No. 4. These burners, together, are capable of a total maximum heat release of 1·5 million B.Th.U. per hour. In other words, there is a capability of releasing approximately 4·7 million B.Th.U. per ton of carbon when working at the 700 lb/hour rate and of 12 million B.Th.U. per ton of carbon when working at 280 lb/hour.

In fact, at York we found that on average the fuel consumption ran at about 100 gallons per day when recycling 300 lb of CAL carbon per hour. This gives about 31 gallons per ton of CAL carbon compared with GILLETTE's 2 gallons per ton, and works out at a heat requirement of 5·5 million B.Th.U. per ton of carbon. It seems that the maximum capacity of the Herreshoff furnace at York, dealing with CAL carbon loaded to the same impurity level as has been experienced there so far, is 570 lb per hour.

It may therefore be that the burner capacity is rather undersized to the furnace requirements if as much as 700 lb per hour is to be recycled. However, there is provision at hearths 6 and 8 for further burners to be fitted if extra heat units should be required in the future. We have no comparable data on the use of this kind of kiln with CAL on other beet sugar factory juices but we understand that on bone char, with cane sugar juices, a typical figure is 1 million B.Th.U. per ton of char.

The hottest hearths are at the bottom of the furnace where the temperature is of the order of 900–950°C and where the impurities are coked to produce CO and CO_2. Air injection pipes, manually adjusted and positioned at hearths 4, 6, 8 and 10, provide oxygen for the composition of the impurities and a Kent paramagnetic oxygen analyser samples the outcoming recycle gases to provide a means for determining optimum furnace conditions and manual adjustment of the injection air.

Too much oxygen will cause a loss of carbon, too little will prevent proper coking of the impurities. In practice the York furnace operated usually at about 2% oxygen.

To prevent excessively high temperatures in the hearths where burning of the coke impurities is effected, relatively cool recycle gas is introduced.

The gas is drawn off the top of the furnace at hearth No. 1. At the 10th hearth it is reintroduced in the extension provided to the combustion chamber. At hearths 6 and 8, the recycle gas is introduced via a suitable ducting. A further branch of this ducting discharges surplus gas to atmosphere via an automatic furnace pressure regulator.

Each hearth is fitted with a thermocouple recording temperature on a multi-point instrument. Typical operating hearth temperatures are as follows:

Hearth 1.	400–450°C	Hearth 6.	900–950°C
Hearth 2.	600–650°C	Hearth 7.	900–950°C
Hearth 3.	750–800°C	Hearth 8.	900–950°C
Hearth 4.	850–950°C	Hearth 9.	900–950°C
Hearth 5.	900–950°C	Hearth 10.	850–950°C

In practice the hearth temperature was controlled to within 2°C of the set points. Each burner is fitted with automatic temperature control, including automatic air:oil ratio, flame failure protection, etc.

The reason why the temperatures in the upper parts of the furnace are lower than in the lower hearths is that much heat is lost here by evaporation of water and in distillation of impurities. It has been suggested that 70–80% of the impurities are normally expelled by distillation in the cooler upper hearths.

A material flow indicator is provided to give a warning if the supply of carbon to the furnace should run down.

The recycle gas passes through a cyclone to remove fine particles and the dry discharge from this has to be collected periodically.

Initially the recycle gas quantity was far in excess of requirements. This caused a large heat loss by radiation from the recycle duct work and a very large wastage of CAL carbon owing to combustion and carry-over of particles into the duct work cyclone and chimney, all of which was glowing red with heat.

At one stage the removal of this carbon from the cyclone represented a loss of over 14% per cycle. Fortunately the recycle gas fan was driven through a vee-rope drive and by changing the pulleys a more reasonable gas velocity was obtained. It is still felt, however, that some fine carbon is removed from the multiple hearths and burnt.

The furnace is normally controlled operationally with reference to the apparent density of carbon leaving the furnace and normally values of 0·45–0·47 are sought. In practice, however, the apparent densities of the CAL carbon from the furnace have averaged 0·48.

In the initial plant the carbon was removed from the furnace by means of a quench tank. Experiments at Bramcote had demonstrated that the loss due to quenching in cold water would be quite negligible but no estimate of this loss was obtained on the plant. The carbon/water mixture was then pumped to the top of the adsorption columns, separated by means of horizontal vibrating screens and the carbon washed into the columns in treated liquor.

This system was found to be unsatisfactory in operation owing mainly to problems associated with blinding of the horizontal vibrating screens and was eventually replaced by water-cooled screw conveyors leading the carbon to a tank filled automatically with treated liquor. The slurry of carbon and treated liquor was then pumped to the top of the three adsorption columns and fed batchwise into the three columns in turn via a supply tank and three air-operated Saunders valves.

It had originally been intended to use water-cooled conveyors with hollow shafts, also water-cooled. The necessary material for the construction of this type of conveyor was not available in time, however, and so these conveyors only have their jackets cooled with water and it has been necessary to spray additional water directly on to the CAL. Since the furnace pressure controller maintains a very slight vacuum on the furnace, this caused a certain amount of steam to enter the furnace through the final discharge port. The total amount of water added to the sprays averaged about 40 gallons per hour and the moisture content of the carbon entering the treated liquor tank was about 50%.

Automatic controls

There are two control cubicles, one for the control of the adsorption process, the other for the control of re-activation. The first of these is sited on the first floor level adjacent to the adsorption columns and the other is on the ground floor beside the furnace. There is also a small multi-motor contactor board beside the first cubicle to enable all the motor drives to be controlled from a central point. All the important control valves are motorized and can be operated from the adsorption control cubicle. Also on this cubicle are the automatic controls for the flow of juice into the columns, the level control of the supply tank, the density control of thick juice, the temperature control of thick juice and the density control of the sweetening-off process. In addition there is an alarm system to show various fault conditions associated with both the adsorption and the re-activation plant.

The level of the supply tank is measured with a differential pressure cell transmitter fitted on a flange to the side of the tank, the signal is piped into a low signal selector relay which in turn controls the desired value of the flow of juice into the columns. It also operates a pressure switch to give a high level alarm signal.

The density of the thick juice is measured by a U-type densitometer which gives a 3 to 15 p.s.i. output over the density range 50° to 65° Brix. This signal is received at the control cubicle by a recorder controller and the output from this operates a Saunders air-operated control valve which can allow sweet water to dilute the thick juice to the controlled set point. This control has not been used much.

The temperature of the thick juice is measured after the heater with a temperature transmitter of the gas-filled type and gives a 3 to 15 p.s.i. output for 20 to 120°C. This signal is again received at the control panel by a recorder controller, the putput from which goes to an air-operated butterfly valve in the vapour line to the heater.

The automatic flow control of this juice is designed to supply the feed equally between the three columns and to make the total quantity dependent on the level in the supply tank and also on the situation at the melter station.

In each of the three lines there is mounted a differential pressure cell with an orifice plate. The orifice plate is designed to produce a differential of 50 inches water gauge when 50 g.p.m. of thick juice at 58°Brix and 85°C is flowing. The differential pressure cell is fully adjustable both for zero and range, and transmits 3 to 15 p.s.i. for the flow rate of 0 to 50 g.p.h.

The signals from the D.P. cell are piped to 3 recorder/controllers fitted with pressure-operated desired-value pointers and the output from these goes to Saunders control valves mounted after the orifice plates.

The desired-value pointers are set from a signal piped from the low signal selector relay whose inputs come from the thick juice tank level transmitter and from the melter station.

The melter station is equipped with a manual control station comprising a regulator for setting the desired values of the flow controllers, and three gauges showing thick juice tank level, regulator pressure, and thick juice flow.

Thus, when the three controllers are set for automatic operation, the flow is influenced by the level in the supply tank, but, if the melter operator should require less flow than that dictated by this level, he can, by reducing his regulator air pressure, override the tank level signal and reduce the flow if necessary to zero. When he does this, the thick juice tank will slowly fill up, ultimately sounding the high level alarm. He can never obtain more juice than that set by the tank level.

The entry and discharge of carbon into the three adsorption columns is controlled by air-operated Saunders valves of the pressure closing type fitted with hard rubber linings. All these valves are controlled via solenoid valves from the main control cubicle where they are switched by rotary switches labelled Open–Shut–Auto. When switched to "Auto", the solenoid valves are operated automatically by timers set basically to a four-hour sequence.

On the transfer chamber there are valves to discharge the CAL carbon to the wet bin, valves to select the destination of the juice or sweet water, a water inlet valve and a vent valve. All these are air-operated through solenoid valves by means of rotary switches on the main control cubicle. When the switches are set to "Auto", they are again operated by means of timers in the panel and also from the density meter controlling the sweetening-off process.

When carbon is to be discharged from one of the columns, the vent transfer chamber valve goes to the "Vent" position. Secondly, the transfer valve to the wet bin goes to the shut position, and thirdly, the appropriate column carbon valve is opened together with the appropriate column carbon feed valve. In the top of the transfer chamber there is mounted an automatic level detector which closes the spent CAL valves automatically on high level conditions.

The next operation is to blow as much of the thick juice as possible through the carbon in the transfer chamber and this is effected by closing the vent valve which automatically admits compressed air to the chamber (if the water/air selector switch is in the correct position). When the sweet water valve is switched to the "Open" position, the (juice tank) sweet water tank valves are selected automatically from a pressure switch operated by the sweetening-off density meter.

This density meter is similar in construction to the one used for the automatic control of thick juice density. So long as the density remains above a certain pre-set figure on the pressure switch, the juice is automatically sent to the supply tank. Next, water is admitted to the transfer chamber in place of air by changing the position of the water/air switch. As soon as the density of the sweet water falls below the pre-set figure, it is automatically switched to the sweet water tank. Finally, when the sweet water falls to 3°Brix it is sent back to the diffusion supply.

As soon as the sweetening-off procedure is finished, the wet bin discharge valve is shut, and the wet bin vent is opened to the vent position. Next, the transfer chamber valve to the wet bin is opened and the juice and sweet water valves are switched to the "Shut" position. Compressed air is once again admitted to the transfer chamber.

The compressed air pressure is manually set from the main cubicle on a regulator, and is usually set at 40 p.s.i. When the carbon water mixture has cleared from the transfer chamber, the wet bin vent switch is shut.

In the bottom of the wet bin there is a screen and the compressed air which comes in through the wet bin vent in the shut position blows the water out through the carbon to drains. Normally the carbon is drained in the wet bin for about three hours.

To empty the wet bin, the transfer chamber vent is first switched to the "Vent" position, the transfer chamber valve to the wet bin is closed and then the wet bin discharge door is opened. Finally the wet bin vent is opened by switching to the vent position.

The discharge from the dry CAL carbon bin is controlled manually by a variable-speed scroll which carries the carbon through a rotary valve into the furnace. At the rotary valve there is a no-feed alarm; this is a paddle switch which initiates a relay and timer circuit and operates a warning light and alarm signal on both the control panels.

On the re-activation control cubicle, there is an oxygen recorder working on the paramagnetic principle. There is also a furnace pressure controller which operates a power cylinder-controlled butterfly valve in the furnace stack. The measured value is obtained from a pressure tapping in the No. 1 hearth. Hearths 3 and 9 have temperature controllers for the burners on hearths 4 and 10. There are also flame failure protection equipments, ignition circuits, etc. A thermocouple is used to measure the hearth temperature; this feeds into the indicating controller which operates an electric reversing motor depending on whether the temperature is above or below the control point. This motor is mechanically connected to valves in the oil and combustion air pipe lines. The linkage to these valves maintains the correct oil/air ratio. Ignition is push button-operated from the panel and there is a flame failure device which operates through a timer and relays and magnetic valves to cut off the supply of oil and combustion air in the event of flame failure. The compressor motor which operates the fuel pump and the combustion air fan are started from push buttons in the panel. Finally, there is a multi-point temperature recorder giving a record of the temperature on all of the hearths and in the re-circulation duct work.

After the CAL carbon has been re-activated, it is cooled in two water-cooled scroll conveyors and then passes into a tank where it forms a slurry with treated liquor collected from the launders at the top of the adsorption columns or overflow juice from the feeder tank. There is a simple on/off level control at this tank which controls the admission of the treated liquor.

This slurry is then pumped by centrifugal pump driven through a variable speed gearbox to the feeder tank above the adsorption columns. The CAL tends to settle out in the feeder tank, and the juice overflow is collected in the supply tank which feeds the slurry tank.

Performance

A typical daily log sheet showing the operation of the plant is shown below. This sheet was filled in daily by the factory chemical laboratory partly on the basis of analyses made within the laboratory and partly from a daily plant log. These sheets were first drawn up so as to provide a record of events during the period when commissioning and evaluation of the many plant improvements took place.

York. CAL Laboratory Daily Log Sheet. Day ending 6 a.m. 16.12.63.

Estimated dry CAL recycled (from no. of transfers)	7500 lb			
Average liquor Brix		57·0°		
Average liquor flow rate (g.p.m.)	34	35	34	
Average liquor temperature and pH	78°C		7·7	
pH drop across columns		Nil		
	On 14	On 44	On 85	Thro' 85
Size distribution of CAL to furnace	—	—	—	—
Size distribution of CAL from furnace	24·32	75·64	0·04	Nil
	1	2	3	
Bulk density of CAL to furnace		0·65		
Bulk density of CAL from furnace	0·47	0·47	0·46	
Depth of column bed at 10 a.m.	Full	Full	Full	
No. of transfers per column in 24 hr	2	1	2	
S.W. loss to diffuser in 24 hr	8685 galls 2·2°Brix			

Invert/100 *Bx*.	
Thin juice	0·10
Thick juice to CAL carbon	0·33
Thick juice ex CAL Column 1	0·30
2	0·28
3	0·25
pH (24 *hr averages*)	
Thin juice	8·6
Thick juice to CAL	7·7
Thick juice ex CAL	7·7
White mass	7·3
1st raw	7·3
2nd raw	—
3rd raw	—
Cryst. as dropped	7·1
Cryst. as spun	6·6
Colours (*Green filter No.* 4)	
Juice to CAL	171
Ex-Column 1	141
" " 2	108
" " 3	98
Ex thick Juice presses	183*
CAL to furnace % sugar	1·1
% moisture	35·0
% water in CAL to quench tank	52·4
No. of bags of make-up/24 hr	12
Oil consumption/24 hr	97 gal
S.W. to process, gal/24 hr	2275
Average sweetening-off time	87 min

* This is standard liquor, i.e. includes work and remelt.

The cost of operating the CAL plant may be summarized as follows:

(1) *CAL carbon wastage*

300 lb/hour cycle rate and 340 tons/day of sugar throughput gives a burn ratio of 0·95%.

Loss of 7% at 2·25 shillings/lb.

Cost = 2·0d per cwt sugar produced.

(2) *Fuel*

Consumption 130 galls/day at 1/1½d per gallon.

Cost = 0·258d per cwt sugar produced.

(3) *Labour*

One man per shift at 5/2d per hour.

Cost = 0·219d per cwt sugar produced.

(4) *Sugar Loss*

1·2% loss in 300 lb carbon per hour.

Sugar at £58.0.0. per ton.

Cost = 0·079d per cwt sugar produced.

(5) *Filter Aid*

Increase in usage of "Fas-Flo" and plate-and-frame filters = 38 lb per hour at 7·33d per lb.

Cost = 0·983d per cwt sugar produced.

Total operating costs = 3·539d per cwt sugar produced.

(6) *Depreciation* of £80,000.0.0. (overall cost of plant at York which is high owing to extensive modifications) at 9% per annum

=£7,200.0.0. per annum.

Campaign sugar output 34,400 tons.

Cost = 2·512 per cwt sugar produced.

(7) CAL carbon: Interest at 4% on value of 181,970 lb of CAL carbon in stock at 2·25s per lb

Cost = 0·286d per cwt sugar produced.

Overall cost per cwt of white sugar = 6·337 pence.

With regard to the above costs, it is estimated that the CAL wastage during normal operations was running somewhere between 4% and 5%. However, owing to difficulties experienced at the end of the operations mainly in controlling the furnace, the very much higher loss of 7% has been determined by careful measurement of the final stock position. It is hoped that further progress will be made in this field and that ultimately a loss of under 5% will be achieved. The fuel costs were also affected by these end-of-campaign difficulties. Labour costs are unlikely to show any significant improvement in the future. The sugar loss on the CAL going to the furnace is very difficult to determine precisely; indeed until an alcohol extraction method was developed at Bramcote no estimate was possible.

Since all the sweet water is returned to the process no other loss has been assumed. Further work is still required to improve efficiency of the filtration, but it is unlikely that any large reduction in the cost of filter aid would be effected.

With regard to the charges made for the depreciation and interest, these bear a direct relationship to the use to which the CAL plant is put. Although the CAL plant was used during the 1963 refining run, we have decided to pass these charges solely onto the beet campaign production of sugar.

Finally, Figs. 8 and 9 show the results of the use of the CAL so far as the factory performance is concerned. Fig. 8 is a plot of the visual grade, the polagraphic height, the turbidity, the colour, the ash, the invert and the foaming index of the sugar from October 1963 to January 1964. It will be seen that there was a very significant improvement in the sugar quality directly the juice was passed through the adsorption columns on the 11th November. There follows a slow deterioration partly owing to difficulties associated with filling the columns because of incorrect screen material being fitted to the outlet sparge pipes. There was also a major blockage in the withdrawal system. All these difficulties were overcome by the end of November and the graphs show the effect of these stoppages and the improvements which occur following the reintroduction of the CAL carbon plant in its final working order. The plant was shut down progressively at the end of December and the immediate worsening in the sugar quality is apparent.

Fig. 9 shows for comparison the beets sliced in tons per day, the percentage of sugar in the beets and the sugar in the molasses as a percentage of the sugar in the beets. As a result of the presence of the CAL plant, alterations were made in the operations at the sugar end of the York factory. The most significant of these were at the centrifugals and included a reduction in the use of wash water. The York factory staff believe that the CAL plant has been generally beneficial to operations at the sugar end and the sugar in molasses figures are certainly encouraging. However, no attempt has been made to put any value on these aspects of the use of CAL carbon.

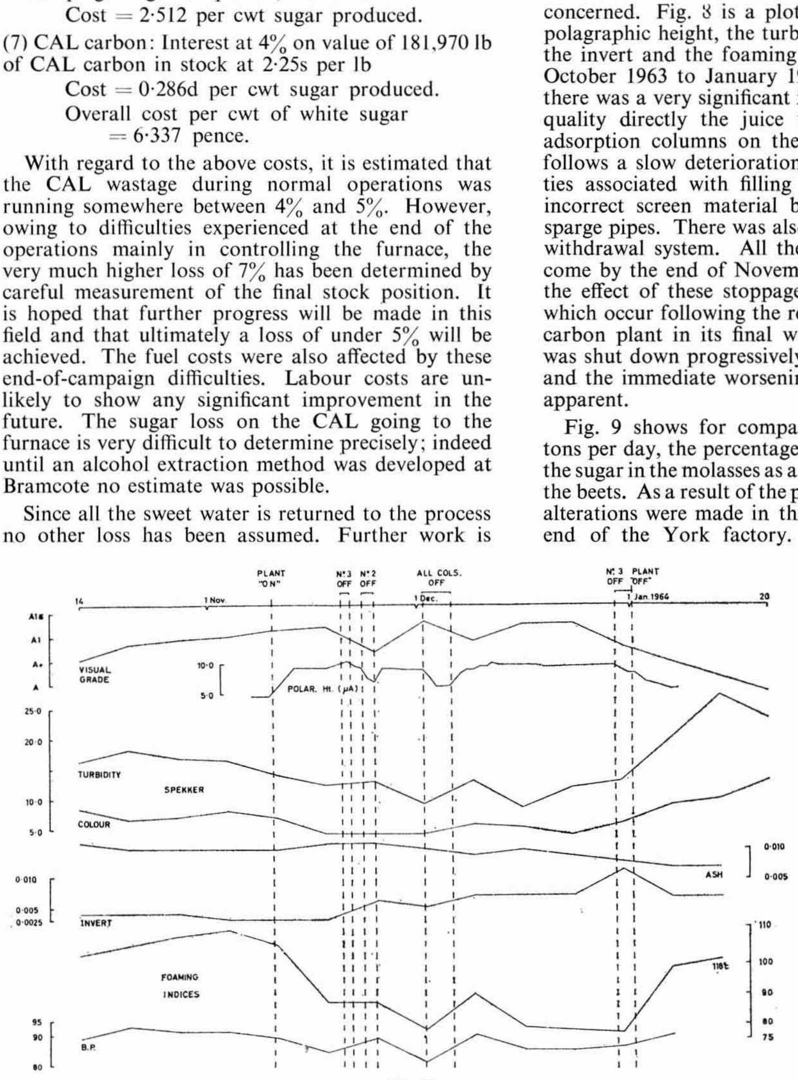

Fig. 8

ACKNOWLEDGMENTS

A great many individuals helped in this project but we would like to pay tribute to J. CAMPBELL MACDONALD, O.B.E., whose support at every

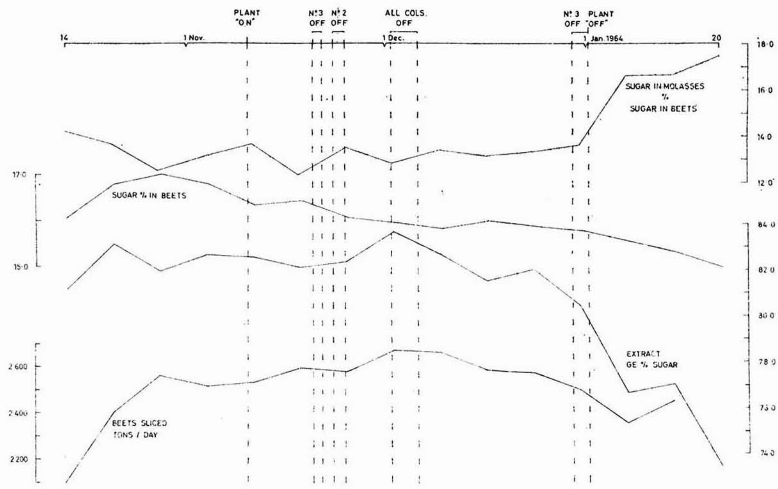

Fig. 9

stage made solutions of the various problems possible, to R. J. M. van der Burg for much help and advice on general problems, to Dr. Carruthers and J. Oldfield for advice and the work carried out at Bramcote, to A. X. Hiltgen and staff of the Pittsburgh Activated Carbon Co., for much practical assistance on the spot, to S. Morrish, lately our Chief Engineer, and T. Coles of the drawing office for help in building the plant, and finally to G. Martin, foreman at York, who cheerfully bore much of the heat and burden of the day.

CORRESPONDENCE

RELATIVE DECOLORIZING POWER OF CAL CARBON AND BONE CHAR

To the Editor, *The International Sugar Journal Ltd.*

Dear Sir,

The data given (*I.S.J.*, 1965, **67**, 80) by Mr. Withers and Mr. Crane are somewhat misleading. Two important considerations can be mentioned—

(1) Not all bone chars are the same; a good stock can have two or three times the capacity of a poor stock, and the most important single factor in decolorization is the *quality* of the adsorbent used.

(2) CAL carbon contains over 90% carbon; good bone char contains 9–10%. There is no fixed ratio between the decolorizing powers. If decolorizing power is expressed in lb solids decolorized per lb adsorbent burned then experience indicates that the relationship is approximately:

% decolorization achieved	*(Relative) solids decolorized per unit weight of adsorbent* — *CAL*	*(British) stock char*
94	3·0 – 3·5	1
88	10	1

At the 99% decolorization level, it is probable that CAL would show no advantage over bone char, and this conclusion holds also for the use of bone char in "battery" operation. The average refinery wishes to achieve 88–93% decolorization, and best practice would indicate the use of 0·5–0·8% CAL or 5% (good) bone char on solids. For comparisons to be valid like must be compared with like, and with the same transit times the cistern volume is independent of the adsorbent used. This can best be shown by a simple table:

	CAL	*Bone Char*
Tons solids to be decolorized 25 T/hr (cu.ft./hr) say	1000	1000
Liquor transit time (hr)	5	5
Volume of adsorbent in contact with liquor	5000	5000
,, ,, ,, sweetening-off and washing basis 24 hr "start"	1000	1000
Value of adsorbent in regenerating and in circulation	1000	1000
Total volume in stock (cu.ft.)	7000	7000
Investment in cisterns, piping, tanks, etc.	same	same
Investment in adsorbent	£28,500	£17,000
Adsorbent to be dried & burned (lb/hr)..	280	2800
Fuel for drying and burning (lb/hr)......	28*	140
*The high residual moisture in CAL inflates the cost of regeneration.		
Cost of fuel (A) (£/hr)	0·06	0·31
Loss in regenerating adsorbent (lb/hr)....	11	14
Replacement cost (B) (£/hr)	1·60	0·55
Capital charges basis 7% on investment in carbon working 6000 hr a year (C) ....(£/hr)	0·33	0·20
Total (A + B + C) (£/hr)	1·99	1·06
Using 0·8% CAL (£/hr)................	2.98	

Labour cost in both cases is negligible.

One man for 2–3 hr a day.

Kiln should be in the boiler house.

Finally, there are some intangibles:

On carbonatated liquor, (British) bone char is a better absorbent than CAL, which is rather weak at the low colour end.

Bone char sweetens-off faster with less water, thereby reducing recirculations of solids. CAL usually gives a small invert grain; good bone char give a small reduction. Bone char both transfers and removes a little ash.

These considerations of volume of plant, investment in adsorbent, operating cost and chemical reactions explain why some new refineries have chosen to use bone char, despite the fact that they must handle and burn 6–10 times as much adsorbent. The tonnages involved are in any case rather small.

Yours faithfully,

F. M. CHAPMAN.

THE FORMATION OF 6-KESTOSE ON HEATING OF DRY SUCROSE

by D. BOLLMANN, H. HIRSCHMÜLLER and S. SCHMIDT-BERG-LORENZ
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THERE are many publications on the decomposition of dissolved sucrose caused by various influences and conditions. By contrast, little has appeared in the literature on the thermal decomposition of *dry* sucrose. Most of the authors who have worked in this field deal with the quantitative loss of sucrose or the degree of discoloration. There are also publications on the nature of the substances formed. However, only the low-molecular substances have been separated and identified, while great difficulties have been encountered in the case of high-molecular caramel substances because of the complexity of the compounds and their great number and similarity. For these reasons one has had to confine oneself in general to classifying the caramel substances into groups. At the 10th C.I.T.S. Session in London in 1957 a survey was given of a number of studies of the Berlin Institute and of the whole literature on this field[1].

Few new studies have appeared subsequently on this subject. TRUHAUT, VITTE and LASALLE-SAINT-JEAN[2] have presented a bibliographic study on caramel substances. NAFFA and ANDRÉ[3], SOKOLOWSKII and NIKIFOROVA[4], SAPRONOV[5] and POLYACHENKO and BARABANOV[6] have reported on various studies concerned with the nature of these substances. SHIGENO and SOTOME[7] and TRUHAUT, CASTAGNOU, LARCEBAU and LASSALLE-SAINT-JEAN[8] have described the analysis of sugar in caramel products. ROSSI, GIOVENTU and MASERA[9] and GREENWOOD, KNOX and MILNE[10] have dealt with distillable and volatile substances.

In the meantine, research work on the subject has continued at the Berlin Sugar Institute. At the 17th Technical Conference of the British Sugar Corporation a survey of this work was given by H. HIRSCHMÜLLER. The following reports in more detail on one of the results of this work, namely the formation of 6-kestose in molten sucrose.

6-Kestose is a trisaccharide consisting of one molecule of sucrose, with the fructose component of which a further fructosyl component is combined in the 6-position. It is synthesized by the action of yeast invertase on sucrose[11]. The formation of kestose as a result of chemical instead of biochemical reactions however has not hitherto been known.

For our tests only very pure sucrose was used in view of the fact that trace impurities have a fairly intense effect on decomposition[1,12,13]. In our preliminary tests heating conditions were established in such a way as to avoid the formation of too many different substances and on the other hand to ensure the production of demonstrable quantities of these substances. For this purpose heating time was set at 15 min. Samples of about 5 g were heated in test tubes in an oil bath. At a test temperature of 130°C only glucose was recognizable in the chromatogram under ultraviolet light, apart from sucrose. At or over temperatures of 150°C condensation products, known as "reversion products", appeared beyond the glucose.

At over 160°C fructose and fructose anhydride became visible. Hydroxymethyl furfural appeared only at 170°C or over. Finally, in all further experiments the sucrose was heated in a uniform manner to 170°C for a period of 15 minutes. In this process the sample melts, so that it can be considered as largely homogeneous. A faint odour of caramel is observed and discoloration is on the point of setting in, that is, the melt is slightly yellowish.

The loss in weight caused by melting is between no more than 0·03% and 0·06% and hence nearly the same as the loss in weight found on drying for 3 hr at 105°C. From this it may be concluded that the intramolecular splitting off of water has hardly occurred. For further examination the melt was allowed to cool off in the air and was then dissolved in demineralized water.

Fig. 1 shows at A the chromatogram of the melt. The control chromatogram (Check) contains for identification raffinose, sucrose, glucose, fructose, dihydroxyacetone (DHA) and hydroxymethyl furfural (HMF). The dissolved melt is spotted at starting point No. 1; at the end of a running time of 20 hours the substances existing in the melt are not completely separated, however, and a vertical "stripe" appears, which extends from the starting point to near the sucrose. A centre of concentration which runs at a speed similar to that of the sucrose is indicated in outline. Glucose and fructose are readily distinguishable, while another substance is to be seen which is

[1] HIRSCHMÜLLER: *Proc. 10th Meeting C.I.T.S.*, 1957, 21.
[2] *Bull. Soc. pharm. Bordeaux*, 1962, **101**, 97.
[3] *Sucr. Franç.*, 1958, **99**, 165, 198, 229.
[4] *J. Appl. Chem. U.S.S.R.*, 1957, **30**, 1333.
[5] *Izvest. Vysshikh. Ucheb. Zaved., Pishch. Tekhnol.*, 1963, (1), 33.
[6] *ibid.*, 1963, (5), 52.
[7] *Bull. Coll. Agric. Utsunomiya Univ.*, 1958, **4**, 129.
[8] *Bull. Soc. pharm. Bordeaux*, 1961, **100**, 78.
[9] *Ann. Chimica*, 1962, **52**, 197.
[10] *Chem. and Ind.*, 1961, 1878.
[11] GROSS: "Methods in Carbohydrate Chem." Ed. Whistler & Wolfrom, 1962, **1**, 360.
[12] HIRSCHMÜLLER & EICHHORN: *Zeitsch. Zuckerind.*, 1958, **8**, 111.
[13] JANICKI: Diss. Tech.-Univ. Berlin, 1952.

faintly marked and which runs slightly more rapidly than fructose. Furthermore, a clearly visible spot appears whose speed is slightly lower than that of dihydroxy acetone.

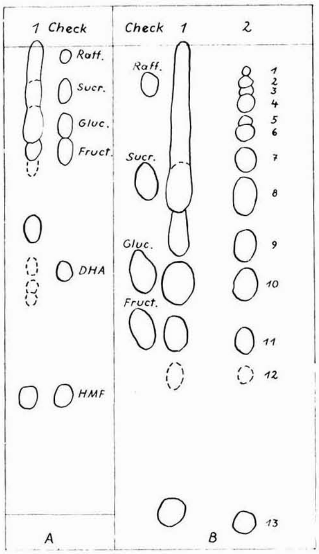


Fig. 1

Fig. 1. Chromatogram of decomposition products of dry-heated sucrose (15 min, 170°C) before and after pre-separation against carbon/kieselguhr columns.
A = Time of run 20 hr; B = Time of run 65 hr;
Check = Check chromatogram.
1 = Non-pre-separated melt.
2 = Melt pre-separated using carbon/kieselguhr columns.

Under ultraviolet light two or three indistinct spots are to be seen which may be either dihydroxy-acetone or glyceraldehyde or some other low molecular weight substances. The hydroxymethyl furfural spot, however, is clearly visible.

In chromatogram B the dissolved melt was spotted again at (1) and developed for 65 hours. Although the substances now lie farther apart from each other, as a result of the prolonged running time, no separation of the "stripe" was obtained, and only new points of concentration appear within the stripe. Even prolonged developing, the use of different sorts of paper and different mixtures of running agents and two-dimensional chromatographing do not result in an improvement of separation.

It is however possible to eliminate the "stripe" by means of pre-separation using carbon/kieselguhr columns. Even under conditions of high column loading (8 g melt/100 g column filling) separation can be obtained. In chromatogram B (Fig. 1) the melt so pre-separated has been spotted at start point No. 2.

The "stripe" as such has ceased to exist and paper chromatographic separation is now possible. When employing benzidine as spraying reagent 13 separate spots appear.

In this paper it is intended to report only on substance No. 4 (spot No. 4 in chromatogram B, Fig. 1). Subsequent studies to be published will report on the results of examinations of other substances. In order to isolate substance No. 4, 100 g sucrose was heated to 170°C in 5 g test tubes in the oil bath for 15 minutes. The melt, after cooling off in the air, was dissolved in 300 ml demineralized water and applied to a carbon-kieselguhr column (1:1 active carbon-kieselguhr, purest grade) 860 mm in length and 65 mm in diameter. Monosaccharides were elutriated with water. Using 5% ethanol first disaccharides appeared and then trisaccharides. The effluents were concentrated *in vacuo* to a syrup and taken up with methanol. The trisaccharides fraction was applied to washed sheets of S. & S. 2043 b Mgl paper on the start line in the form of a line and subjected to descending chromatography with 7:1:2 propanol:ethyl acetate: water. After drying, strips were cut off on the right- and left-hand sides and in the middle of the sheets and sprayed. After the position of the substance had been located in this way, these parts were cut out and extracted with hot methanol. About 200 mg of substance No. 4 was isolated in this way, and obtained in crystallized form from methanol. Of these crystals about 5 mg was partially hydrolysed with diluted acetic acid. For this purpose the acidified aqueous solution in a thin test tube was held in a boiling water bath for 90 sec.

Substance No. 4 and its hydrolysis products were examined by paper chromatography. In the chromatogram (Fig. 2) were spotted the control solution (raffinose, sucrose, glucose and fructose) (Check), substance No. 4 and its hydrolysate (Hy). Development was accomplished at 24°C with 7:1:2 propanol:ethyl acetate:water for 44 hours. Afterwards the chromatogram was dried at 60°C and cut into strips which were treated with various spray reagents, these being, from left to right:

(1) the standard reagent used to render the substances visible, i.e. benzidine (0·5 g) and trichloracetic acid (10 g) in 100 ml water-saturated butanol, a universally used reagent for saccharides,

(2) benzidine-trichloracetic acid, after fermentation with baker's yeast (5% suspension, incubated in water-saturated atmosphere at 24°C for 90 minutes),

(3) alkaline triphenyl tetrazolium chloride solution (TTC) (2% aqueous solution plus NaOH in 1:1 ratio) in order to identify reducing groups,

(4) a 1:1 mixture of 0·2% ethanolic naphthoresorcinol solution with 2% aqueous trichloracetic acid, which shows the presence of ketoses, even if the keto-group is not free, and

(5) aniline phthalate (0·93 g aniline, 166 g phthalic acid in 100 ml water-saturated butanol), which is a reagent for free aldoses.

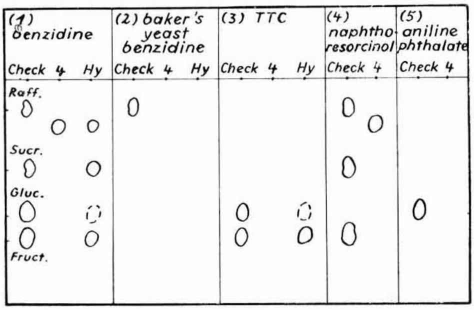


Fig. 2

Fig. 2. Chromatographic examination of substance No. 4 with various spray reagents. 4 = substanceNo. 4, Hy = partial hydrolysate of substance No. 4.

Substance No. 4 has a $R_{sucrose}$ value of 0·45. Comparing its velocity of migration with those of raffinose and sucrose, one may assume that it is a disaccharide or trisaccharide. When the chromatogram after drying is sprayed with yeast suspension, incubated for 90 min, dried and treated with benzidine reagent, the spot no longer appears. The substance is therefore completely fermentable with baker's yeast. Using TTC it shows no reaction, and hence it possesses no reducing group. As it can be rendered visible with naphthoresorcinol reagent, it contains ketose. On treatment with aniline phthalate no spot appears, which excludes the presence of free aldose. On partial hydrolysis, sucrose, fructose and a very small quantity of glucose are produced. The sucrose produced by hydrolysis shows the same velocity of migration as the authentic sample in the check chromatogram. After treatment with yeast it is not demonstrable any longer: it is fermentable. As it contains no reducing group it cannot be rendered visible with TTC. These reactions prove that it really is sucrose which is produced on partial hydrolysis. The identity of glucose and fructose is confirmed by colour formation with the benzidine reagent, as well as the velocities of the spots which coincide with those shown in the control chromatogram. Glucose appears in the form of a brown spot, while fructose reacts to produce a lemon-coloured spot. Both the saccharides are fermentable and therefore are not present in the chromatogram sprayed with yeast. They have a reducing effect and can be rendered visible with TTC in the form of red spots. The intensity of the spots of glucose and fructose which is observed after hydrolysis, reveals that the quantity of fructose produced exceeds that of glucose. There is therefore reason to assume that substance No. 4 contains a trisaccharide consisting of two molecules of fructose and one molecule of glucose with the glucose molecule and one of the fructose molecules linked to each other by sucrose bond.

The "carbohydrases"* contained in baker's yeast (*Saccharomyces cerevisiae*) are α-glucopyranosidase and β-fructofuranosidase. According to the specificity theory[14], α-glucopyranosidase splits only α-glucoside bonds and, consequently, is incapable of fully decomposing a trisaccharide consisting of sucrose and fructose into monosaccharides. If one assumes that the second fructose molecule is linked to a hydroxyl of the glucose, the trisaccharide will not be affected at all by this enzyme. If, however, the second fructose is bound to an OH-group of the fructose, only the glucose can be split off and a difructoside will remain. Besides the β-fructofuranosyl linkage in the sucrose part there is a second fructose molecule of this trisaccharide. If this molecule also contains a β-fructofuranosidic link, the β-fructofuranosidase must be capable of fully decomposing the trisaccharide.

Actually substance No. 4 is fully fermentable. The second fructose molecule therefore is a β-furanoside.

The above described features apply to kestoses[11]. Paper chromatographic comparison shows that the running speed of authentic 6-kestose is the same as that of substance No. 4. Electrophoresis shows that the two substances have the same degree of mobility and cannot be distinguished from one another. The melting point and the optical rotation of substance No. 4 conform satisfactorily to GROSS' values[11] for 6-kestose:

	6-kestose (Gross)	*Substance No. 4*
$R_{sucrose}$ (propanol mixture)	0·48	0·45
Melting point	144–145°C	143°C
$[\alpha]_D^{20}$	27°	26°

The mixed melting point of 6-kestose and substance No. 4 shows no depression.

For further identification X-ray examinations were conducted. DEBYE-SCHERRER powder diagrams were taken of 6-kestose and substance No. 4. The examinations were made with Cu-K_α rays.

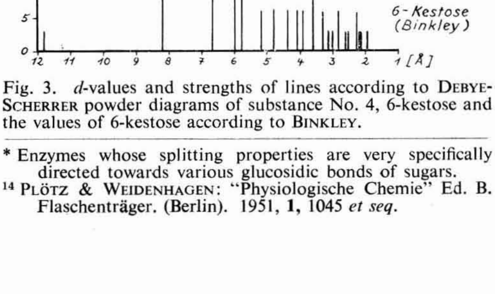


Fig. 3. *d*-values and strengths of lines according to DEBYE-SCHERRER powder diagrams of substance No. 4, 6-kestose and the values of 6-kestose according to BINKLEY.

* Enzymes whose splitting properties are very specifically directed towards various glucosidic bonds of sugars.

14 PLÖTZ & WEIDENHAGEN: "Physiologische Chemie" Ed. B. Flaschenträger. (Berlin). 1951, **1**, 1045 *et seq.*

Fig. 3 shows the *d*-values (inter-lattice plane distance in crystal lattice) and the intensities of the lines. Reproduced are the diagrams of substance No. 4 and 6-kestose and the values of 6-kestose according to BINKLEY[15]. His data of intensity are transferred to the graduations 3, 6 and 9.

The table shows the *d*-values in Angströms and the estimated strengths of the lines in parts from 1 to 10. Column 1 gives the data of substance No. 4, column 2 those of 6-kestose, while the third column indicates the values of 6-kestose as found by BINKLEY[15]. BINKLEY identifies the strengths not by numerical values, but by the letters w (weak), m (medium) and s (strong).

The *d*-values and strengths of substance No. 4 and 6-kestose conform to each other satisfactorily and deviations are within the ranges indicated by SENTI and ZOBEL[16]. There are insignificant deviations as compared with the values indicated by BINKLEY. In personal examinations the line $d = 11·86$ could be observed, but could not be measured. The line $d = 5·8$ is a double line judging from its strength and width. It was separated by BINKLEY. Some additional lines having minor *d*-values were noted. These variations, however, do not affect the proof of identity.

Table I

d-values (in Angström) and strengths of lines according to DEBYE-SCHERRER powder diagrams of substance No. 4, 6-kestose and values of 6-kestose according to BINKLEY[15]. Strengths estimated in steps of from 1 to 10. BINKLEY's symbols: w (weak), m (medium), s (strong).

Substance No. 4		*6-kestose*		*6-kestose according to* BINKLEY	
d-value	*strength*	*d-value*	*strength*	*d-value*	*strength*
				11·86	w
8·15	8	8·24	7	8·19	s
6·63	7	6·64	7	6·66	s
5·82	10	5·84	10	6·02	s
				5·75	s
5·15	5	5·18	7	5·18	m
4·69	4	4·69	5	4·78	m
4·44	4	4·44	5	4·38	m
4·05	3	4·07	4	4·08	m
3·87	3	3·88	4	3·87	m
3·57	7	3·61	7	3·59	s
3·34	6	3·35	6	3·30	m
3·18	2	3·18	2	3·17	w
3·00	3	3·01	3	3·00	w
2·80	7	2·83	7	2·82	m
2·66	3	2·68	3	2·60	w
2·56	2	2·56	2	2·53	w
2·29	5	2·29	5	2·28	m
2·27	2	2·21	2	2·22	w
2·145	1	2·145	2	2·148	w
1·937	4	1·937	4	1·937	w
1·786	1				
		1·690	1		
1·530	2	1·531	2		

The results of these examinations show that substance No. 4 is identical with 6-kestose [β-D-fructofuranosyl-(2→6F)-sucrose]. This confirms the fact that kestose can be formed from sucrose without the action of enzymes. We have not yet dealt with the factors which favour this process. As to the reaction process there is reason to assume that after part of the sucrose has split off, a freed fructose molecule is transferred to an intact sucrose molecule. Here, too, 2,6-linkage seems to be given preference. Unequivocal evidence can only be furnished by means of radioisotopic tests, in a similar way as used recently to demonstrate the formation of isomaltulose from sucrose[17].

Summary

Sucrose was heated to 170°C for 15 minutes. The melt produced was dissolved in water and pre-separated against a carbon-kieselguhr column. After that, decomposition products were subjected to paper chromatographic examination. One of the substances so obtained was isolated and crystallized. It was found to be 6-kestose [β-D-fructofuranosyl-(2→6F)-sucrose].

Acknowledgments

We wish to thank Dr. D. GROSS, of Keston, for a sample of 6-kestose and for the electrophoretic examination of substance No. 4. We also thank the Institute of Prof. Dr. K. PLIETH, Berlin, for X-ray examinations.

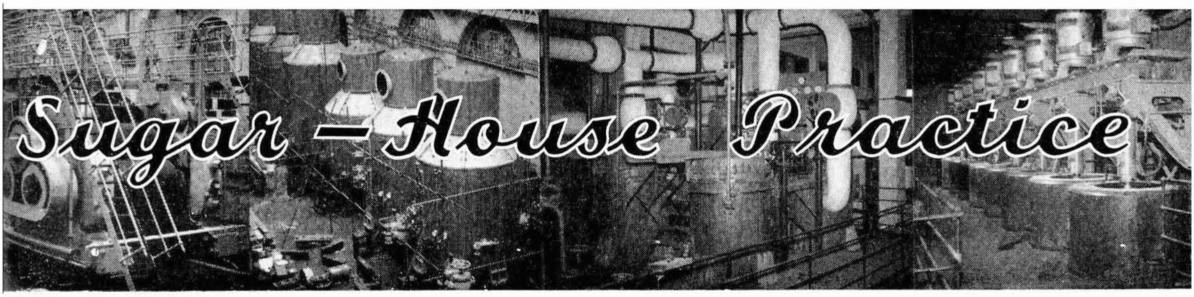
Brevities

St. Kitts (Basse Terre) Sugar Factory Ltd. 1964 report. Crop started on the 26th February and ended on the 13th August with an outturn of 43,219 tons of commercial sugar, equivalent to 43,629 tons 96° pol basis. Sugar for export amounted to 38,735 tons of which 32,442 tons was sold as the negotiated price quota under the Commonwealth Sugar Agreement. Cane crushed amounted to 377,495 tons, from an area of 12,618 acres, an increase after several years of decreasing area. The crop suffered from lack of rain, and the importance of an early start and end to crop is emphasized. The grinding rate has been increased as have the speed of field operations and mechanical loading at the sidings, and this will be necessary to cope with the crop from the increased cane acreage expected in 1965.

* * *

Martinique sugar crop, 1963/64[18].—The sugar season 1963/64 has ended with a total production of 61,520 metric tons of sugar from 733,588 tons of cane, the yield being 8·39%. It was the lowest outturn in ten years and compares with 92,500 tons in 1963 and 83,892 tons in 1962. The principal cause of the drop was the damage caused by cyclone "Edith" on the 25th September 1963 but other factors were the late end of the 1963 harvest, absenteeism among the labour force which prevented much of the replanting of cane, and the taxes which reduced the price of cane, discouraging the planters. Usines Robert and Basse-Pointe closed in the second half of 1963 and Soudon closed after the crop finished.

15 *I.S.J.*, 1964, **66,** 46.
16 "Methods in Carbohydrate Chem." Ed. WHISTLER & WOLFROM, 1962, **1,** 535.
17 MAUCH & SCHMIDT-BERG-LORENZ. *Zeitsch. Zuckerind.*, 1964, **14**, 309, 375.
18 *Sucr. Franc.*, 1964, **106,** 5.



Heat exchange and circulation during the boiling of highly concentrated sugar solutions. I. I. SAGAN'. *Izv. Vysshikh Ucheb. Zaved., Pisch. Tekhnol.*, 1964, (2), 127–128, 146.—Investigations showed that the optimum heat transfer coefficient for sugar solutions of 60–86°Bx boiled under 0·4 atm (abs.) steam pressure increases with the temperature difference across the tube at constant Brix, but is independent of tube diameter. The effect of temperature difference falls with increase in Brix; at 60°Bx the heat transfer coefficient had values some 3 times greater than those at 86°Bx. In the case of a 82°Bx solution heated at 1 atm (abs.) pressure in a film evaporator with deep immersion of the heating surface, the relationship between the heat transfer coefficient and the circulation rate proved to be complex and depended on whether the liquid level was above or below the optimum for circulation. (The optimum level has been found to vary with Brix and tube diameter.) The maximum heat transfer coefficient occurred at levels below the optimum value for circulation. Circulation rates increased with the temperature difference and steam pressure. Dimensionless equations are presented which generalize the effects of the basic factors influencing heat transfer during boiling.

* * *

Temperature and height of the point at which boiling of sugar massecuites starts. V. P. TROINO and M. L. VAISMAN. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1964, (2), 128–130, 146.—Thermocouples were placed at various heights in the boiling tubes of a vacuum pan and the pattern of temperature change throughout the tubes was plotted. The height at which boiling commenced was taken from the point at which maximum temperature was reached. It increased from approx. 30% of the tube height at the start of boiling to approx. 100% at the end of boiling and depended on a number of factors. The experimental values agreed with values calculated from the following formulae:

$$l_{ec} = Cq^{-n}w_{o}^{0.6} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where l_{ec} = height at which boiling starts, q = specific heat flow, w_o = circulation rate, and C and n are constants both decreasing linearly with increase in Brix, from 1500 to approx. 250 in the case of C and from 0·65 to 0·35 in the case of n, at a corresponding Brix increase from 70 to 90°.

$$t_u = t_s + \Delta t_f + 0{\cdot}39\ \Delta t w_o + \Delta t_{gs} e^{-zq} \quad \ldots\ldots (2)$$

where t_u = temperature within tube, t_s = temperature of saturated vapour, Δt_f = physico-chemical temperature depression, Δt = temperature difference across tube, Δt_{gs} = hydrostatic temperature depression and z = 0·000066.

Calculation of massecuite crystallizers. I. A. BELOKON' and I. S. GULYI. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1964, (2), 133–137, 146–147.—Numerous equations are presented for calculation of the factors involved in relating heat and mass transfer in crystallization[1]. A nomogram is given for calculating the increase in weight and length of a single crystal for a target increase in crystal content. An equation is also presented for calculating the total crystallization time (τ, sec):

$$\tau = 3{\cdot}34\ \frac{\Delta G\ v_{me}^{0.3}}{l_k^3\ t^{0.64}}$$

where ΔG = weight increase of crystal, ν = kinetic viscosity (sq.m./sec), l_k = final length of crystal (mm) and Δt = difference in temperature between crystal surface and the outer surface of the diffusion-limiting layer of saturated solution on the crystal surface. Other nomograms for crystallization calculations, reproduced elsewhere, are mentioned.

* * *

Criterial equation of crystallization. I. A. BELOKON'. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1964, (2), 137–143, 146–147.—Theoretical equations are derived for calculation of crystallization factors. These take account of the presence of a diffusion-limiting layer of saturated solution on the crystal surface which is subject to laminar flow (free convection). A dimensionless equation is derived from the theoretical equations and this has been used to process results of crystallization tests under laboratory conditions. It takes the generalized form:

$$Fo' = 582 \times 10^2\ \frac{\pi v}{Pr'\ Gr^{0.64}}$$

where Fo' = Fourier number, $\pi_v = \Delta G/\rho_{kr} l^3$ (where ΔG = crystal weight increase and ρ_{kr} = density of crystalline substance), Pr' = Prandtl number and Gr = Grashof number. A graph is given for determination of Δt as a function of Δ at a Brix of 84–86°. The equation can be written in the form given in the previous abstract for calculation of crystallization time. Calculated results agree with experimental data.

* * *

The importance of the pH value in boiler feed systems. H. ANDERS. *Zucker*, 1964, **19**, 553–554.—After removal of oxygen, the next most important step in protection against corrosion is regulation of the pH of the feed water, preferably at 7–7·5. The simplest method is considered to be the addition of caustic soda to the water; the amount used depends on the composition of the water. Other chemicals considered for raising the pH are sodium triphosphate, gaseous

[1] *See I.S.J.*, 1964, **66**, 264.

ammonia and ammonium salts. The advantages of these and special precautions to be taken in their use are discussed. The pros and cons of recycling alkaline feed water are considered.

* * *

SSA cube sugar. A new Swedish method of making cube sugar. A. Birch-Iensen. *Socker Handl.* II, 1964, **19,** 35–46.—In the Swedish Sugar Corporation process moist granulated sugar is shaped by vibration in moulding elements; these are transferred to a steel belt, dried for ½ min in a high-frequency electric field and cooled for about 2 min by air. The cubes are then collected on the steel belt into blocks which are transferred by suction levers to a cardboard container, which is glued together, check-weighed and automatically packed into a box. Adjustment of weight is obtained by changing the vibrator amplitude and the whole process is automatic, takes about 3½ min and has a capacity of 2400 kg/hr. Different cube sizes are made. The process and products are described in detail and illustrated.

* * *

Electric operation of cane knives with three-phase slip-ring motors in conjunction with a flywheel. W. Siebe. *Bol. Azuc. Mex.*, 1964, (181), 12–17.—Conditions applying in cane knife electric drive using a 3-phase slip-ring motor and flywheel are considered theoretically and equations developed which may be used in designing such a system.

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The De Smet diffusion system. Anon. *Sugar News*, 1964, **40,** 380–387.—An account is given of the De Smet cane diffusion system which is guaranteed to leave a maximum of 0·4% sugar in the cane with a draught of 100 litres per 100 kg of cane, and juice quality at least equal to mill juice, provided the factory feeds the unit with fresh, sound cane without leaves and properly cut and shredded under aseptic conditions, clean sterilized fresh water of pH 7–7·5, steam at 105°C, compressed air at a minimum of 57 p.s.i., and perfectly strained press-water from the dewatering mills. The factory must also be able to receive continuously the raw juice and bagasse from the diffuser, and the incondensable gases from the juice heaters must be vented. Results of the 1962 campaign at a sugar factory in Spain are quoted.

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Automatic cane feeding. E. F. Gamboa. *Sugarland* (Philippines), 1964, **1,** (6), 14–17.—The cane feed control at Victorias Milling Co. is in three parts. A feeler "sled" on the main carrier senses the cane blanket level and has an overriding control on the main carrier speed when the level is lower than normal. It operates a switch when the level is normal or higher, transferring control to a floating feed roller which regulates the speed of the main carrier feeding the crusher. The third part is an "override" feature actuated by the top roller of the crusher which stops the feed roller, main carrier and feeder carrier simultaneously when the top roller reaches a "critical lift point", re-starting them when it returns to its normal level. The controls have produced even feeding of cane to the mill, lower and constant moisture in bagasse, steadier boiler pressure, etc.

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Sugar recovery from clarifier scums by high-speed centrifugation. R. N. Pollet and W. R. Tuson. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 20–30. Two Titan A/S. "Superjector" automatic desludging centrifuges were installed at Colonial Sugars Co., Gramercy, La., for recovery of sugar from clarifier scums. The compaction anticipated was not achieved at first and the effects of feed Brix and flow rate and of aeration were studied. The results were the basis for installing secondary clarifier capacity where the 63°Bx mud, diluted to 20°Bx, is converted to clear sweet-water and thin scums. These are de-aerated, diluted to 10–12°Bx and fed at 1200 g.p.h. to one centrifuge, giving sweet-water and a sludge which is diluted to 1°Bx with hot water and supplied to the other machine. Sweet-water is either recycled for diluting the sludge from the first centrifuge, or sent to process, while the final sludge is discarded.

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Automated cycling deep bottom Sweetland presses. C. O. Walters. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 31–39.—Improvement of the Sweetland carbonatation liquor filtration station at Savannah refinery was achieved by modification of the filters and their operation. They were provided with a deep bottom, mud being directed to the exit port using steam, and the filter was cleared out by periodic boiling, while operation was made completely automatic by means of timers and level controls. Labour requirements were reduced by 65% and capacity increased by 30%. Cloths are discussed, including a promising new polypropylene mono-filament material.

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Control of filter press cycle time for maximum throughput. B. M. Koloski, T. J. Altieri and L. B. Sansaricq. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 40–52.—Maximum productivity for batch filtration depends on the proportion of the productive and non-productive parts of the cycle and also on the falling rate of filtration as the productive part increases. An arithmetical and a graphical method of determining the optimum productive time are described and exemplified. The effect of constant *vs.* increasing pressure (the latter to maintain a constant rate of filtration) is discussed as are the effect of flow rate on clarity, and variations in non-productive time.

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Recent developments in density and consistency control at C. and H. refinery. P. F. Meads and A. O. Maylott. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 53–68.—Massecuite consistency is successfully measured by means of the "Dynatrol" instrument[1]. This

[1] Automation Products Inc., Houston, Texas, U.S.A.

comprises a vibrated paddle, the amplitude of which corresponds to massecuite consistency; if the latter should change, a change in the output signal of a converter is produced. The instrument correlates better to visual observation than load measurement on a circulator motor. A description is given of installation of the "Dynatrol" in a mingler where it has operated successfully. Other instruments for density measurement and control are also reviewed.

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Selective adsorption of carbohydrates on carbon columns. Application to the determination of dextrose and levulose in refinery syrups. S. STACHENKO and H. EBELL. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 69–101.—To eliminate interference by disaccharides and other sugars in determination of dextrose and levulose, all the carbohydrates are adsorbed on a Pittsburgh CAL granular carbon column and eluted with a 0·035% solution of iso-propanol in water to yield fractions, one of which contains the monosaccharides. The dextrose and levulose are then determined individually, the former by the peroxidase method or iodide method and the latter by colorimetry with resorcinol. The method was applied to raw sugar and various refinery products; in the raw sugar it was found that the dextrose:levulose ratio was often other than 1:1, and the effect on polarization is discussed.

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Improving efficiency of solid adsorbents. Basis of plant design. F. M. CHAPMAN. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 102–108.—See *I.S.J.*, 1964, **66**, 352–355.

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Some fundamentals in drying granulated sugar. F. W. SCHWER. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 115–129.—Laboratory studies were carried out on drying of refined sugar under controlled conditions of air flow, humidity, vacuum, time and temperature. Of these, the most rapid drying was obtained by increasing the sugar temperature with minimum air flow to carry off liberated moisture.

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Investigations into sugar boiling. A. P. NEILSON and W. W. BLANKENBACH. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 109–114.—Sugar produced in new pans at British Columbia Sugar Refining Co. Ltd., Vancouver, contained an excessive amount of conglomerates which caused difficulties in drying, bulk storage and packing. The effect of various factors in boiling was studied to provide a basis whereby to eliminate the trouble, and it was found necessary to control supersaturation, absolute pressure and circulation. Installation of circulators and control instruments made it possible to boil low-conglomerate sugar, solving the difficulties, and in addition there resulted increased yield and higher pan capacity as well as lower steam consumption. While completely automatic boiling has not been achieved, the pan boiler's task has been changed to become mainly supervision.

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Automatic line for the packing of crystal sugar. M. PERRIN. *Ind. Alim. Agric.*, 1964, **81**, 761–762.—A description is given of the Swiss Industrial Co. PLN packaging line which weighs sugar into 1-kg packets which it makes and prints in continuous flow. The line has an output of more than 40,000 kg of sugar per 8-hour working day.

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Thermal regeneration of granular active carbons. A. K. KARTASHOV, L. G. VORONA, A. P. KOZYAVKIN and G. P. PUSTOKHOD. *Sakhar. Prom.*, 1964, **38**, 821–825.—Tests on regeneration of AG-5 granular active carbon with superheated steam are reported. The carbon was saturated with a highly coloured artificial sugar solution until adsorbtion power had completely disappeared; it was then dried after washing off the sugar, divided into 11-g portions and regenerated for 30 min at 200–350°C in a ceramic tube in a muffle furnace. After hot water-washing, the regenerated carbon was placed in a flask and 200 ml of a specially prepared juice (colour 42°St, Brix 15·9°, pH 9·1) added and decolorized for 45 min at 80°C. Increasing the regeneration temperature from 200 to 350°C caused the regeneration efficiency to increase from 65 to approx. 90%. A regeneration time of 30–35 min proved adequate. After decolorizing a 200-ml juice sample (colour 59°St, Brix 15·9°, pH 8·15) for 35 min at 78–80°C, the optical density, Brix and pH of the juice were determined and after each cycle (of a total of 36) the carbon was washed free of juice and regenerated for 20 min at 350°C. It was found that the decolorizing power of the carbon was almost the same from cycle to cycle. The pH of the decolorized juice remained constant at 8–8·2 during the test period. Increase in weight of the carbon after each cycle was caused by adsorption of non-sugars and particularly salts of only slightly soluble organic acids. A flow sheet is given of a factory scheme for juice decolorization and carbon regeneration.

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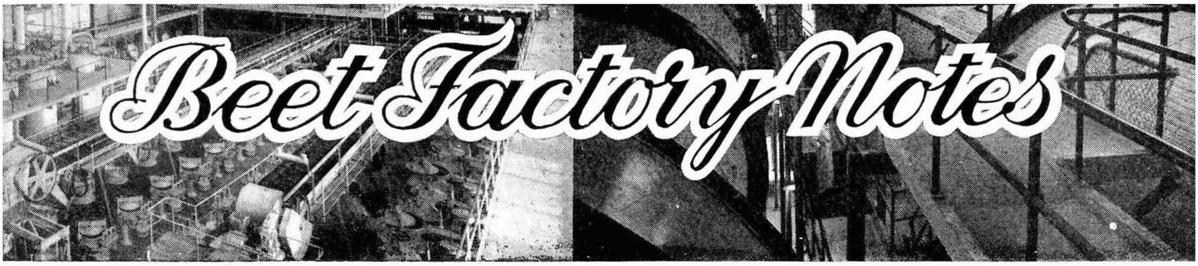
Temperature conditions in boiling, crystallization and curing of 2nd product (final) massecuite. YU. D. KOT. *Sakhar. Prom.*, 1964, **38**, 826–828.—The advantages and disadvantages of boiling at a higher temperature than 80°C are discussed. This temperature should not be exceeded for 2nd massecuite since it leads to increased sugar losses by decomposition, causes a drop in the crystallization rate and increases molasses yield and purity. Tests in which massecuite was cooled during crystallization to 35 and 45°C and heated to 8–10°C above these temperatures before curing demonstrated the benefits of this technique; greater quantities of dilution water could be used in the crystallizer without increasing molasses purity and curing was easier and more rapid. The purity of molasses from the cooler massecuite was 1 unit lower than that from the other massecuite.



Evaluation of diffusion station performance. J. ČERNÝ. *Listy Cukr.*, 1964, **80,** 215–218.—SILIN's diffusion theory[1] was used to evaluate the performance of a battery diffuser and a BMA continuous diffuser. The various factors involved in diffusion are tabulated together with values of A (diffusion constant) and Al (l = cossette length). The nature of the values of A and Al and their dependence on beet tissue permeability are discussed. Variability in the diffusion constant is demonstrated; since it is impossible to evaluate it with just a small number of calculations, further theoretical and practical studies are to be made.

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Losses of weight in sugar beet stored in small clamps in the field and the effect of these losses on its technological value. L. SCHMIDT, J. ZAHRADNÍČEK and V. KEC. *Listy Cukr.*, 1964, **80,** 218–220.—Beet stored for up to 6 days in small clamps (containing approximately 150 kg of beet) uncovered or covered with leaves sustained daily sugar losses of 0·136% by weight (0·081% in covered clamps). Deteriorated beet suffered a further sugar loss of 2·79% during storage at the factory, while the invert sugar rose by more than 100% and the molasses yield by 1·17%.

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Robert (battery) diffusion. E. SLAVIČEK. **I. General quantitative formulation of dffusion processes.** *Listy Cukr.*, 1964, **80,** 204–210. **II. Performance of the first diffuser cell.** *ibid.*, 210–212. **III. Effect of "juicing up" on the performance of a Robert diffuser.** *ibid.*, 212–215.

I. A model battery diffuser system is developed. The system is described by differential equations which have been solved by computer for given ranges of values of juice draught, number of diffuser cells, number of sections into which each cell is divided for the difference method (n) and which include a constant (q) characterizing shape, size and quality of cossettes, the length of time corresponding to n, and the hydrodynamics of juice flow from a layer of cossettes. The validity of the difference method used is discussed for a system where $n = 4$ and similarity is shown between the equations derived and equations developed earlier by the same author.

II. Using the method described above, the author calculates the change in sugar concentration in the first diffuser cell and then presents a worked example for juice draught of 120% and $q = 0{\cdot}10$. Tabulated data demonstrate the considerable scattering of cossette sugar concentrations which rise with increase in p and with reduction in juice draught.

III. The difference method is used to evaluate the effect of "juicing up" (contacting fresh cossettes with juice from a previous first cell) on extraction efficiency. Results of calculations for two values each of draught and q show that "juicing up" reduces extraction by 7–8%. The concentrations of sugar in cossettes as a function of time and in juice in various sections of a "juiced up" cell are calculated and graphs presented comparing diffusion with and without "juicing up".

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Examination of a new type of anti-foaming agent. K. JÁNOSFY. *Cukoripar*, 1964, **17,** 225–229.—The theory of foaming is discussed and mechanical and chemical means of combating it are reviewed. The chemical constitution and physical properties of silicone oils (derived by polymerization, mainly from methylpolysiloxane) are described and their application as anti-foaming agents discussed with descriptions of various laboratory techniques for their evaluation in this field.

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Treating 1st carbonatation juice with flocculants. K. VUKOV. *Cukoripar*, 1964, **17,** 240–244.—A review is given of the literature (34 references) on the use of flocculants for 1st carbonatation juice treatment. The article covers synthetic flocculants (polyelectrolytes), beet raw juice and cane raw sugar. The theory of flocculation is discussed as is the choice of technique for adding flocculants to juice.

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Seeking an optimum between the requirements of power engineering and the destruction of sugar in evaporators. I. Tests with pure sucrose solutions. K. MAGYAR. *Cukoripar*, 1964, **17,** 249–265.—Details are given of an experimental evaporator constructed at the Hungarian Sugar Industry Research Institute for studies of sugar decomposition. The evaporator is described as rapid, easily operable and controllable, and gives reproducible results. Results of tests showed that temperature has a decisive effect on sucrose decomposition and coloration. Sucrose decomposition increases exponentially with temperature. With up to 60 minutes' evaporation, destruction and coloration are linearly proportional to time, but above 60 min decomposition and coloration increase as a result of secondary effects of decomposition. The optimum pH was found to be 9, above which both coloration and destruction increase. The O^{H} concentration is decisive as regards total decomposition. The rate of invert formation decreases with increase in pH. Since decomposition and coloration also increase with mixing, a type of evaporator should be used which would eliminate mixing. Further tests are to be made with 2nd carbonatation juice.

[1] *I.S.J.*, 1958, **60,** 144.

Measures in the sugar industry for maintaining waters in a pure state. H. SCHULZ-FALKENHAIN. *Zucker*, 1964, **17,** 518–525.—Twenty-three references are given to the literature on treatment of factory effluent and for maintaining purity of factory circulation water. The various methods used for effluent treatment are surveyed. Pre-treatment with lime plus decanting has proved successful, unlike treatment in fermentation and putrefaction plants and trickling filters. Lagoon and soil treatment, where the soil is undrained, is claimed to give the necessary level of purification, although activated sludge treatment on its own has failed to give required results.

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New ideas applied in sugar factories built by Polish industry abroad. J. PLICHTA. *Gaz. Cukr.*, 1964, **72,** 185–191.—Information is given on factories, their equipment and processes, built by Cukroprojekt in China, U.S.S.R., Iran, Greece, Morocco and Indonesia.

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Intensification of the pulp pressing process. S. K. SLEPNEV. *Trudy Moskov. Tekhnol. Inst. Pishch. Prom.*, 1962, **20,** 12–14; through *S.I.A.*, 1964, **26,** Abs. 577. Tests were carried out with a laboratory hydraulic press on a thin layer of beet pulp (1·5–9·0 mm). The pulp dry substance was increased to 30% under optimum conditions (1·5 mm thickness, pulp temperature 50°C, mean pressure 22·5 kg/sq.cm., pressing time 12 min). Losses of solids in press water were small (0·5%). The pressed pulp was mixed with bran and molasses and formed into briquettes, without further drying, which stored well.

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Possibilities of utilization of waste heat in sugar factories. E. JUREVICS. *Trudy Latv. Sel'sk. Akad.*, 1963, **12,** 223–229; through *S.I.A.*, 1964, **26,** Abs. 575. The amount of waste heat in a typical beet factory of the U.S.S.R. is estimated at 15–25% of the heat of combustion of fuel, of which 30–35% is lost in flue gases, 20–30% in waste waters, 30–40% by transfer to surroundings, and 5% in eacaping vapours. The use of flue gases for drying beet pulp, etc., and of waste waters for indoor heating in winter is briefly discussed.

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Tests for calculating sugar losses caused by micro-organisms in DDS diffusion. I. JANUSZEWICZ and K. MOSSAKOWSKA. *Gaz. Cukr.*, 1964, **72,** 192–195. The main source of infection is considered to be returned press water. Two methods of determining sugar losses caused by bacteria were examined: determination of total invert sugar by reduction of copper salts, and determination of lactic acid after separation from the test solution on "Wofatit L 150" resin. The results show that invert in raw juice is formed not only as a result of thermophiles in the diffuser but also is formed by the mesophiles in the cossettes. Lactic acid determination gives a close approximation of the sucrose content, but it must be borne in mind that the amount of acid formed is half that of the sugar lost. The tabulated results domonstrate the effect of formalin on bacterial activity and hence on the sugar losses. At 0·003% formalin on beet the losses could be reduced from 0·13% to 0·08% on beet, although 0·009% formalin on beet was used when the thermophile count was very high.

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Storage of washed beet. L. WIKLICKY. *Zeitsch. Zuckerind.*, 1964, **89,** 503–508.—Details are given of the beet storage techniques and results at Tulln during the 1963/64 campaign. The beet are sprayed with water before storage in 9–10 m high piles. These are fed with air blown through 55 m-long concrete ducts by 5·5 kW fans delivering 30,000 cu.m. of air per hr. A total of 60,000 tons of washed beet were assembled during 17 days and stored for 70 days. The temperature of the stored beet was maintained within the range of approx. 1–12°C at an ambient ranging from —1·5°C to about 12°C. Daily sugar losses and weight losses averaged 58·4 g/ton and 305 g/ton of beet respectively. Soluble ash in sugar and molasses yield were higher than when fresh beet were processed (by 5·39 and 20% respectively), while press juice and raw juice purities were lower (by 2·03 and 1·18% respectively).

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Electronic level control in the sugar industry. J. BÖHME. *Zeitsch. Zuckerind.*, 1964, **89,** 448–455, 508–514.—Automatic measurement and control of level in a metal tank or hopper with a vertical metal rod, between the two opposite walls, connected to an electrode at the top of the container is described. The container thus acts as a capacitor and the level is indicated and controlled (continuously or periodically) by changes in the capacity. The use of limit switches to prevent over-filling is discussed and illustrated descriptions are given of equipment manufactured by Endress & Hauser G.m.b.H. & Co. (Maulburg/Baden). Other means of level control described include those using conductivity measurements, ultrasonics and radioactive measurements (with γ-rays). Also described is a mechanical system in which the length of rope played out when a weight is lowered onto the surface of the materials is measured automatically through an electrical circuit. Two examples of automatic level control application in sugar factories are given

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Belt conveyors. H. P. SCHWARZ. *Zeitsch. Zuckerind.*, 1964, **89,** 518–521.—The advantages of belt conveyors over other types of continuous conveyors are discussed and various types described and illustrated. Hints on proper maintenance are given in brief.

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Simplified data processing. W. SCHMIDT. *Zeitsch. Zuckerind.*, 1964, **89,** 514–518.—A description is given of the method of rank variance analysis for detecting significant line and column effects in tests with several factors. It does not assume a normal distribution as in classic variance analysis and permits the significance of interactions to be checked.

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The modern beet sugar factory. A. L. COOPER. *Sugar y Azúcar*, 1964, **59**, (9), 89–90.—Advances in techniques and equipment in U.S. beet sugar factories in the past 50 years are briefly reviewed.

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Effect of clarification of flume-wash waters on their degree of infection. P. F. IVLEV, L. S. TVERDOKHLEBOV, L. M. BATRAK and V. K. MISHINA. *Sakhar. Prom.*, 1964, **38**, 743–745.—Bacteriological studies of flume-wash water before and after clarification showed that the higher the pH of the water, the greater was the removal of bacteria. Even without clarification, the higher pH was accompanied by smaller bacterial colonies.

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Improving production technology. (Second carbonatation lime salts separation.) B. S. ZHALOV. *Sakhar. Prom.*, 1964, **38**, 746–747.—Reference is made to the article by SATKIEWICZ[1] on crystallization and removal of $CaCO_3$ from 2nd carbonatation juice. The practice is recommended for Soviet factories, even though disc filters, in which the mud layer is very thin, are generally used instead of filter-presses. Treatment of cooling water used in crystallizers is also advocated.

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Heat balance and steam consumption with KDA, RDA and DDS diffusers. P. I. STASEVSKII. *Sakhar. Prom.*, 1964, **38**, 756–756.—Heat balances are given for three different types of continuous diffuser (tower, rotary and trough) and the amount of steam required to extract and heat the raw juice is calculated. The juice draught is identical for all three cases at 120% and press-water is recycled.

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Some factors affecting the quality of beet cossettes. P. S. MAKSIMUK. *Sakhar. Prom.*, 1964, **38**, 767–768. Flaws in the design of one type of Soviet-made beet slicer produced in Kiev by the "Bolshevik" factory are blamed for poor quality cossettes. Certain modifications carried out at a sugar factory have reduced cossette spoilage and raised the quality.

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The water economy at Ameln raw sugar factory after installing the "Vortair" process. A. LANGEN and J. HOEPPNER. *Zucker*, 1964, **17**, 546–553.—Details are given of the water scheme at Ameln factory where the total waste water amounts to 63% on beet. After the creation of water circuits and the enlarging of lagoons, a Lurgi activated sludge plant was installed. The untreated water is pumped to an aeration pond where air is fed by two "Vortair" aerators; N and P nutrient solutions are added and milk-of-lime if maintenance of an optimum pH is required. Activated sludge is added and the treated water sent to a settling pond, whence purified water overflows to a drain while the mud is pumped to a lagoon. The capacity of the plant is 18 cu.m./hr. At the start of the 1963 campaign the BOD_5 was reduced by an average of 88%. It has been found that the pretreatment in the lagoons has helped raise the overall purification efficiency. The economics of the Lurgi process and the total water purification costs are considered.

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A rapid method for control of infection in sugar factory juices. R. WEIDENHAGEN, H. GRUSCHKAU and I. GÖSSEL. *Zucker*, 1964, **17**, 574–576.—Details are given of a method of determining bacterial counts which is claimed to meet the requirements of sugar factory control. One ml of a 2% aqueous congo red solution is mixed with 1 ml of the juice and allowed to stand for 10 min. Then 0·01 ml of the mixture is removed by pipette and uniformly spread on a 1000 sq.mm. slide, where it is allowed to dry. It is then treated with ethyl alcohol, the congo red changing to blue, dried and studied under a microscope. All the living bacteria appear white on a blue background, while the dead cells are blue and thus not counted; 25–30 fields of vision are counted at ×1000 magnification and the mean is determined. The bacterial count per ml is then calculated using a conversion factor. The determination takes 20–30 min; the accuracy depends on the bacterial count and on the number of fields of vision. Graphs are presented showing the bacterial counts and lactic acid concentration in tower diffusers (the highest values of both were found in the middle of the diffusers). It was found that at a bacterial count of less than 10 million/ml, the lactic acid concentration was 20–40 mg/litre/10°Bx. This proved to be too small for sugar loss determination, although the bacterial count limit mentioned could act as a guide for disinfection. Press juice from cossettes leaving the slicers had a lactic acid content of 15–30 mg/litre/10°Bx.

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Control of saturation of cation exchangers in sugar juice deionization. P. DEVILLERS, M. LOILIER and J. C. CHARTIER. *Ind. Alim. Agric.*, 1964, **81**, 679–681. A method is described for judging the point at which impurities in the juice or syrup passing through the ion exchanger reach a level where the resin should be considered saturated. The resistivity of the effluent varies with its cationic organic impurity content (betaine, amino acids, etc.); these are the first to pass through the resin and thus measurement of the resistivity indicates their breakthrough, when the resin is saturated.

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Predefecation of diffusion juice with automatic control. S. ZAGRODZKI and H. ZAORSKA. *Ind. Alim. Agric.*, 1964, **81**, 721–729.—See *I.S.J.*, 1963, **65**, 24.

[1] *I.S.J.*, 1963, **65**, 53.

NEW BOOKS AND BULLETINS

The Sugar Cane. A. C. BARNES. 456 pp.; $6 \times 9\frac{3}{4}$ in. (Leonard Hill Books, St. Richard's House, 94–96 Eversholt Street, London, N.W.1.) 1964. Price: 95s. 0d.

The appearance of a new and up-to-date book on sugar cane cultivation at the present time is fitting in view of the expansion that is taking place with the crop in so many countries. This book is well written, accurate and authoritative, the author being widely known in sugar cane circles. He has spent many years on scientific work with the crop in cane growing countries in both the Old and the New World.

All aspects of sugar cane cultivation and production are covered in the 21 chapters of the book. Special emphasis is given to the more recent developments with the crop throughout the world, such as cane breeding and varietal decline, mechanical harvesting and modern transportation, chemical weed control, aerial spraying and overhead irrigation. There are separate chapters on such matters as sugar cane as an industrial raw material, by-products, evaluation of cane and present-day research.

In the earlier chapters of the book a great deal of interesting general information is given, presented in a pleasing and easy style. Such chapters are: history and development as a world crop, botany of the sugar cane, sugar cane growing countries and sugar cane soils. A chapter likely to be read with interest by many readers is that on plantation and field planning, where the impact of modern agricultural methods plays so important a part. It is pointed out how the successful planning of a large new sugar cane venture calls for expert knowledge in many fields—notably the services of civil and hydraulic engineers, surveyors, agriculturalists, architects, etc.—in order to integrate the whole system of cropping with the processing factory. As an example, the author describes in detail the recently inaugurated Bacita sugar project of Northern Nigeria, to involve in all some 15,000 acres with irrigation from the River Niger.

Anyone wishing to acquire, with a minimum of effort, a picture or bird's-eye view of the sugar cane industry of the world could not do better than read the chapter devoted to sugar cane growing countries, for the author has marshalled his facts and summarized his information relating to the many different countries concerned in a truly admirable manner.

F.N.H.

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The Gilmore Puerto Rico-Dominican Republic Sugar Manual, 1964. Ed. F. I. MEYERS and C. O. DUPUY. 176 pp.; $8 \times 10\frac{1}{2}$ in. (The Hauser Printing Co. Inc., 441 Gravier St., New Orleans, Louisiana 70130, U.S.A.) 1964. Price: $10·00.

The Gilmore Puerto Rico Sugar Manual was founded in 1930 and is a survey of the conditions existing on the individual sugar plantations of Puerto Rico, Dominican Republic, Haiti and Virgin Islands. It is published every other year and is intended primarily as a reference book for the managing and operating personnel of the sugar factories who do not have sufficient time to visit other properties. The book gives a list of the centrals and Puerto Rican refineries, details of Puerto Rican sugar associations, a directory of sugar company personnel, and sugar production data for Puerto Rico. Then follow reports of the individual sugar factories. Indexes to advertisers by company and products are appended. Maps are presented showing the locations of sugar factories in Puerto Rico and the Dominican Republic. The book is an extremely useful guide and is an essential for the reader interested in the sugar industries of the four territories.

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Advances in Carbohydrate Chemistry. Vol. 19. M. L. WOLFROM and R. S. TIPSON. 415 pp.; 6×9 in. (Academic Press Inc., 111 Fifth Avenue, New York, N.Y., 10003 U.S.A.; Academic Press Inc. (London) Ltd., Berkeley Square House, Berkeley Square, London, W.1.) 1964. Price: $14·00; 107s 6d.

This latest edition opens with a tribute to Dr. A. THOMPSON, of Ohio State University, who devoted more than 30 years to carbohydrate chemistry and who is described as "an outstanding experimentalist". Monographs are then presented on: crystal structure analysis in carbohydrate chemistry; infra-red spectroscopy and carbohydrate chemistry; nuclear magnetic resonance; the action of hydrogen peroxide on carbohydrates and related compounds; structure and some reactions of cellulose; wood hemicelluloses; and the pneumococcal polysaccharides. Of some interest to our readers will be the section on gas-liquid chromatography of carbohydrate derivatives by C. T. BISHOP, in which the author describes the general methods and applications of this technique and the classes of derivatives (methyl ethers, acetates, acetals, trimethylsilyl ethers, etc.) investigated by this means. Another monograph, by E. F. L. J. ANET, on the degradation of carbohydrates, gives information on the rôle of 3-deoxyglycosuloses (3-deoxyglycosones) and their enolic forms, and of unsaturated glycosuloses, in the degradation of carbohydrates, particularly with regard to the formation of 2-furaldehydes. The book ends with an author and subject index to Vol. 19 and to Vols. 1–19.

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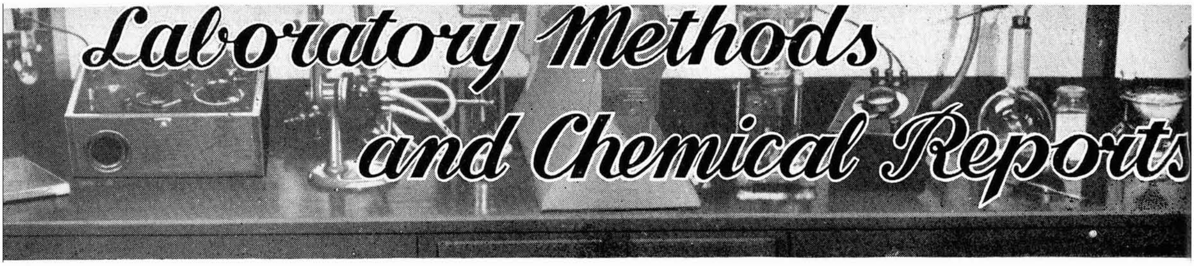
The Sugar Cane Varieties Quarterly Newsletter. 16 pp.; $5\frac{1}{4} \times 8\frac{1}{4}$ in. (Sugar Cane Breeding Institute, Coimbatore, India). Jan.–March 1964.

This, the first issue of this new quarterly (in typed form) is intended to assist research workers, development or extension workers, growers and forestry staffs throughout India in obtaining information promptly about new varieties likely to be of commercial value. It contains articles entitled: Fifty years of varietal research at Coimbatore, Facts about Co 740, Varietal needs of India, and Information on Co canes released in February 1964.

F.N.H.



Determination of starch in sucrose crystal. C. C. Tu and R. H. Okamoto. *J. Agric. Food Chem.*, 1963, **11**, 331–332.—See *I.S.J.*, 1962, **64**, 23.

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The ash content of Peruvian raw sugars. J. C. P. Chen and P. Honig. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 146–158.—The principal defect of Peruvian raws, according to U.S. refiners, is the high ash content, but variations in the comments of individual refiners lead to a call for standardization of the criteria to be used in specifying a sugar of good refining quality. Techniques adopted in order to reduce the ash include export of *A*-raws only, the *B*-raws to be washed and *C*-sugar double-purged and either used for seed or remelted. Refinery green syrup from the first crop may be used to boil a seed for the *A*-raw massecuite, while a further technique mentioned is one developed in Java, i.e. coating of white sugar with a suitable molasses.

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The filtrability of raw sugars. K. Douwes Dekker. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 159–170.—A test was devised to assess the filtrability of raw sugars and has proved to give a fair image of the behaviour to be expected in the refinery; it involves washing the sugar by a standard method, comparable to affination, followed by measurement of the filtration rates of the sample sugar and pure sucrose under identical conditions, viz. addition of 0·35% on Brix of a standard laboratory filter-aid to a 60°Brix solution at 80°C, adjustment with a buffer to pH 9, and filtration under a pressure which increases at a rate of 10 p.s.i./min up to 50 p.s.i. and is then kept constant. The main characteristics of starch and gums in cane juice as affecting filtrability are described, and tabulated data for filtrability, total gums, starch, wax, silica and phosphates are presented for sugars of South African and other origins, together with the extent of their removal in affination. A regression formula for filtrability in terms of the five impurities has been calculated from a large number of analyses. This gives calculated results in fair agreement with measured values and shows that even with zero concentrations the filtrability is still not 100%—indicating that other factors may operate. Wax has no significant effect, perhaps because the test is now carried out at a temperature lower than its m.p., while the most important factor is confirmed to be starch. In order to improve raw sugar filtrability, it is advisable to provide higher purity liquor; this can be achieved by double-curing *A* sugar, by double-curing *C* sugar and remelting this and all *B* sugar not required as footing for *A* sugar, by obtaining better circulation, etc. The Nicholson and Horsley technique for enzymic destruction of starch[1] leads to some sucrose loss but is nevertheless practised in two factories. Improved non-sugars removal can be obtained by techniques more elaborate than simple defecation, the best (but the most expensive) being double carbonatation.

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Physical characteristics of white sugars. M. Roche. *Ind. Alim. Agric.*, 1964, **81**, 631–635.—Physical characterstics which may be used to judge the quality of a sugar are discussed with the techniques for their examination; they include crystal size and regularity, colour, turbidity, filtration, and colour formation on heating.

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Studies on crystallization. G. Pidoux. *Ind. Alim. Agric.*, 1964, **81**, 643–647.—See *I.S.J.*, 1965, **67**, 92.

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Coloration of cossettes and diffusion juice in the sugar industry. O. Lazar and J. Henry. *Ind. Alim. Agric.*, 1964, **81**, 655–670.—The various parts of the beet (top, root sections, tail, etc.) have been examined to determine their content of enzymatic chromogenic agents which stimulate colour formation in the presence of natural chromogenes such as "dopa" (DL-β-3,4 dihydroxyphenyl alanine)[2]. Extracts were prepared and their reactions described. These included cytochemical reactions, colour reactions of living tissue extract on "dopa", tyrosine and pyrocatechol, *in vitro* colour reactions of "dopa" in the presence of increasing amounts of commercial tyrosinase, colour reactions of dead tissues in the presence of "dopa" and commercial tyrosinase, colour reactions of beet slices (1–2 mm thick and several cm long) at 75°C in the presence of SO_2 and/or "dopa", of Fe^{++}, and of Fe^{++} plus SO_2. Chromatography and electrophoresis were used to determine "dopa" in the various tissues, and the action of ultrasonic vibrations on tyrosinase, "dopa" and beet slices was examined. The experimental procedures and results are given in detail with their interpretation. The colour-determining factors were found in decreasing order in the cortical parenchyma (the outside tissue, i.e. peel), in the free-ligneous bundles and the inter-annular tissue

[1] *I.S.J.*, 1958, **60**, 260–263.
[2] *See I.S.J.*, 1964, **66**, 198.

(both forming the internal tissue). The top and tails were intermediate between the peel and the internal tissue. The temperature of 70° activates the "dopa"-oxidase in the beet and this is not completely suppressed by boiling. Addition of Fe^{++} did not accentuate colour formation, while SO_2 is the only known useful inhibitor which will block the activity of the enzymes responsible for melanoidin formation.

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Progress in the field of polarimetry. M. DEMAUX and S. TOURLIÈRE. *Ind. Alim. Agric.*, 1964, **81**, 519–529, 680–696.—The history of the development of automatic polarimeters is briefly reviewed. The three parts of such an instrument are then discussed in greater detail, viz. the optical function, the automation, and the indication of the result. Finally the applications of the instrument are considered; in commercial transactions they can give measurements which are independent of the human factor and can thus be relied on by all parties, while they provide great sensitivity for measurement of exhaustions, etc. in the sugar factory control of laboratory work. Important points in their use—control of the zero, reduction of scale amplitude, voltage effects, colour of solutions, construction and length of service—are discussed.

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Dependence of the coefficient of saturation of sucrose on the concentration of calcium and magnesium chlorides at 25° and 40° (C). Z. BAKASOVA and I. G. DRUZHININ. *Sbornik Mat. Konf. Akad. N. S. Kurnakova* (Frunze), 1963, 112–120; through *S.I.A.*, 1964, **26**, Abs. 697.—The influence of either $CaCl_2$ or $MgCl_2$ on the coefficient of saturation of sucrose solutions was nearly the same at both temperatures, at salt concentrations of 0–1·0%, both having a "salting-out" effect; $CaCl_2$ however had a "salting-in" effect at concentrations greater than 1·0–1·5%. The compositions and viscosities of saturated solutions containing varying amounts of either salt are tabulated. The influence of $CaCl_2$ or $MgCl_2$ on the apparent gravimetric or refractometric Brix of solutions was also studied: the salts respectively increased and decreased the apparent Brix relative to the true Brix; the deviation was less with refractometric Brix in the case of $CaCl_2$, and with gravimetric Brix in the case of $MgCl_2$.

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The rate of inversion of sucrose in the presence of some non-sugars normally present in sugar factory juices. G. MANTOVANI and A. INDELLI. *Zucker*, 1964, **17**, 594–597.—A method used by GUGGENHEIM *et al.*[1] was applied to determination of the rate of sucrose inversion in the presence of various non-sugars. The initial stages of the inversion reaction were observed polarimetrically (using a Gaertner L-320 instrument with a 1-m tube). The results could be interpreted in terms of an equation describing ionic interaction. Values of reaction constant k agreed with previous values. The pH was determined from the inversion rate. Values determined potentiometrically agreed with values calculated from dissociation constants of acids and from ionic concentrations, except in the case of betaine. The pK value found by GUSTAFSSON[2] for betaine and differing from those found by other authors is shown to be correct. Agreement between the pH values calculated from dissociation constants and ionic concentrations was better than between potentiometric and ionic concentration values. The equation of GUGGENHEIM *et al.* ($k = 7{\cdot}45 \times [H^+] \times 10^{c/3} \times 10^{-3}$) is shown to express sucrose inversion rate sufficiently accurately.

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Comparative determination of per cent sugar in beet by the method of hot water digestion and the methods of triple polarization with two enzymes. A. K. GOPAK and A. P. PUSTOKHOD. *Trudy Grupp. Lab.*, 1959, 81–82; through *S.I.A.*, 1964, **26**, Abs. 784. The determinations were carried out on nearly fresh or stored beets over the period October 1956 to April 1957. The results were identical in October and diverged progressively with time up to a deviation of 0·64% of sugar in April (the results of the two-enzyme method being lower in all cases).

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Hydrolysis of sucrose and the breakdown of the hydrolysis products, especially under the conditions of beet sugar manufacture. I. Introduction: hydrolysis of sucrose. K. VUKOV. *Cukoripari Kutatóintézet Kozleményei*, 1963, **8**, 7–57; through *S.I.A.*, 1964, **26**, Abs. 804.—The hydrolysis of sucrose is reviewed in detail (with 341 references) with many tables and graphs, and the results are generalized in the form of equations. Mechanisms for invert sugar decomposition and the Maillard reaction, and the analytical methods used in the study of sucrose inversion are also reveiwed. Three types of inversion are distinguished, catalysed by hydrogen ions, hydroxyl ions and salts respectively. Enzymatic hydrolysis is of minor importance in practice. Each type follows the Arrhenius temperature equation, the respective activation energies being 25·92 ± 0·74, 24·4 ± 1·7 and 24·0 ± 3·1 kcal/mol. The rate constant k for acid hydrolysis is given by the following equation within the range of pH 1–6·5, 20–130°C and 0–0·9 g/ml sucrose concentration: $\log k = 16{\cdot}91 + \log(d - c) - (5670/T) - \mathrm{pH}$, where k = rate constant of hydrolysis (min^{-1}), d = density of solution, c = sucrose concentration (g/ml), and T = absolute temperature. The corresponding equation for alkaline hydrolysis, valid in the range of pOH 1–4 and 90–120°C, is: $\log k = 10{\cdot}39 + \log(d - c) - (5340/T) - 0{\cdot}30\,\mathrm{pOH}$. The equations may be used up to 0·5 pH units above neutrality and from 1·39 units above neutrality, respectively. The rate constant for salt-catalysed inversion k_s, to be added to the k value for acid or alkaline inversion, is given by: $\log k_s = \log S + 11{\cdot}06 - (5250/T)$, where S is the normality of the salt solution (preferably in the range 90–110°C and pOH 2–5).

[1] *Trans. Far. Soc.*, 1955, 1387.
[2] *Ber.*, 1944, **77B**, 66.

BY-PRODUCTS

New by-products from molasses. J. C. Y. TSAO. *Sugar y Azúcar*, 1964, **59**, (9), 98–99.—In addition to animal feed, a number of fermentation products from molasses—alcohol, yeast, glutamic acid, acetone and butanol, etc.—are briefly reviewed.

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Use of molasses for stock feed purposes. ANON. *Sugar J.* (La.), 1964, **27**, (4), 30–32.—Use of molasses as an animal fodder in the U.S. and Australia is reviewed.

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The production of fodder yeast from sugar factory products. A. RIECHE. *Zeitsch. Zuckerind.*, 1964, **89**, 572–576.—Tests carried out at the author's institute in East Germany on the production of yeast from waste water and other carbohydrate-containing materials are reported. Among the sugar products studied (beet raw and thick juice, white and raw sugar, *A*-heavy and final molasses and cane raw sugar and refinery and final molasses) the highest yeast yields are obtained from beet raw juice, beet and cane final molasses and beet thick juice. However, because of its low concentration, raw juice quickly ferments and is therefore not storable. It is therefore suggested that the most rational system would be one in which raw juice was used for yeast production during the campaign, excess juice being processed to thick juice for use during the off-season. *A*-heavy molasses is considered the optimum substrate, since, while it does not yield as much yeast as raw and thick juice and final molasses, it is easily transportable and storable (its Brix being 60°).

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Herbicidal activity of sucrose esters of phenoxyacetic acid derivatives. H. DOMAŃSKA and Z. ECKSTEIN. *Roczniki Nauk Rolniczych*, 1963, **88**, Ser. A, (1), 59–72; through *S.I.A.*, 1964, **26**, Abs. 671.—Laboratory and field tests are reported in which the sucrose esters proved more effective than the corresponding sodium salts. Esters of 2,5-dichlorophenoxyacetic acid (2,5 DS) had the best effects in sugar beet fields, 2,5 DS and esters of 2-methyl-4-chlorophenoxyactic acid (MCPA-S) in flax fields, and 2,4 DS and MCPA-S in oat fields. Results are tabulated.

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Effect of restricted feeding of molasses ration on carcass quality of market hogs. K. K. OTAGAKI, I. I. IWANAGA and E. H. COBB. *J. Animal Sci.*, 1963, **22**, 842; through *S.I.A.*, 1964, **26**, Abs. 684.—Feeding pigs on 90%, 80% or 70% of an *ad lib.* high-molasses diet led to higher feeding efficiency but had no effect on carcass quality.

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Urea-enriched sugar cane bagasse as cattle feed. ANON. *Agric. Res., India*, 1962, **2**, 89–90; through *S.I.A.*, 1964, **26**, Abs. 683.—A diet which included 50% bagasse, 5% molasses, 2% urea and 11·56% crude protein was fed *ad lib.* to three Hariana bullocks for 30 days, with 1 kg of green berseem (Egyptian clover) per day. The digestible protein and total digestible nutrients were 8·67% and 51·57% respectively. The bullocks maintained positive N, P and Ca balances.

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It is feasible to extract wax from filter cake to cover the national demand (of Argentina) and also to export. V. G. MARTEAU. *La Ind. Azuc.*, 1964, **70**, 307–308. The opportunities in Argentina and other countries for extraction of cane wax are generally reviewed, and the fact that such extraction does not harm the extracted filter cake as a fertilizer is emphasized.

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Industrial utilization of sugar and sugar by-products. R. R. COVAR and Y. V. IMPROGO. *Sugarland*, 1964, **1**, (8), 26–30.—The literature on various aspects of sucro-chemistry—fermentation products from sugar, molasses utilization for fodder, cane wax extraction and bagasse conversion to pulp and paper, etc.—is surveyed, the references (except for a patents review of 1961) being dated 1959 or earlier.

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Biosynthesis of dextran for the production of blood plasma substitute. II. Laboratory-scale cultivation of *Leuconostoc mesenteroides* **production micro-organism.** A. VAVRA and I. VAVRA. *Zeitsch. Zuckerind.*, 1964, **89**, 628–631.—Tests are reported in which *Leuconostoc mesenteroides* was cultured on agar slant over a period of one year. Compressed yeast and malt sprouts were used as substrate. The best results were obtained by propagating every 2–2½ months for 12–14 days. The basic cultures and substrates were kept at 2–4°C in a refrigerator. Dry cultures obtained by freeze-drying (lyophilization) kept their activity over a period of several years. The average dextran yield was 32·7% on sucrose.

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The reaction of sugars with alkyl halogenomethyl ethers. G. R. AMES, H. M. BLACKMORE and T. A. KING. *J. Appl. Chem.*, 1964, **14**, 503–506.—Alkoxymethyl ethers of sugars may be prepared by condensation of alkyl halogenomethyl ethers at room temperature or 50°C in dimethyl formamide solution. The reaction products—di-, tri-, tetra-, penta-ethers or mixtures—are isolated by adding ethyl acetate or ether, washing the organic solution with water, drying and evaporating. Characteristic data are tabulated for various ethers.

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Distillery waste for fertilizer and feed. R. A. CRUZ. *Proc. 11th Ann. Conv. Philippines Sugar Tech.*, 1963, 239–246.—Spent wash has been found to be useful as a fertilizer for coconut trees on the Canlubang estate, while the lees, or residual sludge from the fermentation tank, was found to be a good feed supplement for young pigs and dairy cattle.

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.

Cane trailers. Weeks & Co. (Engineers) Ltd., 68–70 Oxford Street, Hull; British Resin Products Ltd., Devonshire House, Piccadilly, London W.1.

Among recent export orders secured by Weeks & Co. (Engineers) Ltd. is one for 65 sugar cane trailers for Ceylon. The trailer illustrated has a maximum capacity of 7 tons and overall dimensions of 12 ft

long and 4 ft wide. Production costs have been cut and an improved finish obtained by using a water-thinnable primer based on BRP's "Epok W.1760" water-soluble resin.

* * *

Steam turbines. Belliss & Morcom Ltd., Icknield Square, Birmingham 16.

These mechanical-drive type turbines are of single stage design for outstanding simplicity and reliability. They are an ideal drive for such applications as sugar mills, pumps, fans, blowers, compressors and generators, etc. Power developed ranges from 150 to 1200 b.h.p. at speeds from 1000 to 6000 r.p.m. Maximum steam conditions are 600 p.s.i.g., 750°F exhausting up to 80 p.s.i.g. or to vacuum. The drives may be direct coupled or with a reduction gearbox of any desired ratio and for constant- or variable-speed drives.

Bearings are interchangeable and split for easy inspection. Forced feed lubrication is provided and both a constant-speed and over-speed emergency governor.

Fully staged turbines are also designed to customers' requirements and have been made for many years, often coupled to a power generator to give sets up to 15,000 kW.

Dust control in pneumatic conveying. Dust Control Equipment Ltd., Thurmaston, Leicester.

Present-day concepts relating to the handling and transporting of granular and powdered materials in bulk with emphasis on hygiene and reduced labour costs call for a far wider application of pneumatic transfer systems with all the advantages of continuous flow and minimum handling. Dust Control Equipment Ltd. supply a range of standard unit filters which have found wide acceptance in this field. The "Unimaster" venting unit, for instance, filters the conveying air of the fine dust still retained after the bulk of the product is deposited in the bin. The collected dust is returned to the bin where the filter is periodically automatically cleaned, thus avoiding loss of material.

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Terylene rope nets. Marlow Ropes Ltd., Marlow House, Lloyds Avenue, London, E.C.3.

Terylene rope nets have a number of advantages in sugar refining, brewing and similar industries where sugar content has caused a great deal of trouble with the conventional sisal nets used to form slings to unload bags of raws.

Terylene can, of course, be washed, is tremendously resistant to abrasion and is much stronger than natural fibre ropes. This means that it need not become dirty and sticky and therefore difficult to handle, but can be washed and kept in service for very much longer than at present.

* * *

New electric motors. British Brown-Boveri Ltd., Glen House, Stag Place, London, S.W.1.

The "Compax" range of lightweight T.E.F.C. three-phase squirrel cage motors, of output from $\frac{1}{3}$ to 10 h.p. and suitable for supply voltages of up to and including 500 volts, consists of six standard frame sizes designed in accordance with I.E.C. recommendations as regards principal dimensions and ratings.

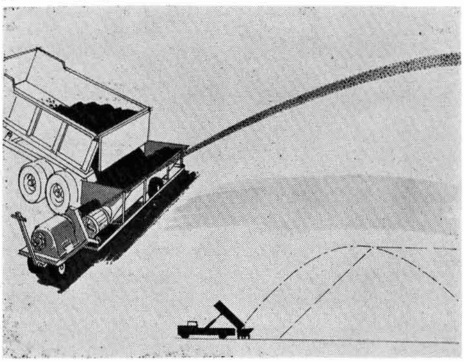
A notable feature is the lightweight but robust construction of these motors. Frame, end shields and terminal boxes are die-cast in light aluminium alloy of high mechanical strength, the frame being cast with the stator pack incorporated in the casting operation, enabling a monobloc construction for strength and maximum heat transfer. All motors have Class E insulation.

The range includes foot, flange, combined foot and flange, and pad mounted motors, all of which are fitted with special non-friction labyrinth seals ensuring constant proofing. All motors can be completely protected against overheating by the insertion at certain points of the winding of precision thermostats, which ensure that adequate and automatic cut-off or warning is given as soon as the temperature limit is exceeded.

Portable truck dump piler. Stephens-Adamson Mfg. Co., Aurora, Ill., U.S.A.

A portable truck dump piler for bulk materials is now available from Stephens-Adamson Mfg. Co. This piler, already performing satisfactorily in several applications, is placed directly under a dump truck at ground level and is easily towed from place to place. It will fill any storage area outside or inside, throwing bulk granular material in a steady, compact stream for distances up to 65 ft and will pile material to heights up to 40 ft. The angle of discharge of the unit may be anywhere from horizontal to vertical. The unique centrifugal thrower action of the machine does not require material drop, but operates with material fed through a side inlet from the hopper.

The standard piler will unload a 5-ton truck of 75 lb/cu.ft. material in one minute. Smaller units are available which will discharge at a rate of 90 tons/hr and pile material to a height of 20 ft, and larger units with higher capacities are also available. The latter require a small ramp to permit the truck to dump from a higher point. It is estimated that volumetric rates up to 150 cu.ft./min are feasible for this type of equipment.



The truck dump piler consists of a receiving hopper with a screw discharger feeding into a side-inlet belt-type thrower. A single motor or engine drives both the feeder and the thrower. The wheel carriage allows pivoting about the centre of the hopper so that the emerging stream can be directed without any change in the dumping point.

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Electronic level controllers and continuous depth gauges. Eurogauge Co. Ltd., Queens Road, East Grinstead, Sussex.

Tank contents measurement, level control, automatic switching and process automation are all aspects of the electronic equipment in the Eurogauge range. They meet all requirements, regardless of the shape or size of the container and of the contents—liquid or solid, conducting or non-conducting, powder or granular—and regardless of agressiveness, pressure, vacuum or temperature. The instruments are constructed using transistors, printed circuits and complete block units to ensure trouble-free operation without surveillance, and simplicity of installation, while an ever-increasing variety of probes and electrodes, in a range of designs and materials, provides versatility to permit the widest possible field of application.

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PUBLICATIONS RECEIVED

RENOLD NEWS LETTER. Renold Chains Ltd., Wythenshawe, Manchester.

Included in the articles on various applications of Renold's chains is an account of the Triangle sugar factory in the lowveldt area of Southern Rhodesia. The original milling train has been modernized recently and details with illustrations are given of the Renold chain drives that have been installed.

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ELECTROCHEMICAL PROCESSES FOR WATER, FOOD AND CHEMICALS. Ionics Inc., 152 Sixth Street, Cambridge 42, Mass., U.S.A.

This Brochure draws on Ionics' 15 years of experience in electrodialysis of saline water and gives information on water treatment and on the applications of electrodialysis in various industries, including de-ashing of sugar products.

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MORPANS. Glovers (Chemicals) Ltd., Wortley Low Mills, Whitehall Rd., Leeds 12.

A new booklet gives information on "Morpans" (long-chain quaternary ammonium compounds) which as cationic surface-active agents are recommended for a number of industries. Among these is the sugar industry, and "Morpans BB" is here advocated for liquid sugar plant sterilization with or without the addition of non-ionic surface-active agents.

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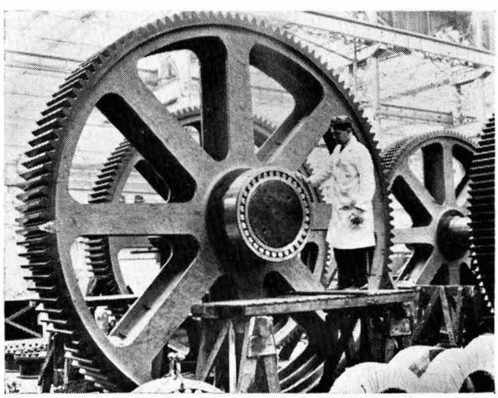
SKF bearings in sugar machinery.—The illustration shows a service engineer of the Skefko Ball Bearing Co. Ltd. checking the mounting of a 3-ft dia. spherical roller bearing to the



output shaft of one of 4 giant gearboxes being supplied by Fletcher & Stewart Ltd. to a British Guiana sugar factory. The gearboxes are designed to transmit 650 h.p. at an output speed of 3·18 r.p.m.

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Western States automatic centrifugals.—The Western States Machine Co. is building two batteries each consisting of three automatic batch centrifugals for The Great Western Sugar Co. The machines are equipped with 48-in dia. baskets which at 36 inches deep are 6 inches deeper than the standard, this being considered the most economical means of increasing centrifugal capacity.

BREVITIES

Beet sugar factory for Morocco[1].—The second beet sugar factory in Morocco is at present under construction in Souk es Sebt near Beni Mellal in south-east Morocco. The factory will be built by three West German firms, and the foundation stone was laid by King Hassan on the 26th December. The existing beet sugar factory at Sidi Slimane in north Morocco was built by the Polish company CEKOP and came into operation in 1963. It has a capacity of 45,000 tons of sugar.

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Mozambique sugar expanion plans[2].—A concession of 100,000 hectares for sugar cultivation in the Zambeze area has been granted to a company whose capital is mainly South African and Australian. This concession is beileved to be the largest ever granted to a private undertaking in Mozambique; annual production is estimated at 250,000 tons.

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Brazil sugar selling procedure[3].—Brazil's Sugar Institute has adopted a new system for selling sugar on the world free market. It is no longer to hold public tenders (except for sugar for the U.S. market) but the Institute's Executive Commission will henceforth consider individual bids, accepting them when satisfactory. The decree announcing this added that the new method would apply "as long as Brazilian sugar is overpriced on the world free market."

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Philippines typhoon damage[4].—After a smooth start to the 1964/65 crop in the Philippines, the canefields suffered considerable damage from winds and floods after typhoon "Louise" swept across the Visayan islands on the 20th November. Several mills had to cease operations for a week or more, according to the Philippine Sugar Association, and about 5/6000 tons of sugar in warehouses was damaged by water. Total damage to the crop is at present put at 10% and the previous month's forecast of 2,139,867 short tons will have to be revised. The final figure of sugar production for the 1963/64 crop was a record 1,855,879 short tons, which compares with 1,713,905 tons for the previous crop.

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Indian sugar factory proposals[5].—A committee appointed by the Gujerat Government has recommended three new factories with an aggregate capacity of 30,000 tons of sugar.

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New Mexican sugar mill[6].—Fondo Nacional de Fomento Ejidal is to build a sugar mill in the region of Apatzingán, Michoacán, with funds amounting to £15 million, lent by French banks and industrialists. The mill will use French equipment and machinery and will have a daily production capacity of 1500 tons of sugar.

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New sugar factory for Bulgaria[7].—A new sugar factory, construction of which started in 1960, has recently been put into operation. Annual production capacity amounts to 30,000 tons of sugar while daily slicing capacity is 2000 tons of beets. The factory is equipped with machinery produced in Bulgaria and East Germany.

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U.S.S.R. sugar factory[8].—A new beet sugar factory is now under construction at Derashnya in the Ukraine, according to *Die Wirtschaft des Ostblocks*. When complete the plant, which will be automatically operated, will have a slicing capacity of 3000 tons of beet per 24 hours which will bring the total rate for all the factories in the Ukraine to some 261,000 tons per day.

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Sugar expansion in Honduras[9].—It is reported that Cia. Azucarera Hondureña of San Pedro Sula is to invest 12 million lempiras (about £3,500,000) in an expansion programme. Cane capacity at the San Pedro Sula plant will be increased from 1300 tons to 3000 tons daily. The company also plans to install a new mill at a site in central or southern Honduras with an initial daily capacity of 2000 tons, increasing by stages to 4000 tons.

Argentina cane crop, 1963/64[10].—The final estimate of the Dept. of Agriculture sets total 1963/64 cane output at 11,827,000 metric tons or 11·6% above the average of the last five years and 13% above the average of the last ten years.

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Chile sugar factory expansion[11].—The beet sugar plant operated by the Industria Azucarera Nacional S.A. at Linares is to be expanded, to increase its production capacity from 37,000 tons to over 50,000 tons a year. Tenders for the supply of the extra equipment are to be invited in the near future; the possibility of producing some of the machinery in Chile is being considered.

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Venezuela sugar expansion[12].—The sugar factory at Carora in Lara State in Venezuela is to be modernized in order that the increased tonnage of cane from the area need not be transported to neighbouring states for processing. A total capital of some £1,500,000 is to be invested in the project. It is planned that the new mill when rebuilt will be able to handle about 1000 tons of cane per day. There are also plans for a second scheme in the state of Zulia which envisages the construction of a new factory.

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Bagasse pulp production in India[13].—The Indian Government is planning to set up a bagasse pulp plant in a bid to reduce shortages in the production of paper and newsprint. A Corporation is to be started which will arrange for regular supplies of raw materials to the paper factories by purchasing and storing bagasse from the sugar factories and pulp from the pulp manufacturing units.

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Mexican sugar crop, 1963/64[14].—The 1963/64 season in Mexico set a new record with a production of 1,815,463 tons, an increase of 12·2% compared with the previous crop.

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Cane borer damage in India[15].—The terai borer, a sugar cane pest, is reported to be causing serious damage to the crop in the U.P. The borer is also spreading over various cane areas of the Punjab and is reported to have damaged 60% of the crop in Jagadhri. It has been observed in the Phagwara cane areas. So far not much success has been achieved in studies of the pest and measures for its control. Efforts are also being made to find a way to control the Gurdaspur borer which causes damage to the Punjab cane crop to the extent of about £1,500,000 annually.

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New sugar factory for South Africa[16].—Permission has been given to Huletts Sugar Corporation Ltd. for the erection of a sugar factory at Bedlane near Nkwalene in Zululand. The Company is to proceed with the erection when cane production in the Melmoth area within economic distance from the factory site reaches a total of 200,000 tons per annum. In the meantime any suitable cane from the area will be transported to the Hulett factories at Empangeni and Felixton and milled there.

1 F. O. Licht, *International Sugar Rpt.*, 1965, **96**, (36), 17.
2 *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 18.
3 *Public Ledger*, 9th January 1965.
4 C. Czarnikow Ltd., *Sugar Review*, 1965, (695), 18.
5 *Indian Sugar*, 1964, **14**, 469.
6 *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **29**, 1063.
7 F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (34), 12.
8 C. Czarnikow Ltd., *Sugar Review*, 1964, (693), 226.
9 *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **30**, 114.
10 F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (34), 17.
11 *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 90.
12 C. Czarnikow Ltd., *Sugar Review*, 1965, (695), 18.
13 *Indian Sugar*, 1964, **14**, 599.
14 *Bol. Azuc. Mex.*, 1964, (185), 1–2.
15 *Indian Sugar*, 1964, **14**, 597.
16 *S. African Sugar J.*, 1965, **49**, 20–23.

New factory for Vietnam[1].—Hitachi Zosen, of Osaka, Japan, have received an order for a sugar manufacturing plant for the Republic Sugar Corporation of Vietnam. The plant will have two milling trains, each of 1500 tons/day capacity.

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Argentine sugar crop, 1964[2].—A total of 11,117,409 metric tons of cane were milled in 1964, with an outturn of 921,883 tons of sugar, a yield of 8·292%. These figures compare with 11,075,900 tons of cane milled in 1963 to yield 990,391 tons of sugar or 8·942%. The cane was harvested from a cane area of 244,600 ha in 1963/64, compared with 223,900 ha in 1962/63.

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Ghana sugar situation[3].—On the 16th January the President laid the foundation stone of the £G4 million sugar factory at Komenda in the Central Region of Ghana. After considerable delays, construction of the factory is now well advanced. Technoexport, Czechoslovakia, are supplying machinery and equipment for the factory which will have a capacity of 1000 tons of cane per day and 10,000 tons of refined granulated sugar per year. In the first eight months of 1964 Ghana spent over £G3 million on imports of sugar and sugar preparations and the President called for an increase in sugar cane production to supply the new factory. A larger, £G5½ million sugar factory at Asuchuare, near Akuse in the Eastern Region, being built by a Polish organization, is expected to start processing sugar cane in 1966; in conjunction with this enterprise 8000 acres of land are being irrigated in the area to produce the requisite amount of sugar cane.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 15th April 1965*)	s d
Anglo-Ceylon (5s)	5/9
Antigua Sugar Factory (£1)	10/–
Booker Bros. (10s)	18/9
British Sugar Corp. Ltd. (£1)	21/6
Caroni Ord. (2s)	1/10½
Caroni 6% Cum. Pref. (£1)	16/3
Demerara Co. (Holdings) Ltd.	3/9
Distillers Co. Ltd. (10s units)	22/–
Gledhow Chaka's Kraal (R1)	18/–
Hulett & Sons (R1)	26/–
Jamaica Sugar Estates Ltd. (5s units)	3/10½
Leach's Argentine (10s units)	19/9
Manbré & Garton Ltd.* (10s)	28/3
Reynolds Bros. (R1)	20/–
St. Kitts (London) Ltd. (£1)	15/–
Sena Sugar Estates Ltd. (5s)	6/–
Tate & Lyle Ltd. (£1)	29/9
Trinidad Sugar (5s stock units)	2/–
United Molasses (10s stock units)	32/4½
West Indies Sugar Co. Ltd. (£1)	9/6

* 1 for 4 Capitalization

CLOSING MIDDLE

New York Stocks (*at 16th April 1965*)	$
American Crystal ($5)	17⅛
Amer. Sugar Ref. Co. ($12.50)	20⅞
Central Aguirre ($5)	25⅜
Great Western Sugar Co.	39
North American Ind. ($10)	14⅜
South P.R. Sugar Co.	28¼
United Fruit Co.	19

Co-operative sugar factories for Mysore[4].—The Indian Government has sanctioned the setting up of three co-operative sugar mills in Bidar, Magutakha Hubli (Belgaum District) and Hirigur (Chitra Durga District) in Mysore.

* * *

British Guiana sugar crop 1964[5].—Total production from the 1964 crop, including sugar made from small farmers' canes amounted to 258,378 tons compared with 317,137 tons produced in 1963. In 1964, an average of 11·58 tons of cane was required to make a ton of sugar, compared with an average of 10·76 tons of cane in 1963. Preliminary estimates for the 1965 crop indicate a target of 335,000 tons. Grinding of the 1965 crop commenced earlier than usual.

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Sugar production in Ireland, 1964/65[6].—Beet sliced during the 1964/65 campaign reached 893,094 metric tons, according to the Irish Sugar Co. Ltd. In the 1963/64 campaign 952,824 tons of beets were sliced. Sugar production amounted to 142,089 metric tons, raw value, compared with 145,408 tons in the previous campaign.

* * *

Glutamate production in Italy[7].—A new Company, with Swiss and Japanese capital, has been formed for the manufacture of monosodium glutamate for use in the food industry. The Company is to build a plant in the industrial zone of Brindisi harbour which will have a capacity of 5000 tons of glutamate, of which 90% will be for export. Raw materials will include 27,500 tons of molasses (about 9·6% of Italian molasses production) and 5000 tons of hydrochloric acid. The plant should come into operation in 1966.

* * *

Rumania campaign results[8].—The 1964/65 beet acreage amounted to 188,500 hectares, 15,500 ha or 9% more than in the previous year. As a consequence of favourable weather during the growing period, the campaign results were better than in previous years, although the extraction was somewhat below that of 1963/64. In the eleven sugar factories 3,065,000 tons of beets were sliced and 467,000 metric tons of sugar, raw value, were produced as compared with 2,065,000 tons of beets and 318,000 tons of sugar in the previous campaign. Domestic sugar consumption in Rumania is around 330,000 metric tons, raw value, so that production will be in excess of requirements by some 140,000 metric tons.

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Colombian sugar expansion.—A new sugar factory is to be installed towards the end of 1965 in the Zulia valley, on the frontier of Colombia with Venezuela[9]. A sugar expert recently stated that the Zulia valley programme, involving investments of 150 million pesos (about £11 million), would provide an initial daily production of 3000 tons from a planted area of 2500 hectares. It is estimated that within two years the output of sugar cane in that region could equal that grown in the Cauca valley. A large sugar mill is to be established at Risaralda, in the Dept. of Caldas.

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Ryukyu beet campaign, 1964/65[10].—Centrifugal sugar production in the Ryukyu islands during the 1964/65 campaign is now officially estimated at 243,000 metric tons, compared with 128,365 tons in 1963/64 and 150,494 tons in 1962/63.

[1] *Sugar y Azúcar*, 1965, **60**, (1), 82.
[2] *La Ind. Azuc.*, 1965, **70**, 15–19.
[3] *Overseas Review* (Barclays D.C.O.), February 1965, pp. 60–61.
[4] *Indian Sugar*, 1964, **14**, 598.
[5] *Overseas Review* (Barclays D.C.O.), February 1965, p. 81.
[6] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (3), 15.
[7] *Zeitsch. Zuckerind.*, 1965, **90**, 95.
[8] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (5), 9.
[9] *La Ind. Azuc.*, 1965, **70**, 8.
[10] C. Czarnikow Ltd., *Sugar Review*, 1965, (701), 43.