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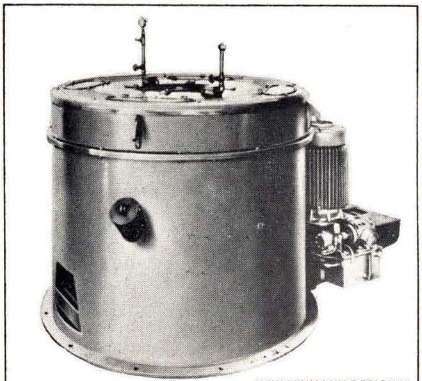

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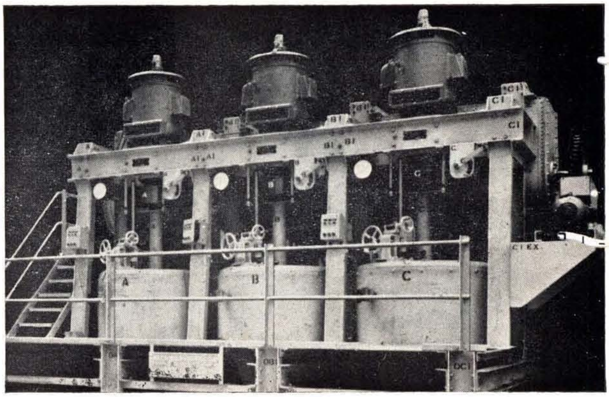

THE
INTERNATIONAL SUGAR JOURNAL

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NOTES AND COMMENTS

Mr. Norman J. King.

We are pleased to announce that Mr. NORMAN J. KING, Director of the Bureau of Sugar Experiment Stations, has kindly consented to join our Panel of Referees and to examine on our behalf manuscripts of original articles which have been submitted for publication.

Mr. King has been Director of the Queensland Bureau for seventeen years and has been employed in that organization in various capacities since 1940.

He is a past president of the Queensland Society of Sugar Cane Technologists, and has also occupied the offices of General Secretary-Treasurer and General Vice-Chairman of the I.S.S.C.T. He was a Royal Commissioner into the Queensland sugar industry in 1950, and a member of the Committee of Inquiry in 1963 which planned the large scale expansion of the Australian sugar industry which has taken place in the past few years.

Mr. King is principal author of the Manual of Cane Growing, the revised edition of which was published this year. We wish to take the opportunity of thanking him and our other Referees for their unselfishness in making available their knowledge and experience in maintaining a high standard for articles published in the *International Sugar Journal* to the benefit of sugar technologists throughout the industry.

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The world sugar price.

At the end of June, the London Terminal price for raw sugar was below £20 per ton c.i.f. U.K. for two days, reaching a low of £19·25 on the 25th June. This was the lowest level since the price was introduced in this form in 1956 and the lowest sterling price for sugar since the end of the 1939-45 war. Since that date the price has recovered to some extent and, at the time of writing, stands at £20·75 per ton. This improvement undoubtedly is the effect of the withdrawal of major Western Hemisphere sellers from the world market, in particular of Brazil whose Sugar Institute Export Director has said that no further supplies would be released to the market until prices were markedly improved.

The white sugar premium over raws has also been low because of the ready availability of Brazilian white sugar at second hand and from the Institute at a premium of only 10% over raws for exchange. The French Government also granted export subsidies in early July for the first of a series of tenders for white sugar, and an improvement in the white sugar market is therefore unlikely while France has surplus sugar for sale.

The low prices have brought sugar into the news, just as did the high prices of 1963. But both the high and low levels are not an indication of the health of the sugar industry, as has been pointed out before. Because more than 80% of the world sugar crop is either consumed in the producing country or traded under bilateral agreements which involve preferential prices, the world market, covering the balance of sugar traded, is narrow and highly susceptible to changes in production levels which may be only small when related to the overall world production. Thus a 10% increase in world sugar outturn will almost double the amount available on the world market, with drastic effects on the world price but little effect on the prices paid for the bulk of sugar traded.

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Cuba and a new sugar agreement.

The Cuban Government's announcements concerning the six million tons plus level of the 1964/65 sugar crop, even if inflated to some degree, make it clear that Cuba has returned to its former position of "sugar bowl of the world". MERRILL LYNCH, PEARCE, FENNER and SMITH have pointed out[1] that: "The re-emergence of Cuba as a force in sugar marketing may have important repercussions in the talks aimed at setting up a new International Sugar Agreement. A Conference has been arranged for this Autumn, and the revitalized Cuban sugar industry looms as a major topic of discussion.

"It is indeed a striking parallel that the interest in a working sugar agreement and the recovery of Cuban sugar production developed simultaneously. The stage appears set for Cuba to step in and assume her position as a shield for the rest of the sugar producers. Her voluntary withholding of supplies when prices were low made the earlier sugar agreement work. The big question remains, can the Castro government be persuaded to return to such a position? Without the wholehearted participation of Cuba, the International Sugar Agreement may find itself in serious difficulty".

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European beet area estimates, 1965.

The first estimates by F. O. Licht K.G.[2] of the area sown to beet in 1965 have been published and total 7,454,350 hectares as compared with the revised total of 7,439,551 ha in 1964. This marginal difference in the total is coincidental, however, since it is the net result of greater changes for individual countries. Thus, the area in Western Germany is to be reduced by 35,000 ha and that of France by 27,000 ha. On the other hand, Italy and Spain will have areas larger by 28,000 and 35,000 ha, respectively, and Holland will have an increase of 16,000 ha. Turkey's beet area will be 8000 ha smaller, while smaller changes are forecast for other Western European countries.

In Eastern Europe most countries are estimated to have the same or slightly changed area, the largest changes being expected in Poland (up 30,000 ha) and Hungary (down 11,000 ha).

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East Germany sugar industry rationalization[3].

Under the general plan to reorganize the sugar industry in East Germany and to improve efficiency it is planned to affiliate the various sugar factories to thirteen large concerns by 1st January 1966. The smallest white sugar factories are scheduled to close down by 1970 as are all the raw sugar factories. The drying plants of these, however, will remain in operation.

A large section of the finance allotted to the sugar industry during the period up to 1970 will be used in connexion with the construction of a white sugar factory at Malchin. Work has already started on the plant which will be capable of handling 4000 tons of beet per day.

The sugar factory at Stavenhagen has been closed down and only the drying plant remains in operation. The refineries at Magdeburg and Rositz are scheduled to be shut down which will leave the refinery at Halle still working.

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Taiwan sugar crop, 1964/65.

The Taiwan Sugar Corporation has announced that a record outturn of 1,005,000 metric tons was reached in the 1964/65 season, some 15% more than had been planned. Domestic requirements amount to some 140,000 tons, leaving 865,000 tons available for export. Production amounted to 795,101 metric tons, raw value, in 1963/64, and the 1965/66 crop is expected to be about 900,000 tons.

C. Czarnikow Ltd. note[4]: "This is the first time since the early years of the second world war that sugar production in Taiwan has topped the 1,000,000-tons mark. It will be recalled that the area cultivated to cane at that time amounted to a little over 120,000 hectares whereas during the past few seasons areas of 90,000–97,000 hectares have been the rule.

"The area planted to cane during 1964/65, however, is reported to be larger than that of the previous campaign and this, together with better yields which have been achieved over the years with increased technical knowledge, has contributed to the larger volume of sugar produced from this crop. A hazard that faces the sugar industry in Taiwan is the occurrence of typhoons which can cause extensive damage to standing cane but happily the crop this season was not afflicted by such weather conditions during its growing period".

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Verenigde HVA Maatschappijen, 1964 report.

Sugar production in 1963/64 of the Wonji and Shoa sugar factories in Ethiopia amounted to 62,747 tons. Sugar consumption was lower than originally expected, however, mainly as a result of a further increase in taxes on sugar, resulting in a higher domestic price. The available surplus was exported at world market prices.

Since consumption is expected to increase again the company has begun to raise the capacity of the Shoa factory. However, as a consequence of unfavourable weather conditions, sugar production in the 1964/65 season will be lower than in 1963/64.

Negotiations with the Ethiopian Government on a licence for the construction of a third factory are in their final stages.

[1] Through *Public Ledger*, 19th June 1965.
[2] *International Sugar Rpt.*, 1965, **97** (11), 1.
[3] C. Czarnikow Ltd., *Sugar Review*, 1965, (719), 118.
[4] *Sugar Review*, 1965, (718), 115.

SUGAR CANE RESEARCH AT LUCKNOW

Annual Report of the Indian Institute of Sugarcane Research for the year ending 31st May, 1963.

THE work of the seven sections of the Institute for the period under review is reported, the seven being—Agronomy, Agricultural Engineering, Agricultural Chemistry and Soil Science, Physiology, Mycology, Entomology and Administration. Agronomy figures prominently in the report. In addition three *ad hoc* projects financed by the Indian Central Sugarcane Committee are reported on, these being: (1) the All-India co-ordinated scheme for research on the control of rust disease, (2) the scheme for entomological outposts, and (3) the scheme of researches on the storage of gur.

Among research results in the agricultural field there were several claimed to be capable of immediate practical application or of being of importance in commercial sugar cane cultivation.

Germination

Studies in the germination of sugar cane setts were continued and the conclusion confirmed that the primary factor affecting germination under northern Indian conditions is the moisture contained in the sett. Detailed investigations have stressed the importance of the deleterious effects of moisture loss in the sett on its germinating capacity. Next in importance is the degree of moisture and the temperature of the environment of the sett.

Indications are that in the usual type of seed-bed prepared for cane in northern India moisture is inadequate for good germination. The polyethylene nursery system, in which the whole nursery bed is covered with polyethylene sheeting to conserve moisture during germination, overcomes this difficulty and a high germination percentage results. This technique gives about 90% germination as against the usual 30%. This should involve a 60% reduction in seed rate but certain problems of even spacing are involved, which are being investigated. Three-budded setts are favoured. Five-budded setts, whilst appearing to give better clump formation, had no significant effect on yield.

The relationship between buds and root eyes in regard to viability was investigated. Under certain conditions root and bud primordia appeared to compete for soil moisture. This competition is due to the fact that root eyes require a higher moisture percentage in the environment than do buds. It is thought the explanation for this difference may lie in the absence of bud scales. This is being investigated.

Germination studies carried out by the Institute during the last 3 years have done much to explain the behaviour of seed cane under local conditions and have yielded results or led to techniques which have been of immediate practical value. It is hoped that further studies in this field will also yield fruitful results.

Flowering

The effects of various chemicals, used as sprays, on the flowering of cane were studied. Most of the substances employed had no significant effect on the time or the extent of flowering. It was found however, that flowering could be efficiently controlled by defoliation although this may not be important in field practice. In the Lucknow region the third week in September, or the latter half of September, was found to be the best time, for all varieties tested, for defoliation to cause the maximum reduction in flowering. In parts of India the variety Co 419 flowers profusely, leading to cessation of growth after October. In experiments conducted at Hospet on Co 419 flowering was reduced from about 22% to about 4%.

Ripening

Work was continued on the ripening of sugar cane stalks of different varieties, and on the general ripening process under northern Indian conditions. Data obtained confirmed the fact that in the coldest part of the year the process of ripening is in abeyance. There was an indication from the year's data that the effect of low temperatures is related to the sugar content of the part of the cane affected—the higher the juice quality, the smaller is the deleterious effect of low temperature. However, these conclusions are regarded as only tentative at present.

Soil and Soil Compaction

The effect of bulk density of soil, or compaction, on root growth and the development of the cane plant received consideration. It was found that the growth of the roots of young sugar cane plants was markedly affected by the degree of compaction of the soil. Compaction of sieved soil at about 69% of its volume reduced root growth by about 75%. Even shoot growth was reduced by about 40%.

In this connexion research was directed towards the designing of a suitable implement for breaking subsoil to render it more amenable to plant growth. Experiments showed that if subsoil is fertilized and its compaction broken-up, sugar cane can grow satisfactorily in it.

The Research Station's bullock-drawn furrower, referred to in the 1961/62 year's report, has now been completed or perfected. The present design ensures very efficient furrowing up to 15 cm depth. Another new implement is the so-called I.I.S.R. Weeder-Mulcher. This is essentially a blade harrow, operating with great efficiency, pulling out weeds without either digging, opening or turning up the soil. It collects the uprooted weeds and deposits them in heaps at intervals whenever a handle is used to operate the blades. It requires very little draft power and is operated by one man. The implement is considered to cause much less moisture loss to the soil than the conventional tined cultivator. This is important in north India.

Experiments with various trace elements used as sprays failed to give any response with sugar cane. In fertilizer experiments a notable observation was the fact that urea, unlike some other nitrogenous fertilizers, did not appear to depress juice quality. Green manuring experiments with sunn hemp (*Crotalaria juncea*) are reported. These have shown the uncertainty of green manuring in northern India since its success depends upon the rainfall pattern during the growth of the sunn hemp and its decomposition after ploughing in.

Diseases

Research work has been continued on the following troublesome or harmful sugar cane diseases in India—red rot (*Colletotrichum falcatum*), wilt (*Cephalosporium sacchari*), smut (*Ustilago scitaminea*) and grassy shoot (a virus). Three well-known vectors of grassy shoot disease were found feeding on sugar cane plants at the Institute's farms. Their colonies were particularly numerous on diseased plants. In a survey of sugar cane areas of Mysore high incidence of grassy shoot disease was observed. Having regard to various symptomatic characters the belief is held that grassy shoot disease of sugar cane and "albino" are identical. Insect transmission experiments have given interesting results and are still under investigation.

New methods worked out for the inoculation of red rot and smut were tested further and positive results obtained. Inoculation of wilt disease was also successful. A technique for the inoculation of rust was evolved. Further investigations on the nature of physiological races of red rot and the metabolic bases for their identy and distinction were made.

Nematodes

Research on nematodes parasitic on sugar cane was continued. Laboratory tests showed that "Telodrin", a new chlorinated hydrocarbon, and gamma-BHC have nematicidal properties when applied to the soil. This may account for the remarkable but hitherto unexplained increases which are sometimes obtained in the yield of cane which has been treated with gamma-BHC for the control of shoot borer and termites. Further investigation is necessary. Assessment of populations of plant parasitic nematodes in the inter-spaces and planted furrows of cane, under the Institute's strip tillage system, showed that by adopting suitable cultural methods, the parasites could be concentrated. This could be of significance in economizing with nematicides which are very expensive at the present time.

Insect Pests

"Telodrin" was found to be as effective as gamma-BHC or "Heptachlor" as a soil insecticide against the shoot borer. For the control of the mite the "Chlorocide"-"Malathion" combination was found to be highly efficacious.

Four more parasites of the army worm (*Pseudaletia unipuncta*) were discovered. A fly (*Sturmiopsis inferens*) was found parasitizing the shoot borer fairly heavily in one area. Its possible use in controlling the shoot borer and stalk borer appears to be worth pursuing.

A beetle grub or borer (*Lacknosterna serrata*) in one area was investigated and remedial measures successfully applied.

A simple device or appliance for applying granular insecticide in tall crops of sugar cane was designed. It may be made locally by any cultivator for his own use.

Entomological Outposts Scheme

An account of the work initiated by the Indian Sugar Cane Committee in 1958 with the establishment of 5 out-stations (at Rajasthan, Madhya Pradesh, Orissa, Assam, and Tanjore) is given. This work involves surveys of a wide range of sugar cane insect pests among which borers figure prominently.

F.N.H.

Agricultural Abstracts

Sugar cane weed control field days. ANON. *Producers' Rev.*, 1964, **54,** (10), 43.—Four field days, on different cane farms in the Mackay district of Queensland, were held to discuss a new pre-emergent weedkiller "Domatol R 66" (Amchem Products Inc., Ambler, Pa., U.S.A.); 75 cane growers attended. The new product was claimed to be effective with Guinea grass. Locally made boom sprays and misting equipment were also demonstrated.

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New drainage system. ANON. *Producers' Rev.*, 1964, **54,** (10), 81.—The merits of P.V.C. lightweight slotted pipe for subsoil drainage in cane are outlined.

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Ratoon stunting disease threat to Q 71. ANON. *Producers' Rev.*, 1964, **54,** (10), 97.—Two serious drawbacks with this otherwise promising "sweet" cane are discussed, viz. its susceptibility to ratoon stunting disease and brittleness of stalk. With mechanical harvesting there is a tendency for the stalks to break at the point of contact with the conveyor chains of a harvester. A bad burn, to which this variety is prone, increases the rate of breakage.

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Hot water treatment increases cane yields. ANON. *Producers' Rev.*, 1964, **54,** (10), 97.—Cane yields were compared of 27 growers who used hot-water-treated setts with 27 neighbouring growers who used non-treated setts. Over a 7-year period the growers using hot-water-treated setts averaged 9 tons per acre more cane.

The production of jaggery or gur. C. André *et al.* *Agron. Trop.*, 1964, **19**, 800–900.—Four different papers are here involved, the authors covering a wide field. The nature of this cottage industry throughout India is fully described along with photographs and a production map. The possibilities of its being further developed in tropical Africa and difficulties likely to arise are also freely discussed.

* * *

The effect of weed competition on the sugar content and yield of sugar cane. M. J. M. Lamusse. *Trop. Agric.*, 1965, **42**, 31–37.—Previous work on the effects of weed competition is briefly reviewed. In this randomized weeding experiment (with variety B 41227) results indicate that weed infestations which began 3, 6 or 9 weeks after planting significantly reduced yield of cane or sugar. After 12 weeks the reduction was not significant. The important period for weed control was from the appearance of the first shoots above ground to the beginning of the "stalk elongation" phase.

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Weed control in Louisiana sugar cane. *Agribull* (Amchem Products, Inc.), 1964, 1–5; through *Hort. Abs.*, 1964, **34**, 805.—In Louisiana "Fenac" at 2½ lb/acre, applied in early spring to shaved or close-cut cane, gave long season control of Johnson grass and other weeds in plant cane. Annual grasses, troublesome in Florida, were suppressed by "Fenac" but broad-leaved weeds required an additional treatment with 2,4-D and/or 2,4,5-T.

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Assessing the utility of pan evaporation for controlling irrigation of sugar cane in Hawaii. F. E. Robinson, R. B Campbell and J. Chang. *Agron. J.*, 1963, **55**, 444–446; through *Hort. Abs.*, 1964, **34**, 806.—The timing of irrigation applications was determined with reference to the net evaporation from a U.S. Weather Bureau pan. Maximum sugar yields were obtained when 2·5 inches of irrigation water were applied after 2·9 inches had evaporated from the pan.

* * *

Designing a furrow irrigation system for sugar cane. J. E. Wimberly. *Agric. Eng.* (St. Joseph, Mich.), 1964, **45**, 138–139; through *Hort. Abs.*, 1964, **34**, 806. Equations are given which enable calculations to be made of the amount of water infiltrated into the soil for a given time from a given size of irrigation furrow, and also the time required to add a given amount of water to the soil.

Soil moisture tension, sugar cane stalk elongation and irrigation interval control. F. E. Robinson. *Agron. J.*, 1963, **55**, 481–484; through *Hort. Abs.*, 1964, **34**, 806.—The elongation rate declined as the soil moisture tension approached 2 bars at the 12 in depth. After the 2-bar stress at the 12-in depth was exceeded a reduction in the average growth rate occurred.

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The effect of some phosphatic fertilizers on the yields of sugar cane and interplanted groundnuts. S. S. Wann and R. S. Chen. *J. Agric. Assoc. China*, 1964, (45), 46–52; through *Hort. Abs.*, 1964, **34**, 807.—The variety F146 gave higher yields of cane and sugar than N:Co 310 when interplanted with groundnuts. Cane and sugar yields were increased by fused phosphate but not by superphosphate or nitrophosphate fertilizers.

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Foliar diagnosis of the nutrient status of sugar cane. L. Recalde *et al.* *An. Edafol. Agrobiol.*, 1964, **23**, 193–199; through *Hort. Abs.*, 1964, **34**, 807.—The paper consists of 2 parts: (i) The relationship of yield to the nutrient contents of the leaf, and (ii) The relationship of yield to the ratios of nutrients in the leaf. The highest cane yields were associated with foliar N, P and K values of 1·95%, 0·2% and 1·73% respectively.

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Additional hosts of sugar cane mosaic virus. E. V. Abbott and R. L. Tippett. *Plant Dis. Rptr.*, 1964, **48**, 443–445; through *Hort. Abs.*, 1964, **34**, 808. The following were infected with sugar cane mosaic (one or more strains) by artificial inoculation under greenhouse conditions—broom sedge, Johnson grass, St. Augustine grass and varieties of wheat, barley, rye and rice.

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Causes of degeneration in plants propagated from cuttings. F. Martin. *Compt. rend. Acad. Agric. France*, 1963, **49**, 1182–1190; through *Hort. Abs.*, 1964, **34**, 808.—Sugar cane plants propagated from basal setts, i.e. those fully ripened, are free from viruses which only affect setts taken from the tip. Basal setts, moreover, are better supplied with mineral elements.

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Sugar cane mosaic on St. Augustine grass in Florida. E. H. Todd. *Plant Dis. Rptr.*, 1964, **48**, 442; through *Hort. Abs.*, 1964, **34**, 809.—The strain found was an undescribed strain, similar to that found on the variety F31-407.

Action of "Diquat" and "Paraquat". W. R. BOON. *Outlook on Agriculture*, 1964, **4**, 163–170.—This is a paper on the chemistry and mode of action of the bipyridylium herbicides "Diquat" and "Paraquat", both of which have been used with sugar cane. Their rapid inactivation by the soil, especially heavy or clay soils, is stressed.

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Sugar cane germ plasm. I. Wild relatives. ANON. *Sugar Cane Varieties Quarterly Newsletter* (Coimbatore), 1964, **1**, (3), 3–5.—The importance of wild relatives of crop plants for germ plasm in breeding is emphasized. This has applied forcibly with sugar cane and examples are given, e.g. the sugar industry of Java having been saved from Sereh disease by the use of a Java clone of *Saccharum spontaneum* in breeding resistant varieties of cane.

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Facts about Co 997. ANON. *Sugar Cane Varieties Quarterly Newsletter* (Coimbatore), 1964, **1**, (3), 6–10.—A general account is given of this variety, one of the newer releases from Coimbatore. It has made its mark in Andhra Pradesh as an early outstandingly rich cane with a satisfactory yield.

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Sugar beet costs and returns, 1963. J. W. WOOD. *Farmers' Report* (Univ. Leeds Dept. Agric.), 1964, (165), 37 pp.—This is an interim report on a 2-year study of the economics of sugar beet growing on Yorkshire farms. Average net cost of growing sugar beet, on data from 74 farms, was £70 per acre. Average profit in 1963 was only £11 11s per acre and as low as £7 12s for some of the smaller growers.

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Brazilian sugar cane varieties. F. M. VEIGA. *Bol. Inform. Copereste* (São Paulo), 1964, **3**, (27), 3 pp. A comparison is made of the merits of some sugar cane varieties bred in Brazil with a number of imported varieties that have been cultivated. Yield figures are included.

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Freeze damage tests. L. L. LAUDEN. *Sugar Bull.*, 1964, **43**, 84.—With cane damaged by frost in the S.E. United States the value of the "inside stalk tissue damage test" is emphasized and the test described. A cane stalk is split lengthwise its full length. Where ice crystals formed inside the stalk the area appears water soaked and off-colour. Unaffected tissue appears white and quite different.

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New code for the good beet planter. N. ROUSSEL *et al. Publ. Vulg. Inst. Belge pour Amél. Betterave*, 1964, (1), 1–22.—All aspects of modern sugar beet production are dealt with and recommendations for growers are made, in abbreviated form. The ground covered includes such matters as choice of variety, use of rubbed and graded seed, soil preparation and treatment, manures and fertilizers, weed treatment, insecticides, spacing and thinning, mechanical harvesting and washing.

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Weed control trial in sugar beet. O. J. V. MÁRSICO. *Reunión Nacional sobre Malezas y su Control* (Buenos Aires), 1963, 2 pp.; through *Weed Abs.*, 1964, **13**, 235.—Disodium "Endothal" (19%) used as a pre-emergence spray at 4 kg in 400 litres/ha gave almost weed-free conditions in sugar beet in loam soil for up to 6 weeks after the crop was sown and greatly reduced the labour requirement for hoeing and singling.

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The effect of some desiccant materials on sugar cane: preliminary report. E. CERRIZUELA and A. J. NASCA. *Reunión Nacional sobre Malezas y su Control* (Buenos Aires), 1963, 3 pp.; through *Weed Abs.*, 1964, **13**, 254.—"Paraquat", applied at 2 litres (commercial product) in 400 litres spray/ha, gave satisfactory desiccation of leaf blades but not the leaf sheaths. "Diquat" was less effective.

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Fertilizers in Northern Nigeria. ANON. *Inst. Agric. Research Bull.* (Ahmadu Bello Univ., Nigeria), 1964, (38), 19.—Most of the sugar cane in Northern Nigeria is a soft, non-ratooning cane used for chewing. Commerical production of the crop is being undertaken in Ilorin Province. The use of 672 lb ammonium sulphate plus 336 lb superphosphate per acre is provisionally recommended for sugar cane.

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Graft-transmissible induction of elongation and flowering in scions of sugar beet bred for resistance to bolting. G. J. CURTIS and K. G. HORNSEY. *Nature*, 1964, **202**, 1238.—Grafting, with six 2x scions at the early cotyledon stage, was carried out in the leaf axils of autotetraploid stock which had been vernalized and on which flower buds were already visible. Elongation took place with 2 of the scions a month later and flowers opened 44 days after grafting.

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Accumulation of oxalate in tissues of sugar beet, and the effect of nitrogen supply. K. W. JOY. *Ann. Bot.*, 1964, **28**, 689–701.—The concentration of insoluble oxalate in field grown sugar beet was low in roots and high in leaves, increasing with age of leaf; 15–30% was magnesium salt, the rest calcium salt. Nitrogen supplied as ammonium sulphate or ammonium nitrate caused both soluble and insoluble oxalate to be low. Accumulation of oxalate appeared to be connected with assimilation of nitrate and the preservation of the cation-anion balance of the plant.

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Chemical pre-emergence weed control. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1964, **11**, (8 & 9), 3, 5.—Several herbicides were tested. "Gesaprim", "Karmex" and 2,4-D ester gave excellent control over the prevailing weeds.

Sampling sugar cane for the purpose of foliar analysis. J. R. GALLO *et al.* *Bragantia*, 1962, **21,** 899–921; through *Plant Breeding Abs.*, 1965, **35,** 83.—The middle 8 in of leaf +3 (according to Kuyper's system) was found to be the most reliable material for testing at 4 and 8–9 months.

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Varieties of sugar cane. Part IV. Trials conducted in the period 1957-1959. A. L. SEGALLA. *Bragantia*, 1963, **22,** 91–115; through *Plant Breeding Abs.*, 1965, **35,** 83.—Thirty varieties were tested in three localities in São Paulo. CB 49/15, N:Co 334 and CB 44/105 gave good yields of cane but the sugar content of CB 49/15 was not very high. (See *I.S.J.*, 1963, **65,** 258).

* * *

Some results of sugar beet cultivation under irrigation. I. BORA. *Probl. Agric. Bucuresti*, 1964, **16,** (6), 34–47; through *Plant Breeding Abs.*, 1965, **35,** 85.—*Hungaro Poli* 1 and 3 gave the highest yields of both roots and sugar in trials of 11 varieties in 1962 and 1963.

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Sugar beet varietal trials in different regions. N. I. ORLOVSKII. *Sakhar. Svekla*, 1964, (6), 22–26; through *Plant Breeding Abs.*, 1965, **35,** 84.—Trials with several varieties in different regions of the U.S.S.R. indicated that the better the soil and water conditions and the longer the vegetative period, the greater the advantage of using varieties with high sugar content.

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Sugar beet in the Hungarian People's Republic. L. MAGASSY. *Sakhar. Svekla*, 1964, (6), 38–40; through *Plant Breeding Abs.*, 1965, **35,** 84.—Past and present work on breeding and the production of new varieties are surveyed. Important varieties, such as those of the *Beta-Poli* numbered series, are mentioned.

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Changes in varietal recommendations for industrial sugar beet in 1964. E. G. LYASENKO. *Sakhar. Svekla*, 1964, (7), 34–35; through *Plant Breeding Abs.*, 1965, **35,** 85.—The new and important varieties grown in the Soviet Union are mentioned, region by region.

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Sugar beet production in Czechoslovakia. I. BÁRZAŠKI. *Kooper. Zemed., Sofija*, 1964, (6), 30–31; through *Plant Breeding Abs.*, 1965, **35,** 85.—The variety Dobrovice A outyielded all other varieties including some of the best polyploid forms from England, Denmark, Hungary and Sweden.

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Herbicidal weed control in sugar cane. J. R. ORSENIGO. *Ann. Rep. Florida Agric. Exp. Sta.*, 1963, 245; through *Weed Abs.*, 1964, **13,** 253.—Out of 40 chemicals tested in a pre-emergence evaluation trial in mid-winter conditions, after ratooning, 10 had a performance equal to or better than the recommended standard treatment with CDAA12,4-D. These are listed.

The comparative value of some of the recently developed chemicals as herbicides in Louisiana sugar cane. E. R. STAMPER. *Proc. 17th Southern Weed Conf.*, 1964, 145–152; through *Weed Abs.*, 1964, **13,** 254.—An account is given of trials during 1959–63 with "Fenac", "Isocil" and "Bromacil", compared with the standard TCA applications. They were found to be equal but not superior in one application. Results are also given of the use of "Fenac" in Johnson grass (*Sorghum halepense*) control.

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Control of aquatic weeds by the snail *Marisa cornuarietis*. D. E. SEAMAN and W. A. PORTERFIELD. *Weeds*, 1964, **12,** (2), 87–92; through *Herbage Abs.*, 1964, **34,** 241.—The water hyacinth (*Eichhornia crassipes*), water soldier (*Pistia stratiotes*) and water fern (*Salvinia rotundifolia*) are all liable to occur, or are capable of occurring, on free water in sugar cane areas and are referred to. The first two were partly controlled and the *Salvinia* eaten readily.

* * *

Required per cent air space for normal growth of sugar cane. F. E. ROBINSON. *Soil Sci.*, 1964, **98,** 206–207; through *Soils and Fertilizers*, 1965, **28,** (1), 89.—In a low humic latosol, air space of 9·2—12·2% (average 11%) of the soil volume allowed normal root development in sugar cane.

* * *

The effect of temperature upon translocation of ^{14}C in sugar cane. C. E. HARTT. *Plant Physiology*, 1965, **40,** (1), 72–81.—This experimental work, carried out from 1956 to 1963 in Hawaii, deals with the effect of temperature of air and roots, regulated separately, on the translocation of radioactive photosynthate (^{14}C), also on the effect of air temperature on translocation in detached blades. It was concluded that the amounts and rates of translocation in sugar cane are affected by the temperature of the air or roots, by light, moisture, and by deficiencies in P, N or K. Air temperature directly affected percentage of ^{14}C photosynthate translocated from the fed blade as well as the percentage moved up or down the stem. It also affected velocity of translocation down the stem. The results from studies of intensity and quality of light, which suggest a photocontrol theory of translocation, are to be reported shortly.

* * *

Queensland cane losses. ANON. *Cane Growers' Quarterly Bull.*, 1965, **28,** (3), 3.—In an editorial the two main causes of losses to growers in the past season (1964) are high-lighted, viz. (1) inability of present mechanical harvesters to operate under saturated soil conditions caused by unseasonable rains and (2) cane deterioration when in a cut-up condition. If effective control measures for the latter cannot be found there may be a resurgence of interest in full-stalk harvesting machines. It is argued that mechanical harvesters should be equipped with suitable tyres and drives by the manufacturers to permit efficient operation on wet soil.

CUBAN CANE HARVEST

THE accompanying illustrations show two pieces of cane harvesting equipment supplied to Cuba by the Soviet Union. Fig. 1 shows a 500-kg capacity PG-0·5 cane loader which has a loading-unloading radius of 2·5 metres and a ground clearance of 3·2 metres. With a work cycle of 1 min 38 sec, it can load up to 14 t.c.h. There are 3500 of these loaders in Cuba and they have completed their second harvest. Fig. 2 shows a KCT-1 cane combine harvester, of which 500 are being used experimentally in Cuba. At a working speed of 1·8 km/h the machine can harvest 24·5 t.c.h., working in rows 1·6 m apart. The speed range is 1·65–2·8 km/h and cane rows 1·6–1·8 m apart can be harvested. The machine has two cutting discs, each with four knife segments. They have a dia. of 690 mm and a forward tilt of 5°, and operate at 696 r.p.m. A 400 mm dia., 1812 r.p.m. centrifugal fan is fitted for trash separation. The harvester has its own hydraulic system and weighs approx. 4·9 metric tons. Both harvester and loader are tractor-mounted on 45–50 h.p. units.

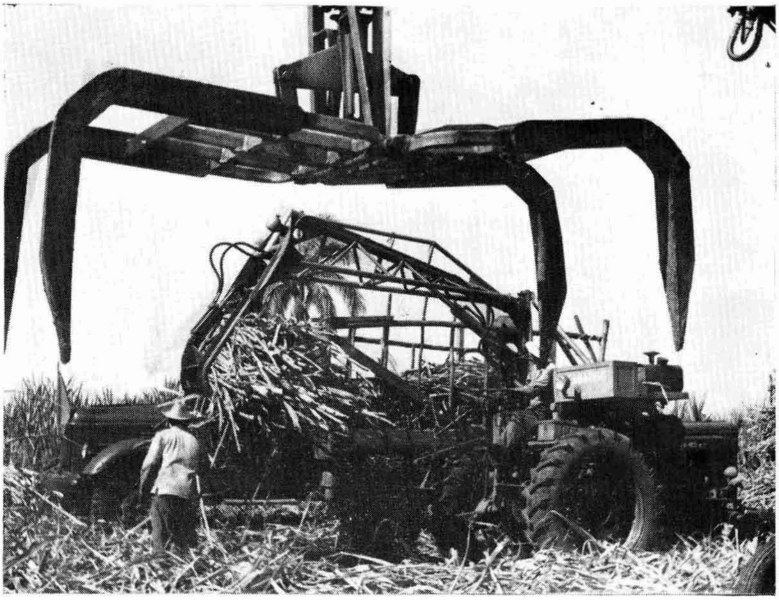


Fig. 1

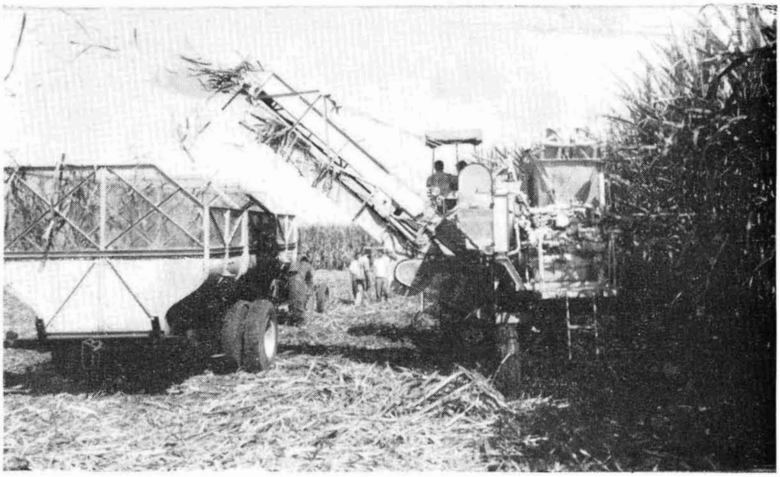


Fig. 2

Cuba has already produced six million tons of sugar this year, the biggest crop since 1959, Prime Minister FIDEL CASTRO announced in Havana on 7th June 1965[1].

In a television broadcast to the nation he said this year's production was 50% higher than two years ago and that Cuba was expected to produce some 40,000 tons more before the harvest ends.

DR. CASTRO disclosed for the first time that last year's sugar harvest was 4,400,000 tons as opposed to the 3,800,000 tons previously estimated by diplomatic sources in Havana.

This year's successful harvest, only surpassed in 1948, 1952 and 1961, is ascribed to mass mobilization of over 60,000 permanent volunteer cane cutters,

[1] *Public Ledger*, 12th June 1965.

early commencement of cutting, better organization and transport facilities, the use of Soviet cane-cutting machinery and a delay in the arrival of the rainy season.

Over two million tons of this year's crop will be exported to the Soviet Union in a barter deal involving oil and other goods. Other socialist countries will also receive large amounts but so far it is not known how much will be put on the world market.

Cuba aims to produce 10 million tons of sugar by 1970.

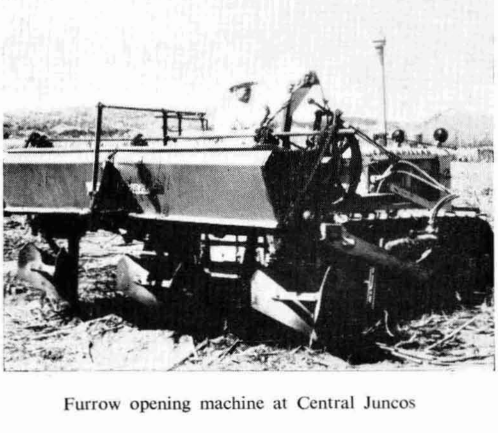
INTERNATIONAL SOCIETY OF SUGAR CANE TECHNOLOGISTS

12th Congress 1965

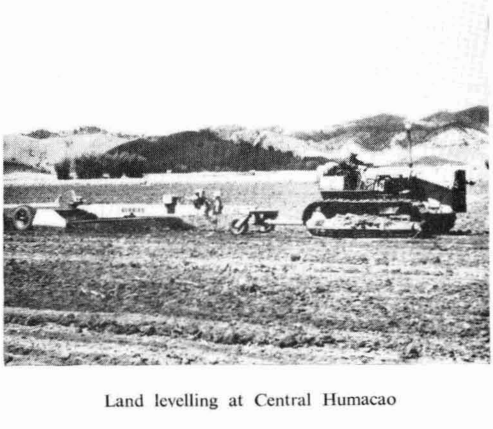
The accompanying photographs were taken during the tours of the field group and are reproduced by kind permission of Dr. L. D. Baver.

Cutting and weighing cane from experimental plots at Puerto Rico Agricultural Experiment Station

Fertilization, filling-up and cultivation at Central Roig



Furrow opening machine at Central Juncos



Land levelling at Central Humacao

Herbicide machine with boom sprayer at Central Juncos

Duncan cut-load harvester at Central Aguirre

POLARIZATION TEMPERATURE CORRECTIONS

By Dr. ROBERT A. M. WILSON
(Central Laboratory, The Colonial Sugar Refining Co. Ltd., Sydney, Australia)

PART I

INTRODUCTION

IN saccharimetry the polarization value of the sugar concerned is expressed in International Sugar Degrees (°S). It is necessary that the polarimeter reading obtained be corrected in such a way that the final result reported is in International Sugar Degrees. The lack of appreciation of this fact has led to much of the confusion and error surrounding the subject of temperature corrections. Although errors in existing corrections are not usually large in magnitude, the reasons for making the corrections are sometimes incorrect. The object of this paper is more to clarify thought on the subject than to correct errors that exist.

The International Commission for Uniform Methods of Sugar Analysis (ICUMSA) definition of the International Sugar Degree (°S) is: "The polarization of the 'NORMAL' pure sucrose solution—26·016 g weighed in vacuo, equivalent to 26·000 g weighed in air with brass weights, dissolved in distilled water *to make 100·00 ml of solution at 20°C,* and *polarized at 20·0°C* in a 200·00 mm tube using white incandescent light and a filter of 6% potassium dichromate solution 15 mm long, or such that the product of percent concentration and length of solution in millimetres equals 90—is the basis of calibration of the 100·00°S point on the International Sugar Scale."

There are two factors in this definition of significance in the present work:

(i) The polarization reading must be corrected to 20°C to give the true polarization in °S of the *solution* under consideration.

(ii) This corrected polarization reading must be corrected further if the solution was not made up at 20°C, and if the true polarization in °S of the *original sample* is desired, because the International Sugar Degree is based on a weight/volume concentration specified at the fixed temperature of 20°C. This correction has nothing to do with the instrument or its reading, and is best kept separate from the first correction.

These two corrections are known as the "polarization reading correction" and the "solution preparation correction" respectively. They are combined in a confusing manner in the traditional equation for correcting pure sugar polarization readings to 20°C:

$$P_{20} = P_T + 0{\cdot}00015S(T_r - 20) + 0{\cdot}00030S(T_r - T_m) \quad \ldots\ldots(1)$$

The equation does not tell us by how much the reading changes when a sugar solution is placed in a polarimeter and the temperature is varied. If the equation is rewritten as:

$$P_{20} = P_T + 0{\cdot}00045S(T_r - 20) - 0{\cdot}00030S(T_m - 20) \quad \ldots\ldots(2)$$

the term $+\,0{\cdot}00045S(T_r - 20)$ is the change in reading when the temperature changes, and the term $-\,0{\cdot}00030S(T_m - 20)$ is the correction applied to the reading to give the polarization which would have been obtained if the solution had been made to the mark at 20°C.

The solution preparation correction applies only when a solution is prepared by a weight/volume method as in the ICUMSA definition of the International Sugar Degree. When a solution is prepared by a weight/weight method, or when a juice is polarized directly, the solution preparation correction is not relevant.

The polarization reading correction can be divided into two: that caused by the effect on polarization, of temperature of the substance being polarized, known as the "substance effect", and that caused by the effect on the polarization of temperature of the saccharimeter, known as the "instrument effect".

These effects broken down into their component parts are listed below:

1. *Polarization Reading Corrections*

(a) Substance Effect

- (i) Quartz Control Plates—Specific Rotation.
- (ii) Sucrose—Specific Rotation.
- (iii) Reducing Sugars—Specific Rotation.
- (iv) Solution Concentration.
- (v) Cell or Tube Length Expansion and Contraction.

(b) Instrument Effect

- (i) Compensator—Specific Rotation.
- (ii) Scale Expansion and Contraction.
- (iii) Quartz-Wedge Expansion and Contraction Perpendicular to the Optical Axis.

2. *Solution Preparation Corrections*

- (i) Solution Concentration.
- (ii) Flask Volume Expansion and Contraction.

Strictly, the cell or tube length expansion and contraction is an instrument effect, but it is included as a substance effect because, like all other factors in this group, the relevant temperature is T_r, the temperature of the solution at the moment of reading.

For instrument effect factors, the relevant temperature is T_p, the temperature of the polarimeter.

For the solution preparation correction factors, the relevant temperature is T_m, the temperature of the solution when made to the mark.

INDIVIDUAL FACTORS AFFECTING SACCHARIMETRY TEMPERATURE CORRECTIONS

1. *Polarization Reading Corrections*

(a) *Substance Effect*

(i) *Quartz Control Plates—Specific Rotation*

The effect of temperature on the specific rotation of quartz is quoted by BATES *et al.*[1]. The correction is proportional to the polarization, the correction coefficient is negative, and a correction equation derived using BATES' coefficient is:

$$P_{20} = P_T - 0{\cdot}000143\ P_{20}\ (T_r - 20) \quad \ldots\ldots\ldots\ldots (3)$$

(ii) *Sucrose—Specific Rotation*

The effect of temperature on the specific rotation of sucrose is quoted by BATES, and by BROWNE & ZERBAN[2], taken from original detailed work by SCHÖNROCK[3]. As the temperature increases the rotation decreases, and so the correction coefficient is positive. The coefficient is independent of wavelength of the light source between 5400A and 5900A, but it is dependent upon temperature. The correction is proportional to the sucrose content, and a correction equation derived using the coefficient is:

$$P_{20} = P_T + [0{\cdot}000184 - 0{\cdot}0000063(T_r - 20)]NS(T_r - 20) \quad \ldots\ldots (4)$$

(iii) *Reducing Sugars—Specific Rotation*

The effect of temperature on the specific rotation of reducing sugars is quoted by BROWNE & ZERBAN[4] and by HORNE[5]. The specific rotation of glucose scarcely alters over a wide range of temperature, and so the correction coefficient for reducing sugars, assumed to be 50% glucose and 50% fructose, is half that of fructose, and is negative.

The correction is proportional to the reducing sugar content, and a correction equation using the reducing sugar coefficient is:

$$P_{20} = P_T - 0{\cdot}004\ NR(T_r - 20) \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The coefficient $-0{\cdot}004$ need not be quoted more accurately, because for substances low in reducing sugars the correction is small, and for substances high in reducing sugars an accurate correction is not usually required.

(iv) *Solution Concentration*

The temperature coefficient of volume expansion of a sucrose solution is quoted by BROWNE & ZERBAN[6] from the original work by SCHÖNROCK[7]. Because the amount of volume expansion depends largely on the amount of water present, and only to a slight extent on the amount of dissolved substance, and because the densities of reducing sugar solutions are similar to those of sucrose solutions of the same concentrations, it is assumed that the coefficient of volume expansion is the same for all types of sugar solutions. As the temperature increases, the volume increases, the concentration decreases and the polarization decreases. The temperature correction coefficient is therefore equal in magnitude to the volume expansion coefficient, and is positive.

The coefficient is both temperature and concentration dependent, but for $90 \leqslant NS \leqslant 100$ and $-15°C \leqslant (T_r - 20) \leqslant 15°C$, a suitable correction equation is closely approximated by:

[1] "Polarimetry, Saccharimetry and the Sugars", *Nat. Bureau Standards Circular*, 1942, (C440), 92.
[2] "Sugar Analysis", 3rd Edn. (Wiley, New York) 1941, p. 271.
[3] *Zeitsch. Ver. Deutsch. Zucker-Ind.*, 1903, **53**, 650.
[4] "Sugar Analysis", 3rd Edn. (Wiley, New York) 1941, p. 396.
[5] *Ind. Eng. Chem.*, 1909, **1**, 567; *Facts about Sugar*, 1912, **7**, 53.
[6] "Sugar Analysis", 3rd Edn. (Wiley, New York) 1941, p. 51.
[7] *Zeitsch. Ver. Deutsch. Zucker-Ind.*, 1900, **50**, 419.

$$P_{20} = P_T + [0{\cdot}00029 + 0{\cdot}0000066\,(T_r - 20)]\,P_{20}(T_r - 20) \quad \ldots.(6)$$

(v) *Cell or Tube Length Expansion and Contraction*

An increase in temperature causes the polarization cell to expand, thereby increasing the polarization. The correction coefficient is therefore negative, and is equal in magnitude to the coefficient of linear expansion of the cell material. Correction equations are:

$$P_{20} = P_T - 0{\cdot}000008\,P_{20}(T_r - 20) \text{ for glass cells or tubes} \quad \ldots(7)$$

$$P_{20} = P_T - 0{\cdot}000017\,P_{20}(T_r - 20) \text{ for stainless steel cells} \quad \ldots(8)$$

More accurate estimates of the coefficients are not necessary because this correction is relatively small.

(b) *Instrument Effect*

(i) *Compensator—Specific Rotation*

For instruments using a rotating polarizer or analyser for compensation, temperature has no effect upon the compensator. For a quartz-wedge saccharimeter, the specific rotation of the compensator is equal to that of the wedge, and the correction coefficient is given by BATES[1]. The coefficient is the same as that for quartz plates, but of opposite sign. A correction equation using BATES' coefficient is approximately:

$$P_{20} = P_T + 0{\cdot}000143\,P_{20}(T_p - 20) \quad \ldots(9)$$

For all types of polarimeters and saccharimeters, the compensator correction equation may be written as:

$$P_{20} = P_T + 0{\cdot}000143\,\eta\,P_{20}(T_p - 20) \quad \ldots(10)$$

where $\eta = 1$ for quartz-wedge saccharimeters, and $\eta = 0$ for other polarimeters and saccharimeters.

(ii) *Scale Expansion and Contraction*

For automatic polarimeters with recorded or digital displays and for visual polarimeters with circular scales, temperature has no effect upon the readout or the scales. For quartz-wedge saccharimeters, which use linear scales, if the temperature increases, the scale increases in length and the measured value is reduced. The correction coefficient is equal in magnitude to that of the scale material, and is positive.

A correction equation using the coefficient for a glass scale is approximately:

$$P_{20} = P_T + 0{\cdot}000008\,P_{20}(T_p - 20) \quad \ldots(11)$$

For all types of polarimeters the correction equation for a glass scale is:

$$P_{20} = P_T + 0{\cdot}000008\,\eta\,P_{20}(T_p - 20) \quad \ldots(12)$$

And for a metal scale the equation is approximately:

$$P_{20} = P_T + 0{\cdot}000018\,\eta\,P_{20}(T_p - 20) \quad \ldots(13)$$

The coefficients need not be quoted more accurately because the scale expansion correction is relatively small.

(iii) *Quartz Wedge Expansion and Contraction Perpendicular to the Optical Axis*

When the temperature increases, the quartz wedge expands perpendicular to the optical axis. The resultant changed thickness of quartz in the light path causes an increase in polarization reading. The correction coefficient is numerically the same as the coefficient of linear expansion of quartz, and is negative. A correction equation using this coefficient is:

$$P_{20} = P_T - 0{\cdot}000013\,P_{20}(T_p - 20) \quad \ldots(14)$$

As this correction applies only to quartz-wedge saccharimeters, the equation for all types of polarimeters is:

$$P_{20} = P_T - 0{\cdot}000013\,\eta\,P_{20}(T_p - 20) \quad \ldots(15)$$

Expansion of the wedges parallel to the optical axis does not alter the amount of quartz in the light path, and hence there is no correction for this effect.

2. *Solution Preparation Corrections*

(i) *Solution Concentrations*

When making up a sugar solution volumetrically a fixed weight/volume concentration at the temperature of making to the mark is obtained. This is different from the weight/volume concentration at 20°C because of solution expansion. Therefore a correction for the temperature of making to the mark must be made to obtain the true polarization of the *original material.*

The temperature coefficient of volume expansion of a sucrose solution is quoted by BROWNE & ZERBAN[6] and by SCHÖNROCK[7], and has been discussed in 1 (a) (iv) above. The polarization correction coefficient is numerically equal to the volume expansion coefficient, and is negative. When $90 \leqslant NS \leqslant 100$ and $-15°C \leqslant (T_m - 20) \leqslant 15°C$ a suitable correction equation is approximately:

$$P_{20} = P_T - [0{\cdot}000{,}29 + 0{\cdot}0000066(T_m - 20)]P_{20}(T_m - 20) \quad \ldots.(16)$$

(ii) *Flask Volume Expansion and Contraction*

If the temperature increases, the flask expands, more water is required to make the solution to the mark, and the polarization is decreased. The correction coefficient is therefore positive and is numerically equal to the coefficient of volume expansion of the flask, i.e. of glass. For flasks normally used in sugar analysis the coefficient is 0·000025. A more precise estimate of the coefficient is not necessary, as this correction is small.

The following correction equation is derived:

$$P_{20} = P_T + 0{\cdot}000025\,P_{20}(T_m - 20) \quad \ldots(17)$$

(To be continued)

GLC EXAMINATION OF MOLASSES CARBOHYDRATES

By H. G. WALKER, JR.
(Western Regional Research Laboratory[1], Albany 10, California)

Presented in part at the 13th national meeting of the American Society of Sugar Beet Technology, February, 1964, and the 148th national meeting of the American Chemical Society, September 1964.

FOR some time we have been interested in the use of gas liquid chromatography (GLC)[2,3] to simplify the analysis of non-sucrose carbohydrates in molasses samples. Although the carbohydrates themselves are not volatile enough for direct GLC separation, they can be converted to volatile derivatives. We wish to report some preliminary results in this field in the hope that others in the sugar industry may be encouraged to apply this new technique to carbohydrate analysis. The GLC separations described here are not the ultimate obtainable—improvements in instrumentation and technique should eventually provide better results.

Carbohydrate sample preparation

To avoid undue complication of the carbohydrate GLC results, ion exchange was used to separate the molasses non-sugars from the sugars. Purification consisted of passing a diluted molasses solution (25% solids) through a strong cation exchanger (H^+ form) at 0°C, followed by immediate passage through a two-layered bed consisting of weak anion resin (OH^- form) and strong anion resin (CO_3^{--} form) at room temperature. The resulting neutral carbohydrate solution was evaporated at reduced pressure and lyophilized to give an amorphous powder readily soluble in pyridine. Model experiments with sucrose-sodium chloride solutions indicated it was necessary to hold the cation column at 0°C to avoid inversion during treatment.

Thin layer chromatograms of molasses samples before and after low-temperature ion exchange showed no qualitative change in carbohydrate composition.

GLC sample preparation

Initial GLC studies on molasses carbohydrates were carried out on completely methylated derivatives prepared by the method of KUHN *et al.*[4] (methylation in dimethyl formamide with methyl iodide and silver oxide). Although this reaction gives good yields of completely methylated sugars, small amounts of incompletely methylated materials are also formed and interfere with the interpretation of GLC analysis. In 1963, SWEELEY *et al.* reported a simple, quantitative preparation of trimethyl silyl (TMS) derivatives of carbohydrates[5]. Our investigation of this reaction by infra-red and proton magnetic resonance spectrometric analysis showed that the quantities of products are close enough to the original quantities of reactants for analytical purposes, and we have since worked exclusively with TMS derivatives.

In the original report[5], 10 mg of carbohydrate was dissolved in 1 ml of dry pyridine at room temperature, and 0·2 ml of hexamethyldisilazane and 0·1 ml of trimethylchlorosilane added as trimethylsilylating agents. After the solution had been allowed to stand 5 minutes at room temperature, an aliquot of the reaction mixture was injected directly into the GLC apparatus for analysis. We vary this procedure by evaporating the pyridine at reduced pressure, triturating the residue in CCl_4, filtering through a sintered glass funnel and, finally, evaporating most of the CCl_4. During evaporation the flask containing the TMS derivative must be protected from moisture to prevent hydrolysis. These additional operations require little time, and the residue contains no solid material to foul the GLC column. Residual CCl_4 improves the storage stability of samples in stoppered containers.

GLC Instrumentation

An "Aerograph 350B"*, equipped with dual columns and thermal conductivity detectors[6], was used for this study. Coiled aluminium columns, $\frac{1}{8}$ in. o.d. × 5 ft long packed with 5% SE-30[7] on 60–80 mesh "Chromosorb W", HMDS-treated[8], were used for the separations. Flow rate of the helium carrier gas was 27 ml/minute. Injector and detector temperatures were maintained at 300°C and column temperature was programmed linearly from 160° to 275–285°C at 6°C/minute. Filament current was 210 mA, and signals were recorded on a 1 mV recorder.

Results and Discussion

Fig. 1 shows the strip chart obtained from a mixture of approximately equal weights of TMS fructose, glucose, inositol, sucrose, galactinol, and raffinose. Initial peaks during the first minute are solvent and silylating reagents. The series of peaks at 187°, 190°, 193° and 201°C are the anomeric and isomeric forms of glucose and fructose—the 187° peak is associated mainly with fructose and the 201° peak with glucose. The reducing sugars were not completely mutarotated to equilibrium in this experiment

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[1] A laboratory of the Western Utilization Research and Development Division, Agricultural Research Service, U.S. Department of Agriculture.
[2] BISHOP: "Methods of Biochemical Analysis", Vol. 10. (Interscience Publishers Inc., New York.) Ed. D. GLICK. 1962, p. 1.
[3] GEE & WALKER: *Anal. Chem.*, 1962, **34**, 650.
[4] *Angew. Chem.*, 1955, **67**, 32.
[5] *J. Amer. Chem. Soc.*, 1963, **85**, 2497.
* Reference to a company or product name does not imply approval or recommendation of the product by the U.S. Department of Agriculture to the exclusion of others that may be suitable.
[6] Wilkens Instrument and Research Co., Inc., Walnut Creek, Calif., U.S.A.
[7] Dow Corning Corp., Midland, Mich., U.S.A.
[8] Johns-Manville International Corp., New York., N.Y., U.S.A.

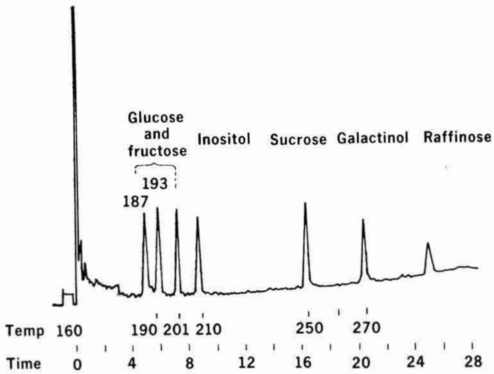

Fig. 1

Fig. 1. GLC separation of TMS derivatives of glucose, fructose, inositol, sucrose, galactinol, and raffinose. Temperature, °C; time, minutes.

as they are in molasses. The 210° peak is inositol, the 250° peak sucrose, the 270° peak galactinol, and the last peak raffinose (not numbered because the temperature programme stopped at 275°C, and the temperature remained there until the peak emerged). The last four sugars give single peaks because they are all non-reducing. Either the emergence temperature or emergence time of a particular compound is fairly constant if starting temperature and programme rate are reproduced carefully. Either of these values has about the same significance as an R_f in paper or thin layer chromatography and may be used for characterization after suitable identification of the peak by comparison with known standard, etc. The figure shows that the TMS derivatives of these beet molasses carbohydrates separate readily in less than half an hour. From peak area measurements and a knowledge of the composition of the synthetic mixture, it can be shown that detector response is about the same for inositol, sucrose, galactinol, and raffinose and about twice as great for fructose and glucose.

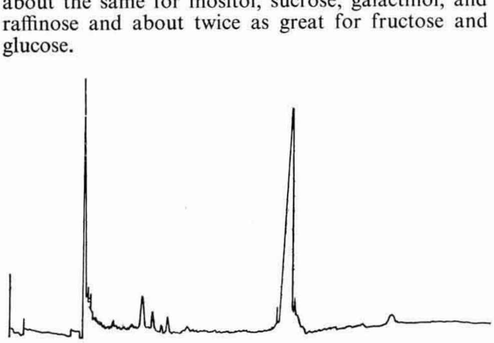

Fig. 2

Fig. 2. GLC separation of TMS carbohydrates from a typical sugar beet molasses. Time and temperature scales same as Fig. 1.

Fig. 2 shows the chart of an actual beet molasses sample run in the standard manner. Reducing sugar peaks appear first, followed by a very small inositol peak. The sucrose peak appears at 255° instead of 250° because of its large size. This peak has been attenuated to $\frac{1}{4}$ of its actual size in order to keep it on the chart paper. The sample shows negligible galactinol in the 270° region. The apparent peak at 285° is due to the change from programmed to isothermal operation; raffinose appears about 1-$1\frac{1}{4}$ minutes after this change. From thin layer chromatography we know that kestoses are present in this sample, but no peak for them appears on the strip chart. By working with standards, we found that the kestoses do not separate from raffinose under the described GLC conditions. Fig. 2 emphasizes another difficulty common to most analytical procedures for molasses carbohydrates—so much sucrose is present that exact measurement of minor constituents on a sucrose basis is almost impossible in a single determination. Because of the attenuation required to keep the sucrose peak on-scale, the apparent sucrose area requires a correction factor.

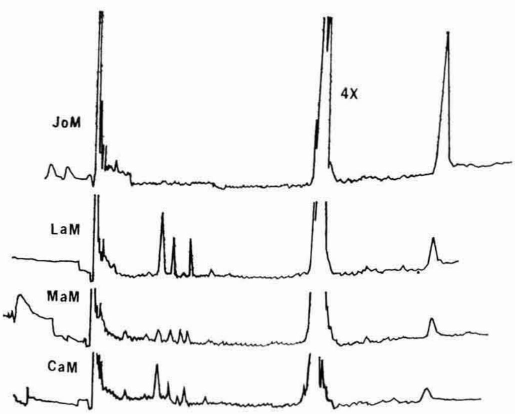

Fig. 3

Fig. 3. Composite chart of GLC separation of TMS carbohydrates in 4 different beet molasses samples. Time and temperature scales same as Fig. 1.

Fig. 3 shows four different beet molasses samples run under identical conditions. The qualitative similarity of the four is striking—only semi-quantitative differences appear. The JoM sample shows negligible reducing sugar and a high raffinose and kestose content as would be expected from a barium saccharate molasses. The LaM sample shows relatively high reducing sugar and raffinose and kestoses because the sample came from an intermountain factory operating with an ion-exchange purification process. The MaM and CaM samples are from California factories. Minor differences in the reducing sugar, inositol, and galactinol content can be seen. The sucrose attenuation problem and the failure to separate kestoses from raffinose make further quantitative interpretation fruitless.

Fig. 4 shows the result of a run on the carbohydrates in a cane molasses sample. In this simpler case, only reducing sugar and sucrose are present in appreciable amounts. Quantitative measurement would be feasible because all peaks are recorded at the same attenuation.

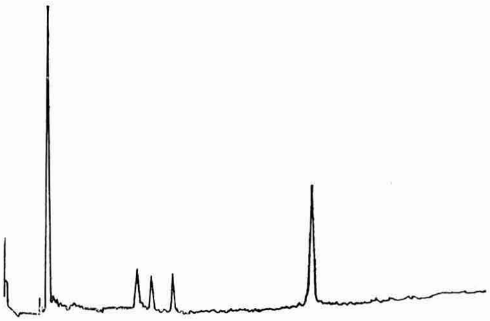

Fig. 4

Fig. 4. GLC separation of TMS carbohydrates from cane molasses. Time and temperature scales same as Fig. 1.

The failure to separate kestoses from raffinose is a serious defect of the GLC method, especially since both paper and thin layer chromatography can resolve them. The GLC separation of the TMS derivatives of a trisaccharide mixture composed of raffinose (galactosyl sucrose), melezitose (glucosyl sucrose), and manninotriose (galactosyl melibiose) is simple under the described conditions—even the anomeric α and β anomers of manninotriose separate somewhat. Why the kestoses (fructosyl sucroses) cannot be separated from each other or from raffinose is puzzling and regrettable.

We have devoted considerable effort to separating kestoses from raffinose by GLC. A variety of polar, slightly polar, and non-polar liquid phases have been investigated. The high temperature required to volatilize TMS trisaccharides breaks down most polar phases. No combination of silicone polymer (non-polar) mixed with a small amount of polyester or polyamide type liquid phase gave useful results. The only separation of kestoses from raffinose achieved to date has been with a 15-ft column with a liquid phase of fluorinated silicone polymer (QF-1)[7] at 250°C. Peak shape is not good. The amount of distortion depends on the quantitative composition of the mixture to be separated, hence quantitative measurements are not reliable at present. 250°C is at, or above, the thermal tolerance of QF-1, so that column stability and bleed become problems.

Work on GLC of the TMS derivatives of beet molasses carbohydrates will continue with more sensitive GLC equipment. At the present time the results are encouraging, but more developmental work is desirable.

DALTON—SOUTH AFRICA'S FIRST MILLING DIFFUSION SUGAR FACTORY

By W. R. BUCK

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PART I

Introduction

THE title of this paper refers strictly to the first new sugar factory in South Africa basically designed to operate the milling-diffusion process. In other words, it is not an existing factory to which a diffuser has been added to handle part of the throughput, or for experimental purposes.

The history of cane diffusion in Natal has been most ably covered in the current (December 1964) issue of *The Condenser*, the annual house magazine of The Tongaat Sugar Company. Mention is made of the Raabe continuous diffuser supplied by Duncan Stewart & Co. Ltd. for Tinley Manor factory in 1927. The diffuser was of the cylindrical variety, divided into 22 equal chambers, the whole being inclined at 4° to the horizontal. The prepared cane entered at the lower end, meeting the draught water introduced at the other, higher end. Each compartment wall consisted of slotted brass screens which held the cane sufficiently long for the juice to penetrate through. It was then wiped off by the wiping arms carried on a central shaft and deposited into the succeeding compartment and so on. There were no fewer than 604 "lifting arms" ("comb-arms" and "wiper arms") arranged spirally in the diffuser, which was directly adapted from the ten Raabe units built and supplied to five beet sugar factories in Britain. One was still operating there quite recently. For that purpose they were quite satisfactory, but working with cane the apparatus did not receive a fair chance owing to poor cane preparation, local prejudice and other difficulties and the project was abandoned. The diffuser, of no mean size—11 ft diameter by 84 ft long—ended its days as scrap.

This was unfortunate and little more effective efforts were made until that South African champion of cane diffusion, Mr. R. SAVILLE, commenced his experiments many years ago, culminating in the forthcoming installation of an immersion type diffuser at his Entumeni factory. It will be extremely interesting to compare the performance of both the Dalton and the Entumeni installations once they are each working normally.

Location of Factory

The new factory is being erected at Dalton in the midlands of Natal, some 85 miles from Durban and 35 miles from Pietermaritzburg, and will be operated by a co-operative concern, of which most of the members are either cane or wattle farmers, or both. Thus, it will become South Africa's second co-operative sugar factory and, like Umfolozi, does not undertake the growing of cane for its own account.

Siting of Plant

The plant is unique in that it is believed to be the first sugar factory-cum-wattle extract plant. It adjoins the company's wattle extract factory and the terms of reference for its establishment stipulated that the maximum use be made of the existing wattle extract plant and machinery, where this was suitable.

In practice, it was decided very early in the project that it was not a proposition to utilize the autoclaves —corresponding to batch type diffuser cells—of the wattle plant, nor its evaporators and "finishers" or vacuum pans. Apart from handling difficulties, their capacity was small, so that further extraction plant, mills or milling diffusion would have been necessary anyhow, in order to operate the factory at an economical crushing rate.

However, the factory water-tube boilers and power house have been utilized, with suitable additions and although certain other adjuncts will serve both manufacturing purposes, the milling-diffusion house and the boiling house are completely new buildings.

Despite this, the part dual nature of the factory has resulted in the overall estimate of capital cost for the whole project not exceeding R2¼ million (£1,125,000). No secondhand plant is installed with exception of the two dewatering mills following the diffuser, described later.

Simultaneous operation of both plants is not envisaged at present, since most of the wattle extract production season lies conveniently outside the normal cane crushing season.

Moreland Technical & Engineering Consultants Ltd. of Durban are responsible for the entire specification, design, tendering, purchase and commissioning of the new sugar factory, as they have been for several others. The contract for the main cane carrier, cane knives, first mill and complete diffusion plant was awarded to BMA of Braunschweig, Germany.

Contracts covering all factory steelwork, the cane feeder table, quadruple-effect evaporator, juice heaters, vacuum pans, crystallizers, all tanks and pipework have been awarded to Dorman Long (Africa) Ltd. of Durban, and all items are of local manufacture. This concern is also the main erection contractor.

Description of Factory and Process

Provision has been made in the yard, sidings and cane gantry layouts for receipt of cane by road and rail. All buildings and equipment have been sized or designed so that the throughput can be readily doubled from the initial crushing rate of 60 t.c.h. to 120 t.c.h. For example, the cane gantry is 205 ft long by 80 ft span and is equipped with a 10-ton cane grab crane, which outfit is easily capable of handling the cane from both road and rail vehicles in order to unload and store sufficient cane to ensure an eventual throughput of about 3000 tons per 24 hours, with the addition of a Hilo unloading carrier.

Cane will be unloaded by grab on to a cross carrier or feeder of 20 ft width by 40 ft length, discharging directly into the 72 in main cane carrier, which is 128 ft long (centres).

The cane carrier follows modern practice in that no part of it is accommodated in any insanitary under-ground pit. These pits invariably become flooded at some stage apart from other objections to them. Where possible, pits have been avoided throughout the factory as being sources of inversion due to flooding and fermentation of the trash which always finds its way into them.

Similarly, every effort has been made, where possible, to avoid the underground installation of pipes, cables and other services.

There are two sets of cane knives, each close-pitched, the first being driven by a 275 h.p. motor. The second knives are driven by a 350 h.p. motor. The knives are included in the diffuser supply so that cane preparation conforms to the makers' strict requirements.

The carrier feeds directly to the first or preparation mill, a turbo-driven 72 in by 36 in unit. No shredder is employed.

The prototype of the diffuser installed operated successfully on high tonnages in Egypt for three complete seasons, producing excellent results and with the minimum of down time due to breakdowns or processing difficulties. There, over 60% of the juice was expressed by this first mill, but the nature of Natal cane varying so much from that of Egypt, it may well be that this figure will not be much over 50%. Accordingly, and as a prudent measure, it was decided to extend the diffuser by adding two compartments so that there are now nine.

Diffuser

The basic construction and operation of this unit are clearly illustrated in Fig. 1.

The overall length of the diffuser is 93 ft 6 in. It is 7 ft 3 in in width and 19 ft 9 in high.

The length of the complete milling diffusion plant from cane carrier tail shaft to centre line of bagasse conveyor below the second dewatering mill is 305 ft 6 in, which necessitated a mill house 275 ft in length.

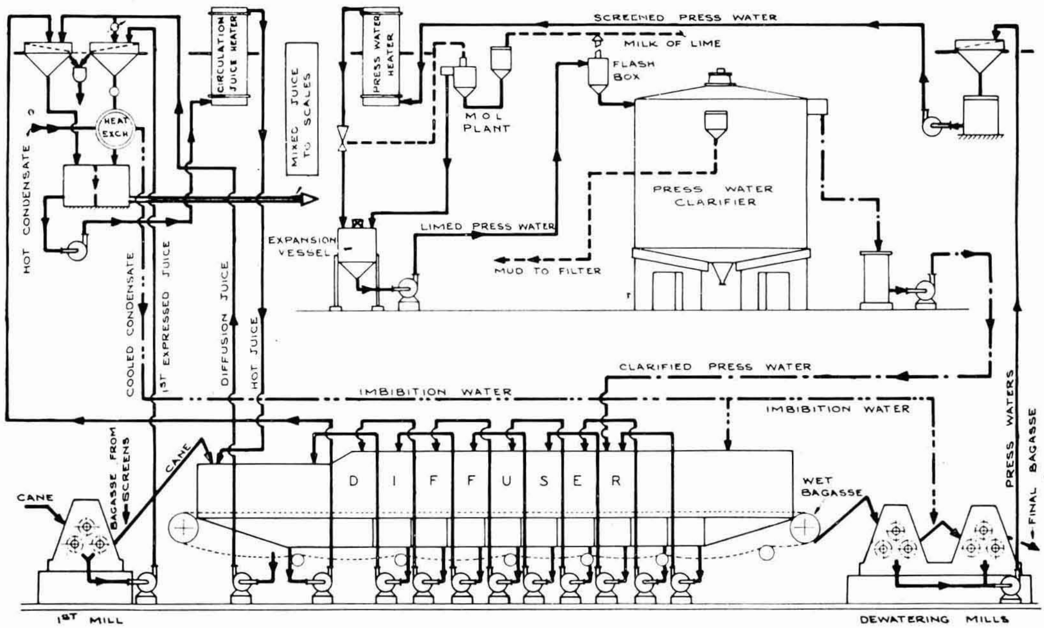


Fig. 1

This was unavoidable because, owing to the limitations of the site, the mill house width could not exceed 60 ft so that the diffuser could not be located parallel to the mills.

The initial quantity of juice removed by the first mill is not treated in the diffuser, but is pumped to the juice scales in the normal manner, via a heat exchanger. It is the remainder of the juice content of the cane which is subject to extraction by milling-diffusion.

Reference to Fig. 1 makes the action within the diffuser quite clear. The diffusion time is about 24 minutes, but the retention time of the cane within the diffuser is about 40 minutes on average. The draught water—corresponding to the imbibition water of the normal milling tandem—amounts to 250% on fibre on an assumed basis of 14% fibre content on cane (or 35% on cane).

Critics of cane diffusion often aver that the amount of draught water employed is excessive, involving heavy steam consumption at the evaporators. It is difficult to appreciate this common criticism because, in the home of the diffusion process, the beet sugar industry, the average draught water can hardly be described as excessive, although it is generally higher than our corresponding imbibition rates.

To refute this constantly repeated criticism, it is pertinent to point out that in Natal, as in many other sugar producing countries, e.g. Australia, the imbibition water % fibre in cane, is often considerably higher than the amount of draught water % fibre applied in the milling-diffusion process under review. For example, the Natal average imbibition rate % fibre in cane was 258 for the season 1963/4, one factory averaging 372%. These figures have occurred without undue use of additional fuel because of the increased amount of water to be evaporated from the juice. Therefore the alleged excessive use of water by the cane diffusion process can be dismissed as having no foundation in fact, at least in those processes in successful use at the present time.

All the calculations, including the heat balances produced, used a presumed average fibre content of cane of 14%. Although it is known that much of the cane grown in this area contains somewhat more fibre, it was considered prudent to use this figure, particularly as no regular analyses of fibre content of cane from the Dalton area are, or need be, carried out by the factories at present handling this cane.

Hence, employing this figure, the amount of mixed juice to the scale will be 132,000 lb/hr at 60 t.c.h., equivalent to only 110% on cane weight.

The design and construction of the diffuser are relatively simple and are not based upon that of some contemporary sugar beet diffuser. Mild steel is used entirely for the body of the diffuser and for the screens, there being no necessity to employ stainless steel or brass, unlike some contemporary designs.

The screens are perforated with conical holes of a mean diameter of 9 mm. These screens do not become clogged in use and chokeless pumps are used throughout.

Various guarantees are embodied in the diffuser supply contract, involving penalties for their non-fulfilment. Subject to certain contingencies, the extraction will be such that not more than 1·8% sucrose will remain in the residual bagasse, which may vary from 50% to 53% moisture content, depending upon fibre content and milling-diffusion performance.

There is every reasonable expectation of achieving the 1·8% (or less) sucrose in bagasse and, under the conditions of sale of sugar and purchase of cane in this country, any increase in extraction which can be obtained over and above the present average % sucrose in bagasse for Natal, is of direct financial advantage to the miller.

Particularly is this advantage attractive if it can be attained by avoiding the tremendous expense entailed nowadays in the purchase of a milling tandem comprising at least a shredder and six mills. True, one factory in Natal does manage to obtain a very creditable extraction of 95·2%, and only 1·9% sucrose in bagasse. However, this target is only achieved by an expensive installation, requiring some 4750 total h.p. in the form of steam turbines for the drives aided by the application of imbibition water to the extent of 371% on fibre.

There are instances of other factories achieving over 94% extraction, some of which also burn additional fuel, which of course could be purely coincidental.

Many other factories find that they are burning additional fuel in order to justify high imbibition water and extraction rates and obviously, in many of these cases a balance must be struck, a point arrived at where it is no longer justifiable to obtain a few decimal points of extra extraction at the cost of an additional fuel bill and no surplus bagasse on hand for emergencies.

This fact was realised long ago in Cuba and the West Indies generally, where there was no cheap coal available and the price of fuel oil (other than in Trinidad) soared to £9 per ton shortly after the last war, so that although scores of factories employed a shredder and seven mills, none attempted to improve extraction by various means to the extent that they were compelled to burn additional fuel to justify this achievement. Consequently, their extraction rarely exceeds 94% with average sucrose at 6·29% bagasse (Cuba excepted).

The diffuser manufacturers carried out experiments with a tower type diffuser at one of the Caroni Ltd. factories in Trinidad in recent years, in order to improve upon this position, but the results were not encouraging. Caroni, having spent a good deal of money on abortive batch-type diffusion systems in the past, were not deterred, but there is no record of any recent development there. However, the method of milling-diffusion to be employed at Dalton has already been well proven elsewhere and is being installed with every confidence in its performance.

The unit is arranged to commence operations by being fed with cane at 60 t.c.h. Subsequently, it can be readily increased to the optimum rate of 120 t.c.h. and it is of interest as to how this is achieved. Within the diffuser proper, the conveyor chains are speeded up, the thick blanket of bagasse naturally increases in depth and quantity and the amount of juice circulated by the pumps (see Fig. 1) is correspondingly increased.

This is attained by employing a diffuser, eventually capable of the desired 120 t.c.h. It is not possible to design this type of diffuser for 60 t.c.h. fixed capacity and subsequently to double this figure to 120 t.c.h., without installing a second such diffuser. Hence an efficient compromise was evolved whereby, although the diffuser has the final size and capacity for 120 t.c.h., it arrives on the site equipped to handle 75+ t.c.h. and commencing—with no disadvantage—at 60 t.c.h.

Steady feed is of the utmost importance so that the whole cane feeding and milling-diffusion stations are controlled from one platform using remote controls. Carrier speed and the speed of the diffuser are controlled by fluid drive torque converter.

The chokeless juice circulating pumps are fitted with impellers sized for their initial duty and these can be replaced by larger ones as the need arises, in two stages, if necessary.

Regarding the juice and recirculation heaters, the suppliers' proposal was that the optimum size heaters be installed with certain of the tubes removed or blanked off, for the earlier stages. This suggestion was firmly resisted and the heaters will be replaced or duplicated as necessary.

The cane is rather coarsely prepared, or would appear to be so to most of us, accustomed as we are to finely shredded cane. However, because of the close pitched cane knives, very few long pieces of cane appear to pass the first mill.

After the initial juice extraction at the first mill, the cane is carried along horizontally in the form of a continuous thick mat, averaging 5 ft deep at 60 t.c.h., over the perforated steel screens previously mentioned.

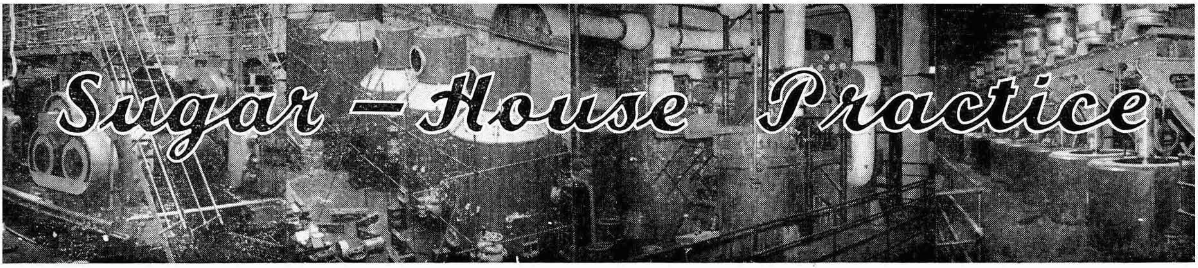
Each of the nine compartments is so screened, with juice collecting hoppers below. The juice, containing a considerable proportion of fine particles of cane in suspension, is removed by means of chokeless pumps and passed through the recirculation juice heater.

It is recirculated by being discharged onto the top of the thick mat of bagasse above the chamber prior to that from which it was collected. The recirculated juice percolates down through the cane mat again, removing more sucrose on the way, largely by the process of lixiviation, but partly and only where the cells of the cane are not ruptured, by true diffusion, that is by osmosis and dialysis. Although this last process only yields a very small proportion of the available sucrose, it is contended that, nevertheless, this proportion is higher than when the cane is subjected to shredding in addition to the usual preparation.

The thick mat (it would be considerably thicker at 120 t.c.h.) is carried slowly through the length of the diffuser by the chain and slat conveyor and it will be readily seen that the process is both simple and continuous.

No elaborate thrower or bagasse extraction device is necessary where the bagasse leaves the diffuser, since the lower run of the conveyor chain passes beneath the diffuser shell where, in its slow passage, it is visible and accessible for inspection and repair or adjustment. One set of chains operated for three seasons in Egypt with only very minor replacements and no down time whatsoever due to chain failure or repair.

(To be continued)



Installation of measuring and control instruments. F. LE GUEN. *Rev. Agric. Sucr.* (Mauritius), 1964, **43,** 313.—In view of the expense of instruments for measurement and control, it is important that they be installed properly, and calibrated and maintained at sufficiently frequent intervals for them to be of use in process control. Aspects of such treatment are discussed.

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The Guimaras bulk (sugar) and molasses installation. ANON. *Sugarland* (Philippines), 1964, **1,** (9), 44–45. A description is given of the facilities for bulk storage and handling of sugar and molasses at the Guimaras terminal. The three warehouses hold a total of 73,500 tons of sugar and can be supplied at 300 t.p.h. and emptied at 500 t.p.h. using Stephens-Adamson belt conveyors, bucket elevators and trimmers. Sugar is supplied from barges which are unloaded using grabs. Molasses is pumped from barges into tanks which hold a total of 35,000 tons from which it can be loaded into tankers through a 14-inch pipeline at 300 tons/hr.

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Colouring matter balance in sugar refining. V. SÁZAVSKÝ. *Zeitsch. Zuckerind.*, 1964, **89,** 678–679. A scheme for drawing up a balance of colouring matter in the refinery is described with the aid of a worked example, in which the colour of the various products is expressed in terms of fuscacinic acid. While this is not a definite chemical compound, the colour intensity of a solution of the substance (1 mg/100 ml) has an approximate value of 1°St. The results of studies made by BURIÁNEK[1] of coloration in refining are discussed. An increase of 148% in colour content calculated by the proposed method in the boiling of *B* and *C*-massecuites agrees with the findings of BURIÁNEK, who, apart from blaming boiling of low-purity massecuites for most of the colour increase, also found that much more colour is formed in refining than is introduced with remelt sugar or thick juice, and that the amount of colour removed by treatment of remelt liquors is negligible in relation to the additional amount of colour formed. It is considered preferable in a colour balance to relate the colour content to the non-sugars or, better still, to the ash content. The major argument for this is that it is not necessary to determine the quantities of the various products but merely to base the balance on laboratory determinations. In the boiling of massecuites, the colour increase is influenced by three factors: boiling temperature, boiling time and pH of the feed. Tests at a white sugar factory have shown that thick juice obtained from thin juice concentrated at pH 7 was much clearer and the colour increase in the *A*-massecuite from this was reduced to $33\frac{1}{3}$%. The crystal colour was also improved. The process[2] was to be tested in the 1964/65 campaign.

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Improvements in clarifier mud filtration. E. R. VRABLIK and D. A. DAHLSTROM. *Bol. Azuc. Mex.*, 1964, (183), 12–20.—A description is given of the principles and design of the rotary belt type of filter[3] with an account of operations in Florida, Louisiana and a beet sugar factory, the results achieved being illustrated with graphs.

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Power generators—South Africa's experience. V. V. N. POUGNET. *Sugar y Azúcar*, 1964, **59,** (12), 33–34.—A brief account with illustrations is given of recent installations by the author's company in Central and South Africa. Generators tend to be of the brushless type for reduced maintenance, with automatic voltage control. The AEI-RENIC epicyclic geargox, linking turbine and generator, provides space-saving and silent running.

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Tubular juice heater calculations. H. J. SPOELSTRA. *Sugar y Azúcar*, 1964, **59,** (12), 35–36.—A capacity coefficient K for tubular juice heaters is defined as $\frac{NL}{d_o}$ where N is the number of passes, and L and d_o the length and outside diameter of the tube, respectively. It features in a simplified equation relating specific heating surface S_o with juice velocity v, viz. $S_o = 1{\cdot}25\,\frac{K}{v}$ or $S_o = 0{\cdot}48\,\frac{K}{v}$, respectively, where the values are in metric and English units (S_o = sq.m./metric ton/hr or sq.ft./short ton/hr) and the constants are based on an assumed juice s.g. of 1·02 and a tube i.d./o.d. ratio of 0·92. Using the equation it is possible to calculate the number and size of tubes needed to meet a specific requirement, or the potential of a given heater, or juice velocity needed to attain a required heat transfer.

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Study of the problem of weight losses of refined sugar during its cooling after packaging at Krasnopresnensk refinery. F. M. POLISHCHUK, L. I. LIBKIND, T. P. SHUL'GINA and Z. F. ANTONOVA. *Trudy Grupp. Lab.*, 1959, 122–146; through *S.I.A.*, 1964, **26,** Abs. 960.—Measurements of weight losses in storage and changes in the moisture content of refined sugar in

[1] Teorie optimálniho schématu rafinace cukru (Theory of optimal sugar refining scheme). (SNTL, Prague.) 1963.
[2] Czechoslovak Patent 4313/64.
[3] *Cf. I.S.J.*, 1959, **61,** 307.

80 kg cloth bags were carried out daily at different times of the year. The results, with details of the temperature and relative humidity of the surrounding air, are reported in detail in graphs and tables. The weight losses amounted to 0·255–0·306% and were in nearly all cases greater than the moisture losses (0·16–0·26%). The differences between the two losses were greatest in summer and least in winter. Mechanical losses were avoided during the experiments. A period of 6–7 days was required before the sugar reached a constant weight. It is suggested that the difference in the weight and moisture losses may be due to moisture losses during sampling and crushing of sugar in the course of moisture determination, which would tend to give low values under warm conditions. It is recommended that bagged sugar should be cooled in the store for ≮ 3 days before delivery to consumers.

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Natural losses of refined sugar during its storage in warehouses at Khodorovsk sugar factory. M. A. Kokhan and E. T. Simakova. *Trudy Grupp. Lab.*, 1959, 147–152; through *S.I.A.*, 1964, **26**, Abs. 961. Bags containing 70 kg of refined sugar cubes were stored for three, six or nine months after which changes in the weight and moisture content were determined. The total weight losses at the end of each period were similar (~0·24% of the initial weight), indicating that the weight losses occurred in the first three months. Only 20% of the weight losses could be accounted for by losses in sugar moisture, and a further 15% was due to a fall in the moisture content of the bag. The remaining 65% was unexplained and was attributed to mechanical losses of sugar out of the bag. With increasing time, the ratio of mechanical (unknown) losses to the known moisture loss tended to increase. The greatest weight losses were recorded for sugar cubes stored at a relatively high temperature and moisture content. It is recommended to store the sugar for ≮ one day before weighing to avoid complaints of short measure.

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The Mexican cane sugar factory "Ingenio Plan de Ayala". W. Liebheit. *Zeitsch. Zuckerind.*, 1965, **90**, 19–21.—Details are given of this new cane sugar refinery supplied by Gutehoffnungshütte Sterkrade A.G. Designed for a crushing capacity of 5000 tons of cane per day, the refinery is equipped to produce white sugar by active carbon treatment of affined and melted *A*- and *B*-products. *C*-massecuite is used as footing for the *A*-massecuite or is melted. The milling plant comprises an 18-roll 38 × 85 in tandem, each mill having its own steam-turbine drive. Semi-automatic conical Gutehoffnungshütte centrifugals are used for refined sugar and *A*-massecuite, while automatic flat-bottomed machines are used for *B*- and *C*-products.

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Cane sugar industry of Bolivia. H. Kampf. *Zeitsch. Zuckerind.*, 1965, **90**, 25–26.—The industry is represented by four white-sugar factories (the first built in 1944) which in 1963 produced nearly 69,000 tons of sugar and in 1964 were expected to produce 92,000 tons, thus giving the country a sugar surplus in view of the very slow increase in domestic consumption. The four factories are situated in the vicinity of Santa Cruz de la Sierra and have daily crushing capacities of 690 tons (La Esperanza[1]), 2100 tons (La Belgica), 1700 tons (Guabira) and 1000 tons (San Aurelio). A fifth factory is to be built at Bermejo, in the south of Bolivia, with a daily capacity of 1000 tons of cane, increasing eventually to 1500 tons. Of the factory by-products, only molasses is utilized in Bolivia for alcohol production, while La Belgica has a plant for the daily production of 1000–1500 kg of fodder yeast, containing 40–50% protein, from molasses. The possibilities of bagasse utilization are being investigated.

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Mill technology research. J. H. Nicklin, G. A. Anderson, B. G. Adkins and A. D. Doolan. *Ann. Rpt. Bur. Sugar Expt. Sta.*, 1964, (64), 83–90.—An account is given of the research work of the Division of Mill Technology during the year. It concerned checking of calibration of new apparatus for use in cane analysis, and tests on continuous centrifugals for low-grade massecuite which proved satisfactory and are expected to be used for future expansion of low-grade stations. Variations in steam demand for a calandria pan and coil pan station were measured and, contrary to expectation, found to be greater at the latter. Investigations were made into cane sampling for analysis, cane deterioration when crushing is delayed, and modifications of a Webre pan to avoid false grain formation towards the end of the strike. Flocculants and aids to clarification were studied and "Sedipur TF2" appeared to be superior to "Separan AP-30". Trials were made on improvement of evaporator capacity by joining the vapour spaces of a pre-evaporator and first effect, and bleeding vapour to juice heaters and pans. The Division aided mills changing from low- to high-voltage generation and distribution systems.

* * *

Decolorization of sugar liquors by means of granular carbon and revivification of the same. A. Vázquez Díaz. *Bol. Azuc. Mex.*, (184), 34–41.—An account is given of experience during two seasons at the refinery of Ingenio Independencia S.A., in which CAL granular carbon has been used to remove colour from sugar liquor instead of the active carbon previously employed. The carbon is in a percolation column 23 ft high by 5 ft dia. which holds 5000 kg. Remelt sugar at 56–60°Bx is clarified by a phosphate/air flotation method at 96°C, filtered, and passed (at 0·3–0·5 g.p.m./sq.ft. filter surface) through the column until the colour of the effluent reaches the limit set (20–30 days). This water-white liquor goes to storage for boiling to refined sugar, and raw liquor flow continues for a further 20–25 days when the carbon is exhausted and the effluent is a brilliant amber.

[1] Now closed for economic reasons.

The column is liquidated, air being used to drive out the sugar solution; it is then washed to less than 0·5°Bx in the sweet water, and removed from the column with water, passed over a circular vibrating screen, and drained in a cone-based tank before passing to the revivification kiln. Here it is heated to 1750–1800°F and tested by determining its apparent density. About 3–4% of magnesite is added before returning the carbon to the column, so as to maintain liquor pH at 6·8–7·2.

* * *

Manufacture of refined sugar by means of defecation and sulphitation of the liquor. J. H. SPOELSTRA and R. J. M. GOOS. *Bol. Azuc. Mex.*, 1964, (185), 28–30. The melt liquor sulphitation process used at Kilombero sugar factory in Tanganyika is described with a diagram of the plant used. The raw sugar is affined and melted in sweet water to give a liquor of automatically controlled Brix and temperature. The raw liquor passes into a dosing tank where 0·5–0·6% CaO on Brix is added as milk-of-lime. The limed liquor passes to a mixing tank to which a certain amount of sulphited liquor is recirculated. The liquor containing seed crystals of $CaSO_3$ is then treated with SO_2 in two continuous sulphitation tanks provided with recirculation pumps and having a retention time of about 12 minutes. A meter/recorder measures pH at the exit of the tanks, the values being controlled by a flow-rate valve at about 8 and 7·0–7·2, respectively. The sulphited liquor passes to a holding tank fitted with heating coils and a mixer. It is filtered and may be treated with active carbon, although the Kilombero installation produces a high quality white sugar, comparable to many refined sugars, without carbon. It contains 0·10% reducing sugars, 0·03% sulphate ash, 50 p.p.m. of CaO, 25 p.p.m. of SO_2 and has a colour of 0·30°St.

* * *

Two new U.S. sugar mills. ANON. *Sugar y Azúcar*, 1965, **60,** (2), 36–40.—Illustrated descriptions are given of the 4500 tons cane/day Atlantic Sugar Association factory at Belle Glade, Florida, and the 4000 tons cane/day Cajun Sugar Cooperative at New Iberia, Louisiana.

* * *

Elgin's floating calandria pan. C. G. M. PERK. *Sugar y Azúcar*, 1965, **60,** (2), 45–46.—The circulation pattern in a pan with a floating calandria is helped by natural convection since the annular downtake is nearest to the cooler external walls of the pans. Also, in the Elgin pan[1] the annular area is equal to the heating tube area, so providing less resistance to flow. A major drawback to floating calandrias is uneven steam supply; radial inlet pipes cause local overheating and uneven steam in the calandria and a central bottom feed interferes with pan discharge. In the Elgin pan, steam is fed to a ring pipe below the pan bottom and then up through the latter by way of three vertical pipes into the calandria, these pipes being at the corners of an equilateral triangle, so leaving a central space for the pan discharge valve. Alternatively, the pan can be fitted with a double bottom which acts as the steam distribution chamber, connected to the calandria by three vertical pipes. The calandria bottom tube plate is stepped twice to aid circulation and reduce dead space and footing volume. The star feed distributor is perforated only under the calandria so that feed cannot rise up the annular downtake but must circulate through the heating tubes.

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Affination of remelt sugars. S. ZAGRODZKI. *Gaz. Cukr.*, 1965, **73,** 1–5.—Affination tests showed that for remelt sugar the best results are obtainable when 3rd product sugar is mixed with hot 2nd product sugar and subsequently cured with the addition of a little hot water (0·9–2·7% on massecuite). The analysis of the remelt sugar is high, the purity of the white sugar boiled from normal syrup with which the remelt is mingled is maintained and the white sugar yield is increased. Moreover, there is no need for separate centrifugals or minglers. Affination of 98·3 purity raw sugar or 2nd product remelt sugar with 98·9 purity high-grade molasses followed by hot-water washing gave an affined product of 99·6 purity. The question of non-sugars and colouring bodies inside the sugar crystal is discussed and a table is given showing the raffinose, invert sugar, and ash in five layers from the outside to the centre of raw sugar crystals.

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Continuous centrifugals at Tirgu Mures sugar factory. I. HALMÁGYI and E. AVED. *Ind. Alimentara*, 1964, **15,** 270–276; through *S.I.A.*, 1964, **26,** Abs. 1103. Experience with a new battery of eight BMA conical centrifugals in 1963 is reported and compared with results for previous years using batch centrifugals. The affination magma of 3rd product sugar was of higher purity than in 1960/61 in spite of a lower purity of the 3rd massecuite. Difficulties were experienced in centrifuging affination magma in batch centrifugals owing to the production of fines in the continuous centrifugals, and it is recommended that the continuous centrifugals should be used also for affination. The theory and practice of the operation of conical and push-type continuous centrifugals is reviewed with 12 references.

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Continuous sugar cane diffusion with the Silver ring diffuser. H. F. SILVER. *Bol. Azuc. Mex.*, 1964, (186), 13–16.—An account is given of the Silver ring diffuser and its development and initial installations. (See also *I.S.J.*, 1965, **67,** 169–172.)

[1] Elgin Engineering Co. (Pty.) Ltd., P.O. Box 184, Jacobs, Durban, Natal, S. Africa.

Natural gas and oil instead of coke in the lime kiln. G. VERNOIS. *Zeitsch. Zuckerind.*, 1964, **89**, 677–678. The advantages resulting from the use of natural gas or oil for lime kiln operation are discussed and the example cited of a kiln at Groningen (Holland) sugar factory where during 80 days the operational costs using natural gas were only 60% of those of a conventional coke-burning kiln. The use of other types of lime kiln such as the rotary tube type, as used in large sugar factories in the U.S.A., and kilns using the fluidized bed process (again as practised for almost 20 years in the U.S.A.) with natural gas or oil burning is discussed.

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Invert sugar and raffinose formation during beet storage. W. UHLENBROCK. *Zeitsch. Zuckerind.*, 1964, **89**, 679.—Results of tests in which German beet was stored for 61 and 68 days showed that the invert sugar rose (by 0·32% and 0·21% on beet respectively) while the raffinose content decreased (by 0·22 and 0·25% on beet respectively).

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A practical study of pre-defecation. K. VUKOV. *Cukoripar*, 1964, **17**, 321–326.—The beneficial effect of progressive pre-liming on the filtration rate of 1st carbonatation juice is discussed. The optimum filtration rate is obtained when progressive pre-defecation raises the juice pH from 7·5 to 11·5 in at least 6–7 stages. The return of unfiltered 1st carbonatation mud to pre-liming affects the settling rate of 1st carbonatation juice in two ways: the additional $CaCO_3$ increases the settling properties, while the increased concentration of solid phase prolongs settling. The optimum amount of 1st carbonatation mud to recycle is about 30%, when the sedimentation rate is about 70% of the rate obtainable by returning a corresponding amount of unfiltered 1st carbonatation juice.

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Effect of natural and forced ventilation on sugar beet storage. L. SCHMIDT and J. ZAHRADNÍČEK. *Listy Cukr.*, 1964, **80**, 313–316.—In piles measuring 10 × 5 × 2 m high and containing about 50 tons of beet, the average daily losses in sugar during 45–50 days' storage (average of 5 years' tests) were 0·166% in unventilated beet and 0·159% in beet ventilated by means of latticed vertical air shafts. (The pile was ventilated mainly at night and when the ambient temperature was at least 2–3°C lower than in the pile.) The average temperature in the ventilated pile differed very little from that in the unventilated pile (3·7°C compared with 3·9°C). In a pile containing 150 metric tons of beet and ventilated by low-pressure fans delivering 1800 cu.m. of air/hr, the average temperature was 4·4°C compared with 4·9° in the control pile. The daily losses in the ventilated and control piles were 0·170% and 0·196% respectively. The percentage of healthy beet in the ventilated piles was higher and the extent of mould growth was generally lower. Some information is given on the moulds identified.

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Holly's Shoup plant on stream. ANON. *Sugar y Azúcar*, 1964, **59**, (12), 29–32.—An illustrated account is given of the new Holly sugar factory at Hereford, Texas, which started operations in October 1964. It slices 6000 tons of beet per day and produces white sugar. Equipment includes Ogden slicers, a Silver-built RT diffuser, Benning carbonatation units, a Dorr thickener, Eimco rotary vacuum filters, U.S. automatic-sluice leaf-type filters for 2nd carbonatation juice, thick juice and standard liquor, a Goslin-Birmingham quintuple effect evaporator and vacuum pans, La Feuille low-grade crystallizers, Western States automatic and Silver-Hein, Lehmann continuous centrifugals, a Link-Belt cooler and dryer, three conditioning bins, St. Regis packeting plant, Stord pulp presses, a Stearns-Rogers pulp dryer, Union boilers and a General Electric turbogenerator.

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Modern engineering at Iran's Kermanshah plant. ANON. *Sugar y Azúcar*, 1964, **59**, (12), 37–38.—An illustrated description is given of the new 1000-ton beet sugar factory at Kermanshah, built by Salzgitter Maschinen A.G., which became operational in November 1963.

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Technological difficulties of filtration through a granular medium. P. SMIT. *Zeitsch. Zuckerind.*, 1965, **90**, 16–18.—Difficulties encountered in filtering through sand filters and ion-exchange resin columns are discussed, including problems connected with rinsing. A nozzle for applying wash water is described which cannot be blocked by the filter medium and details are also given of a twin-chambered ion-exchange vessel design.

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Coagulation of colloidal substances in beet juice. R. KOHN. *Zucker*, 1965, **18**, 1–10, 39–45.—The investigations carried out and reported earlier[1] have been continued. The improvement in filtration of carbonatation juice brought about by counter-current pre-defecation is attributed in particular to the progressive increase in alkalinity with coagulation of the colloidal substances in the absence of any local

[1] *I.S.J.*, 1961, **63**, 79–81, 106–112, 170–173, 204–207.

excessive alkalinity. Local excessive alkalinity does occur during such progressive methods as step-wise pre-liming with direct application of the milk-of-lime; the colloidal substances coagulate instantly at the increased alkalinity and form mud aggregates having an undesirable disordered structure.

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Application of check weighers for bags in the sugar industry. H. J. SACHT. *Zucker*, 1965, **18**, 45–49. The basic designs, applications and efficiencies of check weighers for filled sugar bags are discussed with particular reference to the machines produced by TACHO-Schnellwaagenfabrik (Duisburg).

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Flocculation in the sugar industry. S. GAWRYCH and I. OGLAZA. *Gaz. Cukr.*, 1964, **72**, 281–283.—The use of natural and synthetic flocculants for juice treatment is discussed with reference to investigations in other countries. A starch-based flocculant, NLT, has given better results than "Separan AP-30" polyelectrolyte in the settling of 1st carbonatation juice.

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Intensity of heat exchange during the cooling of massecuite in crystallizers. I. S. GULYI. *Sakhar. Prom.*, 1965, **39**, 107–114.—In the case of crystallizers with clean heat exchange surfaces, the intensity of massecuite cooling is determined by K and K_k (coefficients of heat transfer through a rotary surface and through the crystallizer body to the atmosphere, respectively) and α_3 (coefficient of heat emission from the surface of the massecuite to the atmosphere). K is assumed to be approx. equal to α_1 (coefficient of heat emission from massecuite to heat exchange surface) which in turn is given by

$$\alpha_1 = 0{\cdot}89 \frac{v_f^{0\cdot18}\,\lambda_w^{0\cdot25}\,c_f^{0\cdot63}\,\gamma_f^{0\cdot63}\,\lambda_f^{0\cdot37}\,v^{0\cdot45}}{c_w^{0\cdot25}\,\gamma_w^{0\cdot25}\,v_w^{0\cdot25}\,l^{0\cdot55}}$$

where v_f and v_w = coefficients of kinetic viscosity at massecuite and wall temperatures, respectively (sq.m./sec); λ_f and λ_w = coefficients of heat conduction at massecuite and wall temperatures, respectively (kcal/sq.m./hr/°); c_f and c_w = heat capacity at massecuite and wall temperatures, respectively (kcal/kg/°); γ_f and γ_w = s.g. of solution at massecuite and wall temperatures, respectively (kg/cu.m.); l = calculated mean distance between heat exchange surface and axis of rotation (m); and v = rotary speed (m/sec.) For crystallizers with dirty surfaces the heat exchange coefficient is given by $K\psi$, ψ being a coefficient expressing the effect of the dirt. Approximate values of ψ have been determined for working periods from 1 to 8 years. Under still air conditions for values of Δt_3 from 15 to 50°C (Δt_3 = temperature difference between massecuite surface and air) $\alpha_3 = 4 \times 10^{-4} \times \Delta t_3^{1\cdot6}$ (kcal/sq.m./min/°). At a massecuite temperature range of 40–80°C, $K_k = 5{\cdot}7 \times 10^{-5} \times t_y^{1\cdot6}$ (kcal/sq.m./min/°), where t_y = massecuite temperature. A nomogram[1] has been constructed from these two formulae for determination of Δt_3, α_3 and K_k as functions of massecuite and air temperatures. It is shown by a graph that with increase in the value of KF, where F = heat exchange surface (sq.m.), the cooling period τ initially falls rather sharply at constant water equivalent (W) (kcal/hr/°) to $KF > 1200$, after which any reduction that takes place is negligible. Hence, it is impossible to effect any great reduction in time by improving only certain heat exchange conditions. At constant KF, increase in W reduces the cooling time but at $W > 600$ kcal/hr/° further reduction is negligible. Reduction in the initial temperature of the water (t_1) from 42 to 20°C causes a greater reduction in time than a fall from 20 to 6°C. From analysis of experimental data (also given in graph form) the following optimal ranges of values have been determined: W = 400–600 kcal/hr/°, t_1 = 15–20°C, Δt = 20°C (approx.) and v = 2–7 cm/sec.

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New method of determining the index of natural alkalinity and its application in the control of the technological process in the carbonatation station. N. A. ARKHIPOVICH and S. N. KVITA. *Sakhar. Prom.*, 1965, **39**, 116–123.—The reactions occurring in 1st and 2nd carbonatation are discussed with particular reference to natural alkalinity. Tabulated data for true natural alkalinity and optimum alkalinity as determined by the method described earlier[2], for theoretical natural alkalinity as determined by the conventional method, and for optimum alkalinity as determined by a modification of the conventional method[3] show that for healthy beet the optimum alkalinity = ½ natural alkalinity (the latter being expressed as the content of alkali metal ions). The optimum alkalinities found by the two methods were in good agreement. The theoretical natural alkalinity with few exceptions had a negative value; this is attributed to accumulation of a large number of anions of acids which form soluble salts with calcium. The soluble lime salts content in 1st carbonatation juice is given by $[A^-] = [K^+] + [Ca^{++}] - [OH^-]$ and hence the extent of calcium ion separation is given by $E_{CaO} = \frac{[A^-] - [CaO_{II}]}{[A^-]} \times 100$, where CaO_{II} is the residual lime salts content in 2nd carbonatation juice. Experimental data show how the lime salts content in 1st carbonatation juice and the residual lime salts in 2nd carbonatation juice increase as the campaign advances. E_{CaO} has a value in the range 40–50% for normal gassed juice. The amount of sodium carbonate to be added by weight of juice for lime salts precipitation in 2nd carbonatation is given by 1·9 (0·05 — natural alkalinity); corresponding tri- and diphosphate quantities to be added are given by 1·95 (0·05 — natural alkalinity) and 4·5 (0·05 — natural alkalinity), respectively. The effects obtained

[1] GULYI: Investigation of heat exchange and crystallization in massecuite crystallizers for development of methods for their calculation. (Dissertation, Voronezh.) 1962.

[2] *I.S.J.*, 1964, **66**, 128.

[3] SILIN & SILINA: Khimicheskii kontrol' sveklosakharnogo proizvodstva (Chemical control in beet sugar production). (Pishchepromizdat, Moscow.) 1960. pp. 163–164.

by adding varying amounts of sodium carbonate or triphosphate are determined in the laboratory by a method whereby a 1st carbonatation juice sample is brought to optimal alkalinity, divided into six 100-ml portions, and a 1/2·8N solution of carbonate or triphosphate added in increasing amounts with decreasing amounts of water, i.e. 4 ml water + 1 ml precipitant, 3 ml water + 2 ml and so on. The alkalinities and lime salts contents are multiplied by 1·05 to take account of dilution. Tabulated data show how the quantity of precipitated lime salts decreases with increase in the added sodium carbonate or phosphate because of the additional precipitating effect of the Ca and Na carbonates in the juice which do not have any effect at the initial pH, but do when the pH rises as a result of adding the sodium carbonate or triphosphate. While the method is laborious, it is claimed to be no more costly than the labour involved in determining 2nd carbonatation optimal alkalinity by gradual gassing.

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Operational checking of juice pH in diffusers. D. V. GORBAN'. *Sakhar. Prom.*, 1965, **39**, 123–124.—To check the bacterial activity in diffusion, a small amount of raw juice is continuously drawn off from the battery diffuser heating unit and passed through a glass electrode actuator into a tank. The pH is transmitted to an indicator.

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Structural changes in the cell integuments of sugar beet with freezing and their effects on sugar losses in flume-wash water. N. M. IGNATOV. *Sakhar. Prom.*, 1965, **39**, 129–133.—The effect of sub-zero temperatures on beet and consequent sugar losses was studied with healthy beet extracted from a freshly uncovered pile. Four lots were kept for 13 days in cold storage at —5 to —6°C, —10 to —11°C, —18 to —19°C and —28 to —29°C, respectively, while a fifth lot was stored for 3 days at —5 to —6°C, 4 days at —10 to —11°C, and 6 days at —18 to —19°C. While the beet subjected to rapid freezing at —10 to —29°C suffered no tissue deformation, the beet exposed to a temperature of —5 to —6°C revealed a tubercular, icy membrane formed under the integumentary tissues. Hence, it is advisable to store beet in a fresh state and at as low a temperature as possible (using ventilation), avoiding even a brief exposure to a temperature in the range —2 to —7°C. In view of the risk of high sugar losses in flume-wash water when frozen beet are processed, freeze storing is considered economically inadvisable for any period of 100 days or less.

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New steel apron conveyor design for sugar factories. A. S. OSTASHEVSKII and B. P. SHKOLENKO. *Sakhar. Prom.*, 1965, **39**, 134–136.—The apron conveyor described is a modification of the type used in the coal industry and moves at a speed of 0·27 m/sec, with a permissible angle of bend of 42°.

Device for washing the TG-80-1,6 turbo-gas blower. P. V. GLAVATSKII. *Sakhar. Prom.*, 1965, **39**, 136–137. The gas blower is cleaned by partially closing the suction valve and blowing through ammoniacal water for 15 to 25 min at least once a day. Gas for carbonatation can be kept free from solid particles by replacing wet traps before the scrubber by cyclone traps, and a spray pressure distributor by an umbrella-type screen.

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Application of a Philippe filter for 1st carbonatation juice at Michałów sugar factory. I. OGLAZA and S. GAWRYCH. *Gaz. Cukr.*, 1965, **73**, 6–9.—A description is given of the Philippe DNRS disc filter installed at Michałów sugar factory for test purposes. The tabulated data for 1st carbonatation juice show that at a juice filtration rate of 5·30 litres/min/sq.m. and a pressure of 1·65 atm the throughput of the 84 sq.m. filter was sufficient to treat the juice from 400 tons of beet/day while giving a clearer juice than conventional pressure filters. A greater degree of sweetening-off with lower water consumption was obtained if the pressure of the water was equal to at least the final pressure in filtration. With normal muds and a pressure of at least 5 atm, water washing took 7 min at a consumption of 60% on beet.

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Plastics in the sugar industry. H. GRUSZECKA. *Gaz. Cukr.*, 1965, **73**, 10–12.—Among the plastics discussed are PVC (polyvinyl chloride), polyamides and the many types of synthetic resins (polyester resins, silicones and epoxides, polychlorovinyls, etc.). These have many applications in the sugar industry which are discussed.

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Characteristics of automatic control of multiple-effect evaporator stations. A. M. KOZAK. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1964, (4), 121–126; through *S.I.A.*, 1964, **26**, Abs. 1086.—Possible methods for equalizing the consumption of secondary steam from an evaporator with the total required evaporation of the incoming juice are reviewed. A new scheme is proposed combining elements of both "internal" and "external" regulation. The station is operated on a "hungry régime" in which the production of secondary steam is insufficient for normal factory requirements. The vapour lines from each body are cross-connected in a "cascade" so that each line can be supplemented with vapour of higher pressure. The cascade is automatically controlled by a series of valves according to the pressure downstream of each valve; an upstream-controlled valve is placed between the bottom of the cascade and a concentrator body. Extra evaporating capacity is provided in the first body which should have a total heating surface of 60 sq.m./kg of beet/sec, the total heating surface in all bodies being $\nless$ 210 sq.m./kg of beet/sec. The live steam consumption is controlled by a computer according to the total vapour bleed, thin juice flow rate and thin juice density.

LABORATORY METHODS AND CHEMICAL REPORTS

Influence of temperature and heating period of digestion on the results of determinations of sugar contained in beet. V. N. Ostapenko and V. G. Zozulya. *Trudy Grupp. Lab.*, 1959, 78–80; through *S.I.A.*, 1964, **26,** Abs. 982.—The conditions of hot digestion were varied in the range 70–85°C and heating time of 20–35 min. The water-bath was maintained at 5°C above the required temperature. The digestion filtrate (excluding the first portion which was returned to the filter) was analysed by polarimetry after either 60 ml or 170 ml had been collected. The minimum effective conditions were heating at 70°C for 25 min; further increase in the time and temperature produced no increase in sugar content. Results obtained on a 60-ml sample were identical with those obtained on a 170-ml sample of filtrate.

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Method of investigating the crystallization of sucrose from supersaturated solutions. A. V. Zubchenko, I. G. Samotin and A. Ya. Oleinikova. *Khlebopekar. Konditer. Prom.*, 1964, (8), 7–9; through *S.I.A.*, 1964, **26,** Abs. 990.—The technique is briefly described. The sucrose solution is filtered, evaporated under vacuum if necessary, and introduced into a glass vessel of 500 ml capacity, holding usually 200 ml of solution. The vessel is sealed and contained in a thermostat. Measurements are made on drop samples with a heated refractometer. The solution is constantly stirred at, e.g., 400 r.p.m. Preliminary results have shown a latent period before nucleation begins, dependent on the supersaturation.

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Nucleation of crystals in supersaturated solutions of sucrose. R. A. Yanchuk. *Pratsi Odes'k. Derzhav. Univ.*, 1961, **151,** (6), 44–50; through *S.I.A.*, 1964, **26,** Abs. 991.—A supersaturated sucrose solution (initial concentration 80% solids at 45°C) was stirred at 200 r.p.m. for varying periods. The "latent period", defined as the time interval after which the concentration decreased by 0·4%, was 43 min. The size distribution of the nucleated crystals was determined after they had grown undisturbed to microscopic size. No significant nucleation was produced when the mixing period t was less than one-half of the latent period t_{lat}. The mean size of the crystals was a minimum for $t = t_{lat}$; for shorter or longer periods the crystals formed tended to be larger. A maximum number of crystal nuclei were produced at $t = 0{\cdot}8\ t_{lat}$; the number decreased considerably outside the range of $0{\cdot}7\ t_{lat} - 1{\cdot}4\ t_{lat}$. The rate of exhaustion of the solution as a result of crystallization was, however, increasingly greater as t increased, presumably owing to the increased growth rate of the nuclei with a consequent decrease in the supersaturation. A mathematical analysis is presented.

Determination of sugar entering manufacture and its problems. J. S. Carbonell. *La Industria Azuc.*, 1964, **70,** 419–422.—In order to assess the sugar entering a cane sugar factory it is necessary: to know the exact weight of juice extracted by the milling tandem; to obtain a representative sample with continuous sampling in proportion to weight, at regular intervals, and keeping without deterioration before analysis; and to determine the correct pol and sucrose content in the sample. Difficulties arise when solid materials—earth, sand, etc.—are suspended in the juice, and when it contains gummy substances—dextran, levan, etc.—resulting from microbial action. Techniques to be adopted in these circumstances are discussed.

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Crystallization rate and solubility of sucrose in the presence of inorganic salts. G. Mantovani and F. Faglioli. *Gaz. Cukr.*, 1964, **72,** 278–281.—Supersaturated and unsaturated sucrose solutions were mixed with varying quantities of KCl and $CaCl_2$ for at least 240 hr at 25°C ± 0·01. The sucrose solubility was found to increase in the presence of KCl (the solubility values obtained were generally lower than those obtained by Wise & Nicholson[1]), whereas in the presence of $CaCl_2$ sucrose solubility decreased. Both salts caused a reduction in the crystallization rate. The findings confirm the interpretation that the melassigenic properties of some non-sugars are reflected in their effect on sucrose solubility. Hence, KCl is strongly melassigenic and $CaCl_2$ mildly melassigenic.

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Variation of the ratio $NS_{ap.d.}/NS_r$ as a function of the organic ratio. J. Stambul. *Sucr. Franç.*, 1965, **106,** 29–32.—$NS_{ap.d.}$ is the apparent densimetric non-sugars in an impure sugar solution, i.e. Brix — apparent sucrose or Brix (1 — apparent purity). NS_r is true non-sugars, i.e. solids in solution—true sucrose. The ratio between these values has been found to be approximately 0·9, which has been used as a standard coefficient. The true cofficient (y) varies with non-sugar composition, however, and was found to vary linearly with the organic matter: ash ratio (x) in accordance with the equation $y = 0{\cdot}051575\ x + 0{\cdot}81640$.

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Systematic fundamental measurements and their significance for sugar technology. F. Schneider. *Ind. Sacc. Ital.*, 1964, **57,** 225–237.—Achievements of the Braunschweig Sugar Institute in the field of highly exact measurements of density, viscosity, and diffusion coefficient are surveyed, together with the influence such measurements have had in the study of crystallization, juice purification and the structure of sucrose solutions.

[1] *I.S.J.*, 1956, **58,** 329–332.

Dependence of sucrose degradation rate on effective acidity. S. E. KHARIN and R. A. KOLCHEVA. *Sakhar. Prom.*, 1965, **39**, 103–107.—While the pH of an acid sucrose solution remained unchanged when the temperature was raised from 20 to 80°C, that of an alkaline solution was lower at 80 than at 20°C. This drop in pH is attributed mainly to the effect of temperature on the degree of dissociation of water. The difference in the effective acidity of sucrose in acid and alkaline solutions is explained by the slow loss of invert in acid medium compared with that in alkaline medium. Calculations of the rate constant show how this decreases with reduction in pH in alkaline medium but rises in acid medium. Hence, sucrose degradation reaches a minimum at a certain pH, found by calculation to be 8·35 at 80°C. A graph of rate constant *vs.* pH demonstrates the very small amount of decomposition occurring in the pH range 7·5–10·0.

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Changes in the volume of sugar beet slices in buffer solutions—influence of pH, temperature and time. H. J. DELAVIER and P. SIEWERT. *Zeitsch. Zuckerind.*, 1965, **90**, 65–70.—Cylindrical samples were cut from beet that had been washed and stored at 0°C and approximately 95% R.H. for up to 6 months. The samples were immersed in fluid in a measuring flask, withdrawn after 10 sec, held in a compressed air stream to remove adhering water, maintained at a given temperature with one of a number of buffer solutions (of varying pH values), then quickly cooled to 20°C, dried and re-immersed in the original measuring flask for 10 sec at 20°C. The volume before and after treatment was noted and the volume change calculated per ml of the initial beet volume. Over the temperature range of 60–80°C the volume of the beet samples fell with increasing temperature. With beet having a dry solids content up to approx. 27% there was a fall in volume, while above 27% there was an initial volume increase and the volume fell only after 60 to 45 min according to the test temperature, although the volume change was almost negligible. The maximum volume decrease occurred in beets of up to 27% dry solids at 80°C (7–10% by volume), coinciding with the isoelectric point of the most important amino acids. At 40°C the greatest volume decrease occurred at pH 3, whereas the greatest increase in volume occurred at pH 9. At pH 2 the volume increased, while at pH 11 it decreased. Raising the temperature to 50 or 70°C increased volume reduction or reduced volume increase.

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Formation and composition of beet molasses. I. Solubility equation. G. VAVRINECZ. *Zeitsch. Zuckerind.*, 1965, **90**, 70–74.—The literature on solubility conditions in beet molasses is reviewed (19 references). WIKLUND'S statement that the saturation coefficient of molasses is independent of temperature and is affected only by the composition and the non-sugars: water ratio has been expressed in mathematical terms by WAGNEROWSKI *et al.*[1] This relates to the straight-line section of a surve of solubility *vs.* non-sugars: water ratio. However, the initial section of the curve is bent and represents a salting-out effect. The present author introduces a third term into the WAGNEROWSKI expression so as to render this applicable not only to molasses and low-purity syrups but also to high-purity syrups. The expression takes the form $C = mA + b + (1 - b)e^{-cA}$ where C = saturation coefficient, A = non-sugars:water ratio, e = base of natural logarithm, and m, b and c are constants dependent only on the molasses composition and obtainable from analytical data. Molasses analyses and solubility data from the literature are compared with values calculated with the above formula. In most cases there is good agreement between the values. Reasons for deviations are discussed. A physico-chemical interpretation is given of the three terms in the new equation.

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The effects of freeze damage on some of the non-sugar constituents of sugar cane. J. J. FRILOUX, N. A. CASHEN and S. J. CANGEMI. *Sugar y Azúcar*, 1965, **60**, (2), 43–46.—Changes in the carboxylic acids, starch, gums, pH and titratable acidity of cane juice following mild and severe freeze damage have been investigated. The first increases after severe freeze damage, owing to formation of acetic acid and lactic acid. Starch falls to low levels a few days after mild damage has occurred. Gum or dextran increases only after severe stalk-splitting damage. Titratable acidity rises and pH falls after such damage. N:Co 310 showed less damage than CP 44-101 and CP 52-68, contrary to previous observations.

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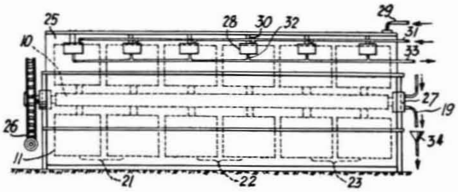
Ultraviolet spectrophotometric studies of heated sugar solutions and certain colouring substances. F. ONDA and Y. URAKABE. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1965, **15**, 47–55.—30% sugar solutions were heated at various pH values for periods of ½ to 5 hr and maximum u.v. absorbancies examined; the typical curves are illustrated and show maximum absorbancy to be greater for pH > 4·6. Pol measurements of the heated solutions showed various curves below pH 5·7 but little or no variation above this value. Maximum absorbancy curves are also presented for 4% solutions of a number of sugars—ribose, xylose, arabinose, etc.—heated for 3 hr at 100°C in pH 5·08, 7·10 and 10·0 buffers; these are classified into five types. No changes were found in maximum absorbancy after heating for 3 hr at 100°C in the case of glucose and fructose to which glycine had been added; glucose, fructose or sucrose with other added amino acids; or glucose solution buffered to pH 5·4 and 9·65 and with 500 p.p.m. of added Ca^{++}, Cu^{++} or Pb^{++}. The action of caramel was found to be stronger than melanoidin and humic acid when investigating their interrelation by u.v. spectrophotometry.

[1] *Gaz. Cukr.*, 1961, **63**, 97–105.

UNITED STATES

Crystallizers for sugar. J. Berger, of Hradec Kralove, Czechoslovakia, *assr.* Zavody Vitezneho Unora, Narodni Podnik. **3,130,080.** 8th March 1961; 21st April 1964.

The cooling element of a crystallizer comprises a series of helical coil sections 11 supported around a central hollow shaft 10. They are in pairs opposite each other on the shaft and displaced from adjacent pairs through an angle of 60°. Two such pairs form a unit 21, 22, 23 each of which is connected to a supply pipe running inside the hollow shaft 10 so that cooling water is supplied to one section of the unit, passing through all four section in turn and finally discharging into shaft 10. The supply pipes are arranged with their ends fitting symmetrically around a plate which is fixed in and rotates with the shaft 10 and coils 11 under the action of a drive through worm gear 26,



the shaft being supported by bearings 27. Against the plate is a distribution plate which carries an arcuate slot at the same radial distance from the centre of the plates as the ends of the supply pipes; thus, as the shaft rotates, cooling water is supplied from the feed side of the distribution plate to each of the pipes in turn for as long as the end of the pipe corresponds to the slot. A discharge port from the centre of the shaft 10 corresponds permanently with a port in the distribution plate which is connected to a pipe 19 delivering to funnel 34.

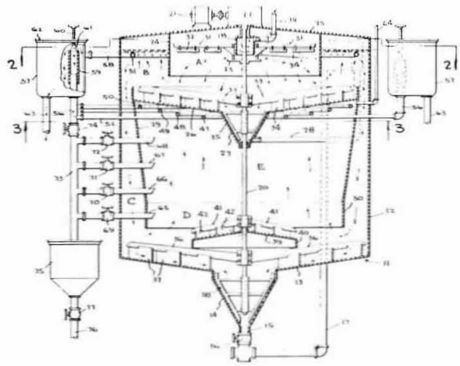
The liquid supplied to coils 11 may be controlled automatically by means of temperature sensing devices which control valves feeding cold and hot water, respectively, to the feed side of the distribution plate whereby to maintain the temperature at a predetermined level for the appropriate stage in the crystallization.

Massecuite to be treated is supplied through pipe 29 with branches 30 leading to chambers 28 from which it enters the trough 25. The chambers have steam jackets to which steam is admitted through pipes 31, condensate being withdrawn through pipes 32, 33.

* * *

Clarifier. R. Rodriguez Chacon. c/o Porto Rico Iron Works Inc., of Ponce, Puerto Rico. **3,314,200.** 30th November 1962; 7th July 1964.

Cane juice enters the clarifier through feed pipe 19 into chamber 18 and is directed outwardly by baffles 23 into flocculating compartment *A* formed by cylinder 24 suspended from the lid 25 of tank 12.



The lid supports the motor 21 and gearbox 22 through which shaft 20 is driven; it carries arms 31 with blades 32 which direct scum from the juice surface into scum tray 34 from which it passes out of the clarifier. The juice passes down into compartment *B*, mud which settles on tray 26 being directed by the blades 34 on rotating arms 33 into the cone 27 where blades 35 sweep it into mud removal pipe 28. The juice flows to the periphery of the tray and into annular compartment *C* which surrounds the frustro-conical partition 29 with its cylindrical bottom section 30. Mud settling is similarly directed by blades 37 on arms 36 to cone 38 and thence to mud pipe 17. The juice rises inside partition 29 into compartment *D*, mud settling on tray 39 being directed downwards by blades 42 on arms 41, eventually to go into cone 17.

Clear juice is withdrawn from the clarifier through perforated pipes 47–50 and 51 from compartments *E* and *B* and so to pipes 56 which have adjustable overflows into collection chambers 57 from which it is withdrawn through pipe 63.

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

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.

"**Suclar**". Fabcon Inc., P.O. Box 187, Chagrin Falls, Ohio, 44022 U.S.A.

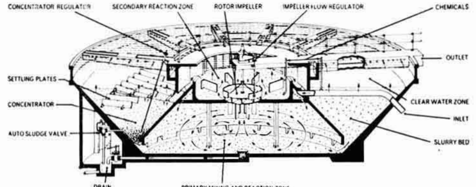
"Suclar" combines several active chemicals in a bentonite carrier to permit the addition of the chemicals to mixed sugar juice in their dry form via a specially designed metering feeder. The formulation takes advantage of typical juice handling, to achieve a remarkable consolidation of floc particles which settle rapidly to leave a sparkling clear, unusually light coloured juice. Additional components promote increased clarified juice purity above normal by inhibiting inversion and degradation of sucrose. With its aid, flocculation is improved and accelerated, juice clarity and removal of non-sugar solids is improved, mud volume is reduced, clarified juice colour is lighter, and inversion and oxidation of sucrose are retarded.

* * *

The "Accentrifloc" clarifier. Paterson Engineering Co. Ltd., 129 Kingsway, London W.C.2.

This system of waste water clarification utilizes an operating principle in which the previous multiple steps of mixing, coagulation and sedimentation are all incorporated in a single unit.

In the "Accentrifloc" the chemicals are introduced directly into the primary mixing and reaction zone in the base of the unit and the chemical reactions take place in the presence of a slurry of previously formed precipitates. This method avoids the necessity of securing the coagulation of finely divided reaction products resulting from the addition of chemicals to the water prior to contact with the slurry. Thus the resulting flocculant or granular product is almost immediately ready for separation.



A rotor impeller produces a powerful hydraulic action and mixes the chemicals and slurry rapidly thereby preventing the settling out of solids in the bottom of the tank. Its special design enables it to move large quantities of water at a relatively low speed without breaking up the floc.

From this zone the water, together with two to four volumes of recirculated slurry, passes into the secondary mixing and reaction zone above, where slow stirring and continued contact with the slurry bring the treatment reactions to equilibrium. A volume of treated water is displaced upwards by the incoming flow of water and the slurry mixture is discharged in an outward and downward direction on to the surface of a slurry pool. The rotor impeller draws back the remaining two to four volumes of circulating slurry into the primary mixing zone.

A feature of this system is that the treated water does not filter upwards through a suspension of sludge but separates from the top of a downward moving pool of uniformly sized slurry. The maximum possible rise rate is therefore not limited by the upward flow but only by the settling velocity of the individual well flocculated particles. The slurry pool is maintained constant and is independent of the throughput. This ensures that a small flow has just as much contact with the slurry as a large flow.

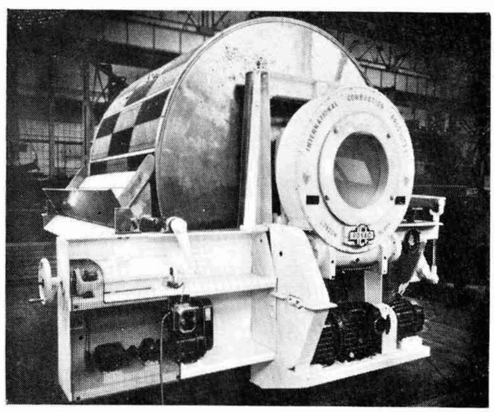
The slurry concentration is kept at a fairly high value in order to provide the maximum amount of surface contact in the action zone. To achieve this, the excess solids are allowed to thicken in the hopper-like concentrators. An automatic valve operated from an adjustable time switch periodically draws off the thickened sludge.

The "Accentrifloc" occupies a fraction of the space required for conventional clarification plant and is therefore ideal for works where space is limited.

* * *

"**Rovac**" **pipe filter.** International Combustion Ltd., 19 Woburn Place, London W.C.1.

The 60 sq. ft. lightweight stainless steel pipe filter illustrated is one of a range designed for use on most general filtration duties and precoat operation. It



allows for filtration of slurries with very low solids content, for processing colloidal suspensions and other difficult materials of a pasty or gummy nature, and for producing filtrates with a very high degree of clarity. The filtering surface is precoated by a bed of diatomaceous earth or pulverized fuel ash on top of the conventional filter cloth; the latter system of precoat filtration is patented by International Combustion.

* * *

Wormgears. John Holroyd & Co. Ltd., Milnrow, Rochdale, Lancs.

Holroyd "Versatile" wormgears are made in standard sizes from $1\frac{1}{8}$-in to 28-in centres and are supplied with the wheel teeth and worm threads completely finished, the advantage being that the customer has merely to machine the shaft ends of the worm and ream the wheel bolt holes to fit his own particular set of conditions.

"R.G." wormgears are similar except that they are fully finished, the worm being ground on the driving extension and ball bearing diameters.

Holroyd's range of wormgear speed reducers covers underdriven, overdriven and vertical output speed reducers with ratios from 5:1 to 5000:1. Many types of single and double reduction units can be supplied with or without flange-mounted electric, hydraulic or air motors, and very compact driving arrangements are possible.

Recent additions to the popular "Verso" range of small wormgear speed reducers are units with $1\frac{1}{8}$-in and $1\frac{3}{4}$-in centres. The driving position of the box can be changed easily, this versatility being achieved by feet at both the top and bottom of the case; the provision of further auxiliary feet enables a still greater variety of positions to be obtained.

Another recent product is the "F2½ Verso", which is part of the f.h.p. range of wormgear speed reducers, but in this instance the aluminium alloy die cast case has mounting feet at both top and bottom similar to the "Verso" units, which enables it to be used in either the overdriven or underdriven positions simply by changing over the position of the breather plug and oil drain plug.

* * *

Weyburn metering pumps. Weyburn Engineering Co. Ltd., Walton Road, Farlington, Portsmouth, Hampshire.

It is claimed that these metering pumps are amongst the most accurate available as a commercial product in the cheaper price range. Units are available to suit virtually every class of process liquids, including those of high viscosity and of aggressive consistency.

Models are available for deliveries ranging from 0·02 to about 50 g.p.h. whilst units can be coupled to increase these ranges. Output pressures of up to 1000 p.s.i. can be provided. They are described in Weyburn Data Sheet No. 1A.500/9.

Plastic bearings. Polypenco Ltd., Gate House, Welwyn Garden City, Herts.

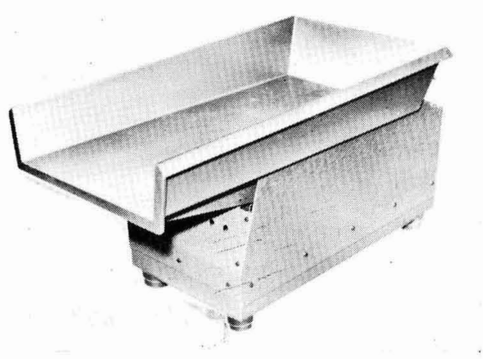
"Fluorosint" (filled P.T.F.E.) bearings can cope easily with temperatures up to 500°F. The material is non-toxic, has long life and does not wear the metal surfaces with which it is in contact. Being chemically inert, it is an ideal bearing material for handling sugar products.

A new standard range of thin-wall bushing-type bearings has been introduced, which are produced from "Nylatron GS" (patented molybdenum disulphide-filled nylon 66). They offer great wear resistance, superior heat resistance, low surface friction, improved dimensional stability, high strength and rigidity. They are suitable for shaft diameters from $\frac{1}{4}$ to $1\frac{3}{4}$ in and are available in 17 sizes. The bearings may be used in corrosive or non-conductive applications.

* * *

Large base-mounted vibrating feeder. The Triton Engineering Co. (Sales) Ltd., Kingsnorth Industrial Estate, Wotton Road, Ashford, Kent.

The new Triton type TF5 electromagnetic vibrating trough feeder is capable of handling up to 45 tons per hour of material having a bulk density of 100 lb per cubic foot. The feeder, in common with all other Triton standard base mounted feeders, will handle the maximum output specified when mounted horizontally.



It is fitted with a single power coil and is supplied with a separate electrical control unit, all wound to operate from a 230 volt, single phase, 50 cycles A.C. supply. The feeder can be wound for other single-phase voltages where required and can also be supplied with a totally enclosed trough for handling dusty or noxious materials. Stainless steel troughs are also supplied at additional cost. The feeder weighs 900 lb and has a current consumption of 8·5 amps at 230 volts, single phase.

PUBLICATIONS RECEIVED

TURBINE FLOWMETERS WITH INTERCHANGEABLE INTERNAL ROTOR ASSEMBLIES. Brooks Instrument N.V., Veenendaal, Holland.

A new line of turbine flowmeters, designed to permit the use of interchangeable internal rotor assemblies, is described in a new leaflet. The meters have a simple self-cleaning journal bearing in tungsten carbide, "Teflon", carbon graphite or other material, providing sustained accuracy, long life, simple servicing and reassembly without recalibration, and a range of sizes from 0·005 to 15,000 g.p.m.

* * *

THERE'S SOMETHING NEW IN THE SUGAR CANE INDUSTRY. Cane Machinery & Engineering International Inc., Box 571, Thibodaux, La., U.S.A.

So says a new leaflet introducing "Cameco" sugar cane equipment, a range of equipment which includes harvesters, loaders, implements, mill yard cane feeder tables, cane transport equipment and unloaders, as well as a complete line of repair parts for all other makes of cane equipment, and engineering services which are offered to cane producing areas throughout the world.

* * *

SUGAR EQUIPMENT. Brill Equipment Company, 37–57 Jabez Street, Newark 5, N.J., U.S.A.

A detailed leaflet provides a list of the used sugar equipment offered for sale by the Brill Equipment Company, ranging from granulators, pans, centrifugals, filters, power plants, evaporators, crystallizers, mills, boilers, steam engines, turbines and pumps, to complete sugar factories, a refinery and distilleries of various capacities.

* * *

NEW FLUID MIXER DATA LEAFLETS. L. A. Mitchell Limited, 37 Peter Street, Manchester 2.

Four new technical data leaflets, describing a fully comprehensive range of top-entering fluid mixers, are now available. Each leaflet covers a particular type of top entering mixer for specific tank duties, and includes illustrations of available drive unit and mixer head variations.

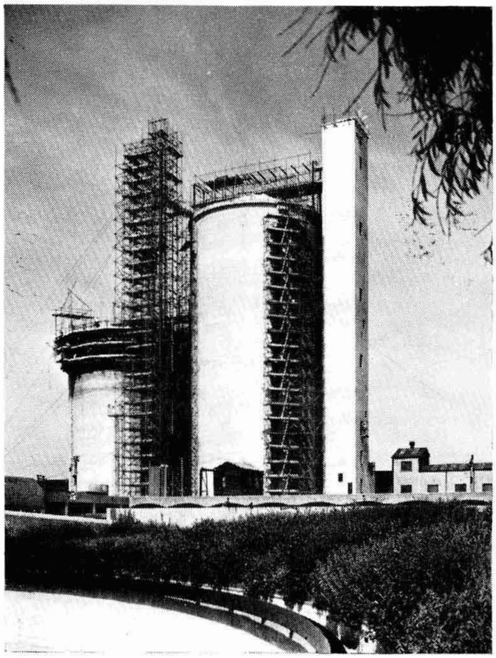
* * *

GUIDE TO "BROOKSMETER" APPLICATIONS. Brooks Instrument N.V., Veenendaal, Holland.

A new 10-page technical bulletin in English, No. 6311-T-001, provides basic technical information on the fundamentals of variable-area flowmeters and their applications, indicating the various types of Brooks instruments available, and presenting information on viscosity effects and the sizing of "Brooksmeters" for various applications and fluids.

Sugar machinery for Portuguese West Africa.— A £750,000 order has been received by Fletcher & Stewart Ltd. for the Tentativa and Dombe factories of Cia. do Assucar de Angola in Portuguese West Africa. The new equipment which will be supplied under this order will increase the sugar cane crushing capacity and, consequently the actual sugar production at both factories. The machinery will include cane mills, juice heating and clarification equipment, evaporation and crystallizing plant. Boiler house and electric power plant is also being supplied.

Record climbing speed for Spalding silos.—Using their advanced sliding formwork technique on a 200-ft rectangular elevator tower for the British Sugar Corporation at Spalding, civil engineers of John Laing Construction Ltd. recently achieved a rate of climb of 21 ft 1½ in during a twelve-hour night shift. In a single day of 24 hours, the tower was raised by 40 ft, and the average speed of climb at 28 ft per day was double the usual rate. This speed was achieved by 27 three-ton Tangye hydraulic jacks, grouped in batches and climbing on high tensile steel rods of 1⅛ inch diameter at the rate of ⅝ inch per lift. The 20 ft × 14 ft 3 in elevator tower forms part of a £210,000 contract which includes two massive 175 ft high circular sugar silos of 66 ft internal diameter, with 9-in thick



reinforced concrete walls, post-tensioned by Freysinnet cables. All the buildings stand on 4 ft 3 in-thick reinforced concrete raft foundations, supported by a total of 344 piles to a depth of 40 ft. Each silo has 4 ft-thick reinforced concrete sugar floor 10 ft above its base.

* * *

Wright Rain irrigation in Malawi.—The Wright Rain Group is to supply irrigation equipment and works totalling £500,000 to a new sugar estate 40 miles from Blantyre, Malawi, where rainfall supplies only one-third of the total crop requirements. The contract was awarded by Lonrho Ltd., a U.K. company with interests in Africa, which is forming a new company, the Sugar Corporation of Malawi, to operate the 15,000-acre Lower Shire River Estate where the equipment will be used. The irrigation scheme, including civil engineering works, will cover approximately six square miles of the estate. Water for the project will be drawn from the Lower Shire River and fed into 22·5 miles of asbestos cement pipes and 50 miles of 3-in portable aluminium pipeline to be finally distributed by 2500 sprinkler heads. A total of 2·5 in of water will be applied every eight days. Power for the scheme is being brought from a public supply 40 miles away and distributed 9·5 miles around the estate to 17 pump units which between them require approximately 2750 h.p.

BREVITIES

Polish sugar crop, 1964/65[1].—According to recently published final results, the Polish sugar industry produced 1,654,000 metric tons of sugar, white value, during the 1964/65 campaign. This corresponds to about 1,838,000 tons, raw value. Beets processed exceeded 12,500,000 metric tons.

* * *

Bagasse paper in Costa Rica[2].—The Comisión Consultiva de Industrias has decided in favour of the establishment of a second paper mill in the country. The new mill would be situated at Turrialba and would represent an investment of some 22 million colones (£1,200,000), 70% of which would be raised within the country. The plant would produce 18,000 tons of paper products a year, using bagasse as a raw material.

* * *

New sugar factory for Syria[3].—A third beet sugar factory is to be built with Czechoslovakian aid in the region of Jisr-al-Shugur near the village of Frayki. It is planned to foster beet cultivation in this region by suitable measures so as to have sufficient beets available for the factory.

CANADA SUGAR IMPORTS [4]

Raw sugar imported by refiners	1964 *tons*	1963 *tons*
Australia	115,460	130,328
Barbados	9,952	7,353
Brazil	—	2,069
British Guiana	111,663	89,292
British Honduras	1,673	2,958
Cuba	250	62,255
Dominican Republic	13,206	—
Fiji	42,922	68,883
Haiti	6,744	—
India	—	93,488
Jamaica	91,130	80,008
Leeward/Windward Isles	4,980	10,240
Mauritius	123,987	49,090
Mexico	4,543	—
Peru	—	3,616
Rhodesia/Nyasaland	20,965	18,862
South Africa	85,370	77,835
Trinidad	42,656	27,548
	675,501	723,825
Raw sugar N.O.P.		
British Guiana	993	724
Cuba	—	3,956
Dominican Republic	5,603	4,570
India	—	81
Jamaica	—	61
South Africa	—	74
United States	9	22
	6,605	9,488
Refined sugar		
Belgium/Luxembourg	—	148
France	—	148
Germany, West	14	12
Holland	89	4
Hong Kong	3	—
Mexico	591	—
Panama	759	178
South Africa	49	40
United Kingdom	1,249	918
United States	7,005	5,517
Venezuela	2,376	—
	12,135	6,965

Jamaica sugar strikes.—Sugar cane loaders went on strike at Clarendon in Jamaica[5], and as a result industry-wide negotiations with the sugar workers, scheduled to start at the Ministry of Labour, were postponed. Picketing has ended at Frome estate as the back-to-work movement gathered momentum. The Jamaican Government is setting up a commission to investigate the strikes at the Frome and Monymusk sugar estates[6]. The decision has been taken because of continuous unrest in the sugar industry and the impact that failure of sugar crops would have on the country's economy. Frome and Monymusk, owned by the West Indies Sugar Co. Ltd., together produce about half Jamaica's sugar.

* * *

Flood damage in Brazil[7].—Widespread flooding after heavy rains has choked irrigation canals and inundated large areas under cultivation in the sugar cane growing district of Campos in the State of Rio de Janeiro. A report sent to the State Legislative Assembly puts the damage suffered by planters at 11,000 million cruzeiros (more than £2,000,000).

* * *

Mozambique sugar factory[8].—The Industrial Development Corporation of South Africa has granted a 12-year loan of 200,000,000 escudos (£2,500,000) to the Banco de Fomento Nacional to finance the installation of a sugar mill in the District of Manhiça. It is expected that the mill will have an annual production capacity of 40,000 tons, which may be increased subsequently to 60,000 tons.

* * *

New refinery for Brazil[9].—Cia. Usinas Nacionais has announced that a modern electrically controlled sugar refinery, with a capacity of 600 metric tons a day, is to be installed at Recife, capital of Pernambuco.

* * *

Brazil sugar crop plan, 1965/66[10].—The Executive Commission of the Brazilian Sugar and Alcohol Institute is discussing the 1965/66 sugar crop plan which has been drawn up by the Technical Department of the Institute. This plan is based on a production estimate of 67,845,000 bags (4,070,070 metric tons). Of this quantity 13,540,000 bags (812,400 tons) would be available for export. Cane equivalent to 3,000,000 bags of sugar will be turned into alcohol.

* * *

Cane diffuser for Australia[11].—In the Directors' Report for presentation to shareholders of Fairymead Sugar Co. Ltd. at its annual meeting this year, it is stated that among new plant being installed at the mill to improve efficiency and the extraction of sugar from cane is "a cane diffuser, which is our own design. This is the first installation of this process in the Australian sugar industry and is the largest single unit of its kind in the cane sugar world".

* * *

Australian automatic saccharimeter[12].—A new standard, K 157, available from the Standards Association of Australia (166 Ann Street, Brisbane, Queensland) at a cost of 6s 0d plus postage, is entitled "Automatic Saccharimeter for Cane Juice Analysis". Developed in Australia, the saccharimeter specified is of advanced construction and performance, capable of being operated by unskilled persons, semi-portable and of robust construction, capable of analysing within tight accuracy limits up to 200 specimens in an 8-hour period and of running for periods of up to 8 months between regular overhauls.

1 F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (13), 10.
2 *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 555.
3 F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (13), 18.
4 C. Czarnikow Ltd., *Sugar Review*, 1965, (717), 109.
5 *Public Ledger*, 29th May 1965.
6 *The Times*, 28th May 1965.
7 *Public Ledger*, 29th May 1965.
8 *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 541.
9 *Sugar y Azúcar*, 1965, **60**, (6), 77.
10 F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (15), 13.
11 *Australian Sugar J.*, 1965, **57**, 173.
12 *Producers' Review*, 1965, **55**, (5), 45.

Refining in Greece[1].—The Greek authorities are reported to be giving consideration to the possibility of the production of refined sugar from raw sugar in the three sugar factories in the country with the aim of reducing the cost price of sugar produced in Greece. If the proposals are approved, imports of raw sugar will be effected.

* * *

Brazil sugar crop[2].—The 1964/65 season in Brazil closed at the end of May and, according to press agency reports, final production amounted to 3,527,613 metric tons. This compares with 3,055,884 tons manufactured during the previous campaign and 3,348,078 tons produced from the last record crop in 1961/62.

* * *

Roumanian sugar plans[3].—The target for the 1965 beet crop in Roumania has been set at 3,200,000 metric tons compared with the average for the last four years of 2,870,000 tons. In 1964 the beet crop amounted to 3,065,000 tons and it is planned to raise this to 4,000,000 tons by 1970.

* * *

Canadian sugar campaign, 1964/65[4].—Final figures for sugar production in the 1964/65 beet campaign in Canada have been published, as follows: Total sugar amounted to 142,831 long tons, made from 1,158,038 tons of beets harvested from 100,472 acres.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at* 19*th July* 1965)	s d
Anglo-Ceylon (5s)	5/9
Antigua Sugar Factory (£1)	10/6
Booker Bros. (10s)	17/7½
British Sugar Corp. Ltd. (£1)	20/3
Caroni Ord. (2s)	2/5¼
Caroni 6% Cum. Pref. (£1)	16/3
Demerara Co. (Holdings) Ltd.	3/7½
Distillers Co. Ltd. (10s units)	22/6
Gledhow Chaka's Kraal (R1)	15/9
Hulett & Sons (R1)	20/–
Jamaica Sugar Estates Ltd. (5s units)	3/9
Leach's Argentine (10s units)	15/–
Manbré & Garton Ltd. (10s)	29/9
Reynolds Bros. (R1)	17/–
St. Kitts (London) Ltd. (£1)	13/–
Sena Sugar Estates Ltd. (5s)	7/6
Tate & Lyle Ltd. (£1)	30/9
Trinidad Sugar (5s stock units)	2/4½
West Indies Sugar Co. Ltd. (£1)	9/3

CLOSING MIDDLE

New York Stocks (*at* 17*th July* 1965)	$
American Crystal ($5)	17⅝
Amer. Sugar Ref. Co. ($12.50)	23¼
Central Aguirre ($5)	28¼
Great Western Sugar Co.	40
North American Ind. ($10)	13¾
South P.R. Sugar Co.	20⅝
United Fruit Co.	20⅝

Dutch refinery closure.—Wester Suikerraffinaderij in Amsterdam, owned by N.V. Central Suiker Maatschappij, is to be closed in November 1965 and the buildings sold to a trading company.

* * *

Bulk handling in Trinidad[6].—Caroni Ltd. have opened their bulk loading installation for sugar at Point Lisas[7]. The plant has a storage capacity for 20,000 tons of sugar, which can now be handled at the rate of 600 tons an hour. This will reduce the loading time for a ship from three or four days to one day, and it is estimated that between 180,000 and 200,000 tons will pass through the plant in the course of a year.

* * *

Maine beet sugar factory contract[8].—Contracts for the $14·7 million beet sugar factory at Easton, Maine, U.S.A., have been awarded to Braunschweigische Maschinenbauanstalt who will also operate the plant for a year after its completion. The capacity of the plant, originally 3000 tons of beet per day, is to be raised to 4000 tons, so as to handle the crop expected from the 33,000-acre allotment for the area.

* * *

Congo (Léopoldville) factory resumption of production[9].—The sugar factory of Sucraf S.A. in the Congo (Léopoldville) Republic, has resumed production following its closure during the riots of 1964. It is anticipated that production this year will be some 10,000 tons.

* * *

Bagasse pulp factory in the Philippines[10]—A new bagasse pulp factory at Canlubang Sugar Estate was inaugurated recently. This enterprise is the spearhead of a programme for conversion of a million tons of bagasse a year into pulp for the manufacture of paper.

* * *

Bagasse board in Egypt.—In addition to the bagasse pulp factory at Edfu[11], which produces 60 tons per day, a cardboard plant is to be erected at Ratka which will also utilize bagasse as raw material[12].

* * *

U.S. cane sugar production, 1964/65.—Sugar production in Florida during the 1964/65 crop is put at 570,169 short tons, raw value, from 6,574,315 tons of cane[13]. This compares with 424,129 short tons, raw value, produced from the 1963/64 crop of 4,631,726 tons of cane. The Louisiana crop produced 572,827 short tons of sugar, raw value, from 7,383,164 net tons of cane[14].

* * *

New sugar mills for West Pakistan[15].—Two sugar mills, one at Darya Khan in the District of Mianwali and the other at Kot Addu, in the District of Muzaffargarh, are under construction.

1 F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (16), 13.
2 C. Czarnikow Ltd., *Sugar Review*, 1965, (718), 114.
3 F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (16), 13.
4 C. Czarnikow Ltd., *Sugar Review*, 1965, (718), 114.
5 F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (17), 7.
6 *Overseas Review* (Barclays D.C.O.), July 1965, p. 73.
7 See *I.S.J.*, 1964, **66**, 275.
8 *Sugar y Azúcar*, 1965, **60**, (7), 62.
9 F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (17), 15.
10 *Sugar y Azúcar*, 1965, **60**, (7), 66.
11 *I.S.J.*, 1961, **63**, 388.
12 *Sugar y Azúcar*, 1965, **60**, (7), 67.
13 C. Czarnikow Ltd., *Sugar Review*, 1965, (719), 118.
14 *Willett & Gray*, 1965, **89**, 261.
15 *Sugar y Azúcar*, 1965, **60**, (7), 67.