International Sugar Journal

VOL. 66 *April 1964* No. 784

Published by
The International Sugar Journal Ltd.
Central Chambers, The Broadway,
London, W.5.
Telephone: EALing 1535
Cable: Sugaphilos, London, W.5.

Annual Subscription: 32s 0d or $5.00 post free
Single Copies: 2s 6d or 45 cents plus postage

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THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXVI APRIL 1964 No. 784

NOTES AND COMMENTS

Cuban-U.S.S.R. sugar agreement.

Following the visit of the Cuban Premier, Dr. CASTRO, to Moscow in January, a new long-term agreement was announced by the Russian news agency Tass under the terms of which the Soviet Union will buy 2·1 million tons of raw Cuban sugar in 1965, three million tons in 1966, four million tons in 1967 and five million tons in each of the years 1968, 1969, and 1970. A provision is that the U.S.S.R. will pay 6 U.S. cents per lb, f.a.s. Cuban ports, during the period of the Agreement, which price is roughly in line with the "negotiated price" received by producers under the Commonwealth Sugar Agreement. This price stability was referred to by Mr. KRUSHCHEV in a speech when he spoke of eliminating the influence of world market price fluctuations on the Cuban economy, and establishment of a firm foundation for her long-term development planning. It is understood, however, that the actual payment will be made in goods rather than money.

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World sugar stocks.

In two recent issues of the *International Sugar Report*[1], F. O. Licht K.G. analyse the stock positions in, respectively, the exporting and importing countries of the world. For the former they calculate total stocks to amount to 4,242,012 metric tons at the end of the campaign year 1962/63, compared with 6,748,803 tons in 1961/62 and 10,043,181 tons in 1960/61. The 1962/63 campaign end stock cannot be used for export purposes in 1963/64 since the larger part is needed for the domestic requirements of the sugar exporting countries. Further, the possibilities for increasing sugar exports are apparently limited since sugar production in 1963/64 will not be much more than in the previous year; consequently a tense situation is expected in the sugar statistical position until the end of the 1963/64 campaign year.

Among the importing countries total stocks have also been reduced in the period concerned; from 7,192,287 tons in 1960/61 to 6,885,802 tons in 1961/62 and 5,125,914 tons in 1962/63. In a number of countries no official statistics are available and the figures used are estimates; however, although there may be differences of opinion as to these estimates, "it cannot be doubted that they have reached a dangerously low level at the end of the campaign year 1963/64."

It cannot at present be foreseen whether the campaign year 1964/65 will lead to radical changes in the beet or cane sectors, say Licht. While mention is made of expansion plans in a number of beet and cane sugar producing countries it is not known for certain how many of these will be put into practice, and, it should be emphasized, "as a result of the annual rate of 2·5 million tons consumption increase in the case of a normal world sugar production, and as a result of the exhaustion of world sugar stocks, a very substantial increase of world sugar production is necessary in order to normalize the situation."

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Developments in Swaziland sugar[2].

The production of raw sugar in the low veld area is likely to increase considerably during the next few years. With expansion already in progress and with further expansion now approved, production may reach a total of 320,000 tons in 1966 (170,000 tons from the Triangle estates and 150,000 tons from Hippo Valley) of which some 250,000 tons would probably be available for export.

The development now approved includes a £5 million programme at Hippo Valley which itself includes the construction of a second sugar mill costing £3,000,000; tenders have already been invited for the clearance of up to 10,000 acres of land at Hippo Valley as part of a programme to increase the area under sugar cane to over 21,000 acres.

Triangle Ltd. and the Imperial Cold Storage Co. have agreed on a further programme of capital development costing £1,750,000 which includes the planting of 5000 more acres to sugar cane. It has also been announced that negotiations are taking place for the formation of a company with a capital of £3,500,000 to develop the area to be served by the waters of the new Chiredzi dam which is now under construction in the lowveld and where a further 50,000 tons of sugar might be produced annually.

[1] 1964, **96**, (2), 1–5; (3), 1–4.
[2] *Overseas Review* (Barclays D.C.O.), January 1964. p. 25.

U.K. distribution payment reductions.

The continued falls in world market values have made it necessary for the Sugar Board again to reduce its distribution payments on sugar. A reduction was announced on the 5th March, taking effect from the following day, when the distribution payments were reduced from 18s 8d to 9s 4d per cwt of refined sugar (from 2d to 1d per lb). The payments were again reduced from the 13th March, to 4s 8d per cwt (½d per lb). The changes permitted corresponding increases in the ex-refinery price of sugar and were made in order to bring the Sugar Board's trading position more into line with current levels of world prices. The changes were the fourth and fifth, respectively, of this year, this frequency reflecting the current instability of the world market.

* * *

British Sugar Corporation Ltd.

Agreement has been reached between the Directors of the British Sugar Corporation Ltd. and the Government on new financial arrangements whereby shareholders will in future bear risks similar to those of ordinary equity shareholders while the existing restriction on the Corporation's dividend will be removed. The proposals were to be put to an Extra-ordinary General Meeting of shareholders on the 25th March and have also to be approved by Parliament.

There are two main features of the proposal. Firstly, over the years since April 1957 the Sugar Board has been the source of £14·2 million profits of the Corporation of which £5·5 million has been put to reserve for re-investment in the renewal and improvement of the Corporation's equipment. It is proposed to issue five million fully-paid £1 shares, doubling the existing share capital, and to issue half of these to existing share holders in a one-for-two proportion while the remaining 2,500,000 shares would be issued to the Sugar Board. Dividends received by the Board would go to reduce the sur-charge on sugar or to increase distribution payments.

Secondly, since its formation, the Corporation has had its dividend limited (to 7% since 1960) to what the Government considers adequate and fair to shareholders in view of the absence of commercial risks. Should the proposals be accepted, the limitation will be removed but there will be introduced an element of risk into the Corporation's activities. A formula has been agreed to calculate a "standard price" for sugar beet—one which the Corporation ought to be able to pay and still make a reasonable return on their capital. The difference between this standard price and that set by the Government at the Annual Farm Price Review (a price dictated by political rather than economic considerations) will be met either by a payment from the Government to the Corporation or *vice-versa*; thus the Corporation will effectively pay the "standard price" for all the beet it buys. It will still be obliged to buy all the beet available from the acreage fixed by the Minister for Agriculture, and thus the total slice will largely be governed by weather conditions. The profits—and dividends—of the Corporation will then depend on the efficiency of its operations and the size of the crop. For the first year to be covered by the new arrangements, the Board expects to recommend a 6% dividend on the increased capital—equivalent to 9% for existing shareholders compared with the limit of 7% at present.

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U.S. supply quotas, 1964.

Towards the end of February the U.S. Dept. of Agriculture reallocated the remainder of the Western Hemisphere Supply Quota Deficit of 23,407 short tons to the Dominican Republic and Peru (14,227 tons and 9180 tons, respectively)[3]. On the 6th March the Department announced the declaration of a shortfall of 50,000 short tons in respect of Puerto Rico[4]. Taking into account 25,407 tons which had been withheld at an earlier date from Paraguay, British Honduras and Panama—countries which had failed to fulfil their quotas in 1963—this made a total of 75,407 tons to be redistributed. Of this quantity it was announced that 35,608 tons had been allotted to the Philippines whilst the balance was held for distribution to Western Hemisphere countries. In the week following it was announced that the Dominican Republic and Guatemala have received allotments of 34,733 tons and 5066 tons, respectively, which completes the allocation.

Details of supply quotas as at present, including reallocations and global quotas, are as follows:

	short tons, raw value
Domestic beet	2,698,590
Mainland cane	911,410
Hawaii	1,110,000
Puerto Rico	915,000
Virgin Islands	15,832
Philippines	1,219,878
Argentina	20,000
Australia	215,366
Belgium	182
Brazil	182,363
British Honduras	6,224
British West Indies & British Guiana	143,495
Colombia	30,346
Costa Rica	72,663
Dominican Republic	392,896
Ecuador	55,393
El Salvador	20,679
Fiji	54,848
France	1,006
French West Indies	32,911
Guatemala	46,592
Haiti	20,326
India	116,521
Ireland	10,000
Madagascar	11,550
Mexico	476,953
Nicaragua	45.748
Panama	19,092
Peru	234,505
South Africa	121,307
Southern Rhodesia	10,600
Taiwan	83,799
Global quota not authorised	503,925
	9,800,000

[3] C. Czarnikow Ltd., *Sugar Review*, 1964, (650), 48.
[4] *ibid.*, (652), 56.

SUGAR CANE CULTIVATION IN THE UNITED STATES

Proceedings of the 1959-60 *Meetings of the American Society of Sugar Cane Technologists.*

IN this bulky volume of 300 pages about a third is devoted to agricultural matter, represented by 13 papers in the agricultural sections of the report.

Breeding and Selection

Two interesting papers are devoted to the breeding and selection of the sugar cane. That by R. D. BREAUX *et al.* outlines the present system of breeding and selection of varieties of sugar cane for Louisiana which has evolved over the years. Seedlings are raised in a greenhouse and their resistance to mosaic disease tested at an early stage. The subsequent field culture and selection is explained in detail.

The second paper, by M. T. HENDERSON, is of a more general nature and contains a good résumé of the breeding work with sugar cane as it has been developed in different parts of the world. The writer points out that according to modern concepts five species of *Saccharum* or sugar cane are recognized, viz.: *Saccharum officinarum* (Noble cane), *S. barberi*, *S. sinense*, *S. spontaneum* and *S. robustum*, the two last-mentioned being wild species. It may not be generally realized that it was not until 1949 that the first sugar cane seedlings were grown in the United States (by the Dept. of Plant Pathology).

In the past 25–30 years sugar cane production in Louisiana has been based on varieties developed from interspecific hybrids made in Java and India, viz.: *S. officinarum*, *S. barberi* and *S. spontaneum*. However only two forms of *S. spontaneum* were involved, the Java form and one from India. It is now recognized that many other forms of the wild *Saccharum spontaneum* occur in India, Burma, Sumatra and other areas. They differ genetically from the two forms used previously and it is thought they probably contain genes that would be of value in a cultivated cane for Louisiana.

Harvesting

The effect of trash and topping on the quality of harvested sugar cane is discussed by R. E. COLEMAN, who points out that, since the advent of mechanical harvesting, trash in mill cane and improper topping have created serious problems in both harvesting and milling, especially by reducing sugar quality and sucrose content. This is particularly noticeable when the trash is wet, after rain. The results of topping experiments with a mechanical harvester are outlined. It was concluded that lower "average topping" would effectively increase the quality of the cane delivered to mills without an economic loss to the growers, and under certain conditions would effect a practical gain to both growers and processors.

In his paper C. SAVOIE records the performance of the new Cary combine harvester with that of a conventional harvester. The machine was considered satisfactory where chopped cane was not objected to by the mill.

Insect Pests

The sugar cane borer, *Diatraea saccharalis*, has been the most serious and destructive insect attacking sugar cane in Louisiana for many years. Present estimates indicate that cane growers of the State have since 1937 suffered an average annual loss to the sugar cane borer amounting to about 13% of their sugar yields. This is the view expressed by W. H. LONG *et al.* in a paper on the control of the sugar cane borer with insecticides. A brief history of the use of insecticides for cane borer control in Louisiana is given, followed by an account of elaborate field trials over several years to test the efficiency of "Endrin", "Ryania", "Toxaphene" and other insecticides applied by aircraft. Tables with results are given showing the overwhelming superiority of "Endrin", in granular form, over all the other insecticides tried. Recent studies to determine what effect field applications of "Endrin" will have on insect predators found in Louisiana cane fields are expected to be published shortly.

In another paper on the same subject by L. D. NEWSOM, he discusses the use of the potent insecticide "Endrin" against sugar cane borers and its possible toxicity to other forms of life, especially fish. It will kill many species of fish at a concentration of only 0·00003 p.p.m. It is also toxic to mice and kills meadow mice at a rate of 2 lb or more per acre. The writer states that evidence so far shows that "Endrin" has little effect on *Trichogramma* but it has reduced the populations of a complex of suspected predators of the sugar cane borer by about 50%. It could be that use of "Endrin" will allow some hitherto unknown potential pest of sugar cane to develop into an important pest. However, the same possibility existed when cryolite and "Ryania" were first used, or when any insecticide is first used commercially. All insecticides must be capable of upsetting the so-called balance of nature or they would not control any insect.

A third article concerned with the sugar cane borer is that by E. A. CANCIENNE on the imported fire ant programme and its effect on the borer. Eradication of the fire ant pest, established in Louisiana for some 15 years or more, is by the application of 20 lb of 10% granulated "Heptachlor" per acre broadcast by aircraft or jeep-mounted Buffalo turbines. The treatment, although effective with the fire ant, resulted in an unexpected build-up of the cane borer population. The conclusion reached was that the "Heptachlor" destroyed predacious insects as well as a number of sugar cane borers and that borers from adjacent untreated fields then moved back into the

treated fields later in the season while the predators did not. The borers were then unmolested and increased in large numbers.

Diseases

Mosaic disease is considered to be the most serious disease confronting the Louisiana sugar industry at the present time. In his study of the mosaic problem in Louisiana, E. V. ABBOTT refers to work previously carried out on the existence of different strains of the virus and gives the result of further work. On most varieties of sugar cane grown commercially some strains of mosaic do not differ greatly in the symptoms they produce although they may have markedly different effects on the growth of the varieties. However it has been found that on certain selected varieties they produce distinct symptom patterns which serve to distinguish them. A new strain is described and a table showing the relative prevalance of different strains is provided. Factors affecting infectivity of the virus, losses caused by mosaic and control are discussed.

Another paper by L. J. CHARPENTIER on sugar cane mosaic deals with vector studies in Louisiana, four or five different insects being considered responsible.

Weed Control

The control of grasses or grass weeds in sugar cane fields in Louisiana is a serious problem in many areas. In a progress report on chemical weed control in sugar cane over the last ten years E. R. STAMPER summarizes the earlier work on chemical weed control in cane fields in Louisiana and refers to some of the more recent developments. Over a hundred different chemicals and formulations have been screened for their herbicidal action in the weed programme with sugar cane during the last 12 years. Cost prohibited the extended use of some of the chemicals that showed promise. In 1955 a survey showed that 75% of the cane acreage was treated with some chemical or other for weed and grass control. In the same year trials were started with "Dalapon" and the three-way combination of TCA, "Dalapon" and 2,4-D introduced to cane growers for trial in 1958.

L. L. ARCENAUX writes on the control of Johnson grass on Smithfield plantation, where it had become almost impossible to grow any row crops economically in the early 1950's because of the serious infestation of Johnson grass. The use made of certain varieties of sweet clover (*Melilotus*) for smothering young Johnson grass and later of chemical weedkillers (TCA and 2,4-D) is discussed. Johnson grass (*Sorghum halepense*), a native of southern Europe and Asia, was introduced as a forage plant from Turkey to South Carolina about 1830 and is now the major problem in Louisiana weed control. Investigations have shown that the seeds of Johnson grass may remain viable in the soil for a long time: 8 to 10 years if they are in the soil at a depth of over 3 inches. It is considered that 80–90%of the Johnson grass seed produced in cane fields is capable of germination.

F.N.H.

The South African Python— The Cane Growers' Friend

THE South African python, with its partiality for cane rats, has long been a friend to the cane growers in the coastal districts of Natal and Zululand. As this large reptile is not venomous and is virtually harmless as far as man and the larger animals are concerned, it is distressing to learn that this interesting creature is so rapidly decreasing in numbers in South Africa. One writer[1] puts forward the possibility of the python becoming extinct in South Africa within ten years, but there are others that do not share this view, although regretting its diminishing numbers. They point out that in Natal the Parks Board protects pythons in its reserves where they live out their natural lives. The python may be theoretically protected by law, but this is not always respected, especially as there is a demand for the python's skin.

The python's chief enemy is man. Although it has its natural enemies, such as leopards and baboons, it can survive these in the wild state. The python is a large and easy victim for man, for it has no speed and can take no evasive action. Acording to observers in South Africa there was a time when it was common to find a python measuring 18 feet but today one reaching even 12 feet is considered exceptional. The maximum length it may attain is about 25 feet. A python needs about 20 years of life to attain a length of 18 feet, with food reasonably plentiful. Pythons have been known to live 25 years in captivity where they can become quite tame.

A python's food consists of birds, rodents, and small mammals. In Natal the cane farmer is grateful to the python for its destruction of the cane rat, for it is, or has been, the major control over cane rats in some areas. It would be the cane farmer who would be affected most if the python were to become extinct or very rare.

F.N.H.

Commercial roguing as a practical control of sugar cane mosaic in Louisiana. C. H. HADDON and I. L. FORBES. *Sugar Bull.*, 1963, **41**, (24), 301.—In 1961 and 1962 roguing for mosaic was carried out by a commercial firm in seed cane plots. Roguing did not entirely eliminate mosaic from any location but infection was maintained at a low level.

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The chemical control of *Mimosa pudica* and *M. casta*. L. KASASIAN. *Trop. Agric.*, 1963, **40**, (4), 315–317. Of the various herbicides tried on the sensitive plant, *Mimosa pudica* and *M. casta*, a less common weed, the most effective was 0·5 lb acre of 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) as an overall spray to be followed by spot spraying if necessary two to three months later.

[1] CLARK: *S. African Sugar J.*, 1963, **47**, 329–331.

SUGAR CANE AGRICULTURE IN JAMAICA

Annual Report, Research Dept., The Sugar Manufacturers' Assoc. Ltd., 1961

EXPANSION in sugar production in Jamaica continued during the year under review and 434,252 tons of commercial sugar were made. Juice quality was relatively poor, although slightly better than in 1960 and it required 9·86 tons of cane to produce a ton of 96° sugar. More cane was processed than in any previous year to obtain the record figure for sugar production, the amount exceeding the 1960 figure by 43,329 tons.

The acreage of estates canes reaped increased by 3% over the previous year, but cane yield per acre, at the creditable figure of 33·6 tons per acre, was actually less than that for 1960. Eight estates recorded at least 35 tons per acre, one of these reaching 40·9 tons. Only four estates produced less than 30 tons per acre.

Varieties

Efforts to improve juice quality were reflected in the extended planting of B 4362 and the reduction in planting of B 41227: 44% of the plant acreage reaped was under B 4362 and 16% under B 41227. These two varieties along with B 42231 account for about 80% of the total acreage reaped, such is their popularity. A number of new varieties are being tried, the most promising being B 5037, B 51410, B 51415 and Eros. Recent introductions of Australian, Cuban, Brazilian, United States, Indian and Puerto Rican varieties were established in estate nurseries after quarantine.

Canefly

Heavy and widespread infestations of canefly (*Saccharosydne saccharivora*) occurred at several places. One outbreak was successfully dealt with by a single spraying. Others required periodic spraying because of reinfestation from unsprayed areas. With one plantation the outbreak came to an end of its own accord.

Through a study of canefly populations some light was thrown on the reasons for the outbreaks. Canefly prefers fields of young sprouts for oviposition and the population builds up for two generations; thereafter it declines through the combined effects of emigration, a Stylopid parasite, an undetermined egg mortality factor, entomogenous fungi, and the age of the cane. Usually 8 to 9 months cane has a very low population; any factor allowing a higher than normal population in mature cane can contribute to an outbreak. A long crop favours canefly in that there is a prolonged succession of young cane to which the adults can migrate.

An unsuccessful attempt was made to control canefly by means of the Hawaiian egg predator (*Cyrtorhinus mundulus*). There was no sign of establishment although individuals could be found for some weeks after liberation. Eight insecticides were tested on canefly but no suitable alternative to "Malathion" was found. It is considered that a vigorous field of cane will recover from a heavy canefly infestation but under poor growing conditions any setback due to canefly will be magnified.

Leaf Feeding and Leaf Analysis Surveys

Leaf feeding has given encouraging results on areas where uptake of a nutrient may be restricted. In the case of ratoons in heavy clay areas potash was better supplied to the plants when sprayed on than when applied on the soil surface. Phosphate was more easily assimilated when the material was sprayed on the foliage than when it was dibbed in the soil in calcareous areas. The chemical analysis of leaves from a large number of fields continue to supply evidence of the nutritional status of soils in the industry. With the possibility of further restriction of field experiments owing to labour difficulties, it is proposed to intensify the leaf analysis survey.

F.N.H.

Sugar cane variety tests in Louisiana during 1962 with a summary for the five year period 1958-1962. T. J. STAFFORD, R. J. MATHERNE and L. P. HEBERT. *Sugar Bull.*, 1963, **41,** (23), 281–289.—Tables are given showing the performance of various commercial and unreleased varieties during the last five years and the results discussed. The variety CP 52-68 was the outstanding commercial variety in 1962 but over the five year period the following varieties differed very little in average yield—CP 44-101, CP 48-103, CP 52–68, N:Co 310. The variety CP 52-68 averaged well in sugar per ton and sugar per acre in all areas and on both light and heavy soils. Some other varieties with lower yields were considered important because of their greater resistance to mosaic. The most promising unreleased variety was CP 55-30, although it is susceptible to mosaic.

* * *

Spread of sugar cane mosaic in the fall in Louisiana. N. ZUMMO. *Sugar Bull.*, 1963, **41,** (24), 298–300. Tests showed that mosaic disease spread less (in the spring) in late-planted than in early autumn-planted cane, owing to activity of insect vectors in the autumn. It is considered that roguing for mosaic should be carried out at least once in the fall if possible and that varieties susceptible to mosaic should be planted as late as practical.

* * *

Cultivation is useful for insect control. R. B. MOLLER. *Cane Growers' Quarterly Bull.*, 1963, **27,** (2), 59.—It is urged that, with the increasing use of chemical insecticides, often far from cheap and of short duration, the usefulness of correct cultural practices in reducing damage from certain insect pests should be borne in mind.

"Atrazine" damage to sugar beets. ANON. *Up and Down the Rows*, 1963, (133), 2.—An unfamiliar type of injury to sugar beet in June 1963 is described: a burning of the leaf, starting at the tip, causing the whole plant to wilt and die. In each case investigation showed that in the previous season corn (maize) had been grown and sprayed with "Atrazine". Investigations are proceeding.

* * *

Yield performance of sugar cane varieties from field experiments (1959–62). ANON. *Victorias Milling Co. Expt. Sta. Bull.* (Philippines), 1963, **10,** (8 & 9), 3, 5. Yield and other characteristics of eight new varieties, including resistance to leaf scorch and yellow spot disease, are given. It is recommended that the present major cane variety, POJ 3016, occupying 54% of the district's total cane area, and the variety H 37-1933 be replaced by any 4 or 5 of the 8 varieties here described (i.e. Phil. 54–60, B 43-62, B 37-172, F 140, H 49-5, Q 57, N:Co 310, H 38-2915).

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Graminaceous moth-borers in West Pakistan. K. CARL. *Tech. Bull. Commonwealth Inst. Biol. Control*, 1962, (2), 29–76; through *Hort. Abs.*, 1963, **33,** (3), 640. Information is given on the incidence and population trends of sugar cane borers, varietal susceptibility, the effect of fertilizers on borer attack and parasitism.

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An assessment of the damage caused by *Diatraea spp.* in Grenada, April 1961. F. D. BENNETT. *Tech. Bull. Commonwealth Inst. Biol. Control*, 1962, (2), 87–100; through *Hort. Abs.*, 1963, **33,** (3), 640.—The relative abundance of *Diatraea saccharalis* and *Eodiatraea* (*Diatraea*) *centrella* (= *D. canella*) and the damage to sugar cane caused by them were investigated. There was no evidence of parasitism, and it appeared that none of the introduced parasites had become established. Further introductions have been made.

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Effect of *Trichogramma* releases on parasitism of sugar cane borer eggs. R. W. BURRELL and W. J. MCCORMICK. *J. Econ. Ent.*, 1962, **55,** 880–882; through *Hort. Abs.*, 1963, **33,** (3), 640.—Frequent releases of *Trichogramma fasciatum* did not increase significantly the parasitism of *Diatraea saccharalis* eggs.

* * *

Canefields rat baiting. F. W. BLACKFORD. *Producers' Rev.*, 1963, **53,** (8), 41.—The advantages of thallium sulphate, properly used, are stressed, 5 milligrams being enough to kill most rats attacking cane. In the method described, wheat impregnated with thallium sulphate (1 lb in aqueous solution per 300 lb wheat) is packed in small sachets ($\frac{1}{8}$ oz per sachet), each sachet being enough to kill two rats. Four packets or sachets are placed every 10 yards in every 7th row in small cleared areas. The cleared area is an essential feature as it attracts the natural curiosity of the rat.

* * *

Effect of different modes of vector inoculation on symptoms and yield reduction of beet yellows virus. K. BJÖRLING. *Socker Handl. II*, 1963, **19,** (1), 1–23. An account is given of experiments to study the influence of different methods of vector inoculation on the symptoms and on the yield depression caused by beet yellows virus. Earlier experience in Sweden that *Myzus persicae* was a more potent vector than *Aphis fabae* was confirmed.

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Some observations on the effect of cane borer attack on yield and sugar recovery. M. AHMAD. *Agric. Pakist.*, 1962, **13,** 90–93; through *Hort. Abs.*, 1963, **33,** (3), 640.—Canes attacked mainly by *Scirpophaga auriflua* and *Argyria tumidicostalis* were found to be 39% less in height and 34% lower in weight than healthy canes. The juice content of damaged cane, however, was increased by 6% although the Brix of the juice fell by 3·7%.

* * *

Mechanical thinning of sugar beet. M. MARTENS. *Pub. Vulgar. Tech. Inst. Belge pour Amél. Betterave*, 1963, (1), 7–22.—The progress of mechanical thinning of sugar beet in Belgium is stressed, about 2000 hectares having been thinned in this way in the 1963 season. General guidance for the sugar beet grower, in regard to it, is given.

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The Punjab plans to put "finis" to sugar cane's gurdaspur borer. P. S. DEOL. *Indian Farming*, 1962, **12,** (8), 29; through *Hort. Abs.*, 1963, **33,** (3), 640. *Bissetia steniellus* and the damage it causes are described. The most effective control measure is the early removal and burning of all affected shoots.

* * *

Pre-emergence herbicide screening trials in irrigated sugar cane, 1961–1962. S. D. HOCOMBE and D. H. GREEN. *Misc. Rpt. Trop. Pestic. Res. Inst.* (Arusha), 1962, **368,** 7 pp.; through *Hort. Abs.*, 1963, **33,** (3), 636.—Trials are reported of herbicides required to persist for 3 to 5 months in furrow- and overhead-irrigated cane. In furrow-irrigated cane "Prometon" and "Atraton" at 1·3 lb per acre gave effective weed control for 11 weeks. Similar quantities of "Simazine" or "Altrazine" persisted for only 9 weeks. In overhead-irrigated cane "Prometon", "Atraton", G 32292,

"Simeton," "Simazine," G 34698, "Diuron" and C 2059 all showed approximately equal persistence; generally, however, the methoxy-triazones were more persistent than the chloro-triazines.

* * *

Forage cane variety trials. A. P. TORRES, D. F. DE SOUSA and A. P. TRIVELIN. *An. Esc. Agric. Queiroz*, 1961, **18**, 217–234; through *Plant Breeding Abs.*, 1963, **33**, (4), 615.—Twice yearly crops of eight varieties were compared for two and a half years; Co 419 gave the highest yield but Kassoer, CB 40-49, Co 413 and IAC 36-25 are also recommended. Taguara and Co 290, the varieties recommended at present, were inferior to the above varieties.

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Phil 49–22, a wonderful cane hybrid. F. T. AALA. *Philipp. J. Agric.*, 1959 (issued 1962), **24**, 45–48; through *Hort. Abs.*, 1963, **33**, (3), 635.—This cross between a Trojan mother cane and an Alunan pollinator has proved resistant to Fiji disease, and has given higher cane yields and sugar percentages than the parents in both plant and ratoon crops.

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The influence of soil drought on the growth, yield and quality of cane varieties in relation to their drought endurance. H. S. GILL. *Indian J. Agron.*, 1962, **7**, 148–159; through *Soils and Fertilizers*, 1963, **26**, (5), 373.—Six important varieties were tested and 1, 2, 4 or 6 hot-weather irrigations were applied. Tillering and growth were adversely affected by low irrigation, though three of the varieties were less affected than the others; yields were highest with six irrigations but in the same three varieties the yield was little reduced by low irrigation. Cane quality was not greatly influenced by frequency of irrigation.

* * *

Weed control practices and research for sugar cane in Hawaii. N. S. HANSON. *Weeds*, 1962, **10**, 192–200; through *Hort. Abs.*, 1963, **33**, (3), 636.—An account of the chemical control of weeds in Hawaiian sugar cane plantations since it commenced in 1913 (with sodium arsenite and sodium chlorate) up to the present time is given. At present over half a million acres are sprayed each year at a cost of nearly seven million dollars for labour and material.

* * *

The decline of a beet eelworm (*Heterodera schachtii Schm.*) population in microplots in the absence of host plants. F. MORIARTY. *Nematologica*, 1963, **9**, 24–30; through *Soils and Fertilizers*, 1963, **26**, (5), 363.—The rate of decline of beet eelworm was measured from 1955 to 1958 in 20 microplots and from 1957 to 1958 in 10 others: the plots had previously grown susceptible plants. With new cysts, decline was negligible for one year and then became about 30% per year. The decrease in egg numbers was 36% in the second year; at other ages it was about 60% per year.

The technical status of sugar cane growing in Venezuela. L. GARCÍA LOZADA. *Ingen. Agron.*, (Venezuela), 1962, (9), 7–17; through *Hort. Abs.*, 1963, **33**, (3), 634.—Information is given on production, control of flowering, mechanization, nutrition, irrigation, the control of weeds, diseases and pests, and the co-ordination of harvesting and transport.

* * *

Sugar beet variety trials. H. LÜDECKE. *Mitt. deutsch. Landw. Ges.*, 1962, **77**, 1538–1540; through *Plant Breeding Abs.*, 1963, **33**, 617.—General views and recommendations are based on trials held at Göttingen. Such questions as planning the trials, judging the value of a variety, using introduced varieties and assessing yields are discussed.

* * *

Note on induction of flowering in trailing shoots of clones of *Saccharum spontaneum*. K. SRINIVASAN and M. B. G. R. BATCHA. *Curr. Sci.*, 1963, **32**, 36–38; through *Hort. Abs.*, 1963, **33**, (3), 635.—Such shoots were induced to flower by training them up bamboo canes to assume an erect habit; recumbent controls remained vegetative.

* * *

Diseases of sugar cane in the Cauca Valley. C. A. ESCOBAR PAÉZ. *Acta Agron.* (Palmira, Colombia), 1962, **12**, 49–123; through *Plant Breeding Abstracts*, 1963, **33**, (4), 617.—Numerous fungal, bacterial, viral and physiological diseases are dealt with in this monograph. Varieties reported in the world literature to have resistance or partial resistance, or known to have those properties in the Cauca Valley, are enumerated.

* * *

The improvement of sugar cane production in Somalia. Trials and results. F. BIGI. *Riv. Agric. subtrop.*, 1962, **56**, 602–667; through *Hort. Abs.*, 1963, **33**, (3), 634. Annual production figures are quoted for 1934–1950. The measures adopted for reclaiming saline and alkaline soils are described, The variety Co 331 proved to be very tolerant to salinity, and Co 310 was reasonably good in this respect. *Phaseolus mungo* and *Crotalaria juncea* were the most satisfactory green manure crops used. The beneficial effects on yield and sugar content of improved cultural practices and urea application are shown in tables and graphs for the period 1950–62.

* * *

The improvement of sugar cane production and other agronomic aspects in Kachin State, especially No. 1 Resettlement Unit, Myitkyina. G. A. W. WAGENAAR. *Rpt. ETAP/FAO*, 1962, (1505), 22 pp.; through *Hort Abs.*, 1963, **33**, (3), 633–634.—Recommendations on an ex-service resettlement scheme in Burma include some details of sugar cane cultivation (rotations, varieties and cultural practices).

Preservation of pollen. J. H. BUZACOTT. *Cane Growers' Quart. Bull.*, 1963, **26**, 106–107; through *Plant Breeding Abs.*, 1963, **33**, (4), 616.—A description of the freeze-drying technique as applied to pollen storage is given. It is reported that sugar cane pollen freeze-dried in America has been successfully used to pollinate Co 419 in Australia, seventy seedlings having been produced.

* * *

Chemical weed control on a Hawaiian sugar plantation. H. HALL. *Proc. 16th Southern Weed Conf.*, 1963, 94–97; through *Weed Abstracts*, 1963, **12**, (5), 239. Weed control measures on a large plantation under a two-year rotation are outlined. The first operation is pre-emergence treatment from the air using "Diuron" (80%) at 4 lb per acre in 7 gal spray solution. Later "Atrazine" (80%) at the same rate is used against weeds that have survived. In the established cane, spot treatment using TCA + PCP is given. The more important weeds are listed.

* * *

Evaluation of "Fenac" and related compounds for the control of Johnson grass and other weeds in sugar cane. R. W. MILLHOLLON. *Proc. 16th Southern Weed Conf.*, 1963, 91–93; through *Weed Abstracts*, 1963, **12**, (5), 240.—Trials are described in which "Fenac" and "Simazine", incorporated at planting at 4 and 12 lb per acre were used. "Fenac" was injurious to the crop, especially on clay soils, the extent of the damage depending on the cane variety. "Fenac" gave the best control of Johnson grass (*Sorghum halepense*), as assessed four months after treatment.

* * *

Water hyacinth, a pest of world waterways. W. T. PARSONS. *J. Agric. Vict.*, 1963, **61**, (1), 23–27. The biology and distribution of the water hyacinth (*Eichhornia crassipes*) are reviewed, as are its vigour or danger as a weed and control with 2,4-D. Successful control of two outbreaks in Australia is described.

* * *

Estimating cane yields in evaluating sugar cane seedling selections. L. P. HEBERT. *Crop Sci.*, 1963, **3**, 277–278; through *Biol. Abs.*, 1963, **44**, 1547.—Comparisons were made between weighing all the cane on an experimental plot with the estimate obtained based on number of stalks and average stalk weight—from a few 10-stalk samples from each plot. It was concluded this estimate method of obtaining cane yield had some merit in evaluating sugar cane clones in the early stages of a variety improvement programme, although actual field weights are to be preferred whenever it is possible to obtain them.

* * *

Evaluation of land suitability. G. C. BIESKE. *Cane Growers' Quarterly Bull.*, 1963, **27**, 41.—Advice is given on points to be kept in mind in considering new areas for sugar cane cultivation in Queensland. This appears under the following headings: existing vegetation, topography, soil profile, climatic conditions, geographical position and pests.

New cane varieties in Queensland. *Cane Growers' Quarterly Bull.*, 1963, **27**, 42–45.—Descriptions (with photographs) of two new varieties for Queensland, Q.77 (by J. H. BUZACOTT) and Q.78 (by S. O. SKINNER), are given. The former is intended for the northern mill areas Mossman, Hambledon and Mulgrave and the latter for the Tully, South Johnstone, Mourilyan and Goondi areas. Q.77 is much more resistant to wind damage than Pindar while Q.78 shows marked freedom from lodging and may be well suited for mechanical harvesting.

* * *

Lightning strike symptoms in cane fields. N. MCD. SMITH. *Cane Growers' Quarterly Bull.*, 1963, **27**, 46–47.—The symptoms of cane struck by lightning during storms in Queensland are given. This causes dead patches not usually exceeding 15 feet in diameter and stalks may be found in the centre of the strike that have split or burst open with some shredding of the rind and exposed stalk tissues.

* * *

The grass moth. ANON. *Cane Growers' Quarterly Bull.*, 1963, **27**, 47.—A description and outline of the life history of this insect (*Psara licarsisalis*) is given. It is a notorious pest of couch grass lawns, but the larva rarely attacks cane. Instances of attack of small plant cane and suggested remedial measures (DDT) are given.

* * *

Two vine weeds. H. E. YOUNG. *Cane Growers' Quarterly Bull.*, 1963, **27**, 48–49.—Descriptions, with photographs, are given of Star of Bethlehem or Cupid's Flower (*Ipomoea quamoclit*), not regarded as a serious weed of cane in Queensland, and of Red Morning Glory (*Ipomoea angulata*).

* * *

Cowpea wilt in "black eye 5." I. M. COOK. *Cane Growers' Quarterly Bull.*, 1963, **27**, 50–51.—An account is given of severe damage to cowpeas, alleged to be the variety "black eye 5", by stem-rot or wilt (*Phytophthora vignae*), this variety being assumed to be resistant to the disease. It was shown that the cowpea in question was not the genuine "black eye 5". Cowpeas are used as a green manure crop with cane in Queensland.

* * *

Rust disease. B. T. EGAN. *Cane Growers' Quarterly Bull.*, 1963, **27**, 52.—A popular description of this sugar cane disease, not serious in most parts of Queensland, is given, accompanied by a photograph showing the under surface of a cane leaf attacked by the disease.

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A two row, cut-up cane harvester at Bundaberg. N. MCD. SMITH. *Cane Growers' Quarterly Bull.*, 1963, **27**, 58.—A description is given of the harvester developed by Mr. K. YOUNG and his elder son to handle the 1963 crop on two farms. The machine took three years to produce. A photograph shows it in action.

DETERMINATION OF EXTERNAL WATER IN WHITE SUGARS BY DIRECT TITRATION WITH KARL FISCHER REAGENT

By R. G. BENNETT, R. E. RUNECKLES and H. M. THOMPSON
(Tate & Lyle Refineries Ltd., Research Laboratories, Keston, Kent.)

Introduction

FOR control of the granulation (or drying) process for refined white sugar crystals, determination of the surface moisture by drying at 105°C under atmospheric pressure is too slow and somewhat imprecise. It was thought that the use of Karl Fischer reagent would be more satisfactory.

Indirect titration is more often used with this reagent since direct titration may give premature and fading end-points. Nevertheless, the latter is preferable from the standpoint of simplicity. ZERBAN *et al.*[1,2] have outlined direct titration systems of high precision, whilst BROWN & VOLUME[3] use this method for routine work. It will be shown that direct titration is applicable to the determination of external moisture in white sugars if conditions are standardized.

This investigation involved the design of suitable apparatus and determination of the conditions both for standardizing the Karl Fischer reagent and for the actual estimation. The vacuum distillation method of HILL & DOBBS[4] was selected as the basis of comparison.

Apparatus

The electrode circuit, similar to that of CORNISH[2], is shown in Fig. 1. The complete apparatus is shown in Fig. 2, whilst Fig. 3 comprises a detailed schematic diagram.

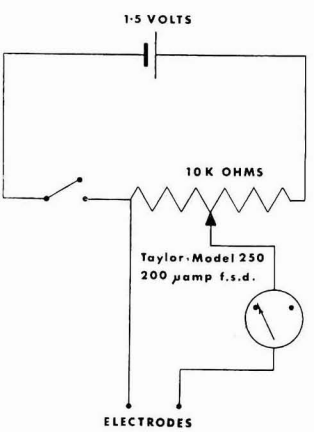


Fig. 1. Electrode circuit.

A standard screwed wide-mouth 4-oz glass bottle is used for the titration vessel, a butyl-rubber washer bonded to a threaded stainless steel cap on the apparatus housing making the joint air-tight. The only access to the atmosphere from the titration vessel is via a drying tube and, since any slight contamination with atmospheric moisture which may occur during the stirring period is allowed for in the blank titration, the passage of dry nitrogen during a determination is unnecessary. Stirring is accomplished by a stainless-steel shaft, with paddle, passing through an airtight coned bearing into the titration vessel. The titration vessels are dried at 105°C for at least 3 hours and cooled and stored in a desiccator.

Prior to titration, the electrodes and stirrer are sprayed with acetone and dried by compressed air. The former are cleaned, when necessary, by immersion in chromic acid at 60°C for an hour followed by water-washing and drying; they are readily detached for this purpose.

The methanol burette levels automatically at 35 ml capacity but the Karl Fischer burette sets itself at 0·5 ml above zero, allowing for accurate manual setting to zero. Prior to commencing an estimation, it is essential adequately to flush both burettes. The Karl Fischer reagents tend to decompose in the vicinity of the burette tap on standing overnight.

Standardization

The Karl Fischer reagent as received is diluted with an equal volume of anhydrous methanol (<0·01% water): the resulting water equivalence is about 2·4 mg/ml.

Sodium *d*-tartrate dihydrate was selected as the primary standard. This contains 15·65 ± 0·10% water and is remarkably stable[5]. A single batch under normal storage conditions checked periodically over the 3 years of this work showed no appreciable change. The water content is determined by heating 5 g at 150°C for 5 hours. For water levels up to 50 mg, stirring for 4 minutes is sufficient for the complete dehydration of the salt by the 35 ml of methanol.

Procedure

Having prepared and charged the apparatus, the 35 ml of methanol are run into the titration vessel and stirred fairly rapidly. The electrode circuit is switched

[1] ZERBAN & SATTLER: *Ind. Eng. Chem.*, 1946, **18**, 138.
[2] CORNISH: *Plastics*, 1946, 99–103.
[3] *Analyst*, 1956, **81**, 308.
[4] *ibid.*, 1958, **83**, 143.
[5] NEUSS *et al.*: *Anal. Chem.*, 1951, **23**, 1332.

on; the ammeter will read zero. The reagent is rapidly added in increments of about 0·3 ml, each addition causing a rise in current. As the end-point is approached, shown by the lessening rate of discharge of the colour of the reagent, the incremental volume is reduced to 0·1 ml and the potentiometer adjusted to pass 100 μA. The titration is complete when the current remains steady for 10 seconds following the addition of the last increment of reagent.

A current of 100 μA was chosen since this gives a rapid rise in polarization voltage accompanied by little, if any, electrolysis[5]. The applied e.m.f. drops by about 130 mV during titration. A 10-second end-point is in general agreement with other workers; HOFFMANN[6] recommended this for white sugars whilst BROWN and VOLUME[3] and ALMY *et al.*[7] used 15 seconds.

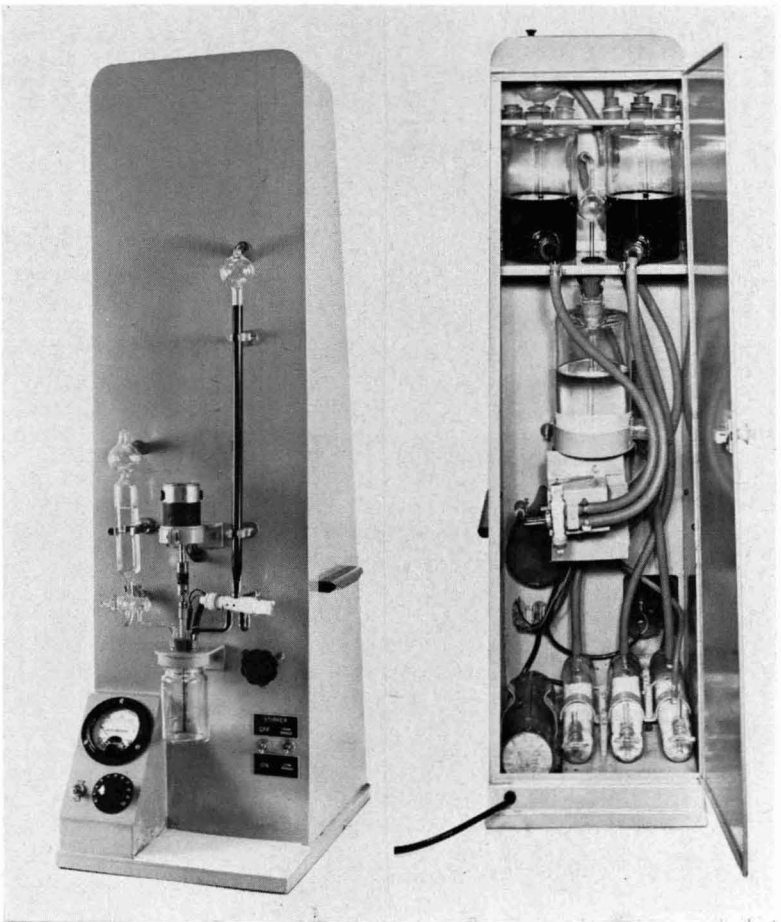
An appropriate weighed amount of sodium *d*-tartrate dihydrate is now added via the aperture in the cap holding the titration vessel (normally closed by a rubber bung). After stirring for 4 minutes, the titration is completed in a similar manner.

However, because of side reactions occurring in the system during the stirring period, the volume required to titrate the added water is slightly greater than the calculated value and hence allowance must be made for this. Accordingly, a further 35 ml of methanol is titrated to the end point and the volume of reagent subsequently to be added to restore the end-point after 4 minutes' stirring constitutes the blank correction. This is subtracted from the volume required to titrate the water added in the form of tartrate.

Hence the water equivalence of the reagent $= \frac{M\ W_s}{[T_2 - (T_1 + B)] \times 100}$ mg water/ml

where M = weight of sodium *d*-tartrate dihydrate (mg), W_s = % water in the above salt, T_1 = initial titre for the 35 ml methanol, T_2 = final titre and B = blank correction for 4 min stirring.

Fig. 4 shows the volume of reagent plotted against mg of water up to 50 added as tartrate; the relationship is linear and passes through the origin.



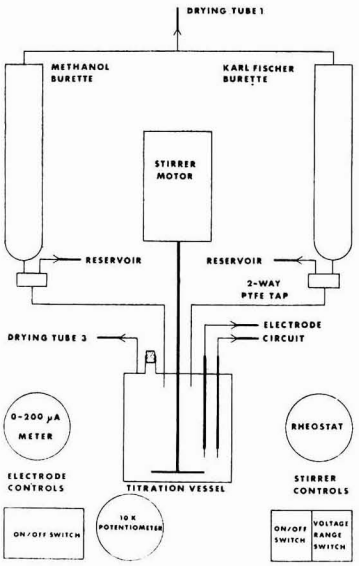
Front Rear

Fig. 2.

Determination of External Water of White Sugars

Although JOHNSON[8] suggested 30 minutes at 60°C to extract the external water, it was considered advisable to work at room temperature. HOFFMANN[8] states that 6–8 minutes is adequate for complete

[6] *Zucker*, 1959, **12**, 274.
[7] *Ind. Eng. Chem., Anal. Ed.*, 1940, **12**, 392.
[8] *ibid.*, 1945, **17**, 312.



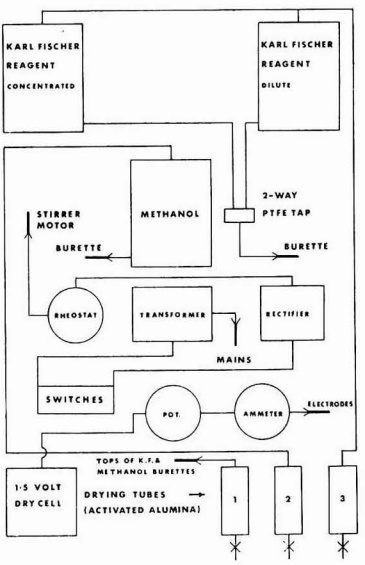


Fig. 3.

On a basis of this table, it was decided to adopt 25 minutes stirring for extraction of the water.

For routine purposes, to use the apparatus itself for extraction of the water would be too slow and hence an alternative method must be employed. This consists of rotating the titration vessels attached to opposed pairs of spring clips on a horizontal shaft at about 80 r.p.m. (Fig. 5). This allows a dozen samples to be handled in an hour. The 35 ml of methanol are titrated with the reagent and the weighed sugar sample added. The titration vessel is then removed and rapidly sealed with a metal cap and butyl-rubber washer. The electrodes and stirrer are sprayed with acetone and dried with compressed air. A fresh vessel is attached to the apparatus and the process repeated. The charged vessels are then attached to the extraction apparatus and, after mixing for 25 minutes, removed and titrated one by one.

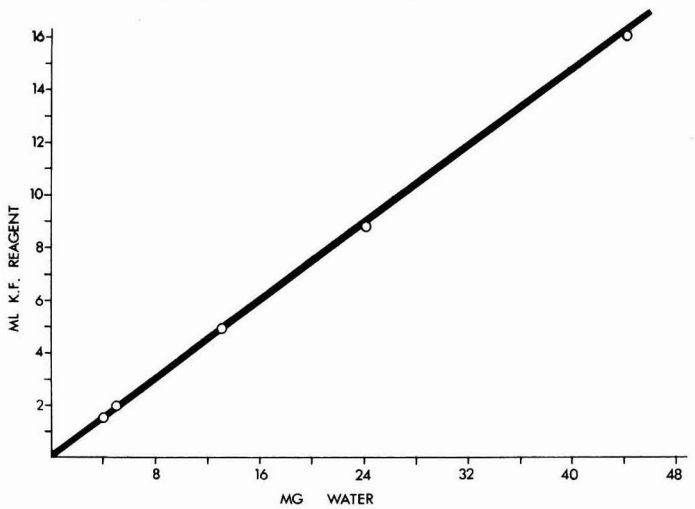


Fig. 4. Standardization curve for Karl Fischer reagent. (35 ml methanol, 100μA, 4 min stirring time, sodium *d*-tartrate, correction volume 0·60 ml).

Table I. % External water

	Karl Fischer Stirring Time, min			*Vacuum Distillation*
No.	10	15	25	*Method*
1	0·006	0·018	0·018	0·021
2	0·014	0·023	0·022	0·029
3	0·018	0·018	0·022	0·026
4	0·016	0·025	0·028	0·027
5	0·026	0·025	0·033	0·038
6	0·023	0·020	0·035	0·037
7	0·031	0·034	0·033	0·037

extraction of 25 g sugar by 20 ml methanol but it would seem that the degree of conglomeration of the crystals would affect this. It was therefore decided to determine the optimum extraction time for our particular conditions.

Subject to a maximum of 50 g, the weight of sugar used was arranged to contain about 15 mg of water. The results are shown in Table I.

It was later found that drying the electrodes and stirrer prior to attaching the fresh titration vessel to the apparatus could be omitted without introducing appreciable error provided that the latter operation was performed quickly.

As shown in the two Karl Fischer results for samples 1 and 2, and subsequently confirmed, using the rotating shaft for extraction of the water tends towards a lower result than obtains when the whole of the operation is performed on the titration appar-

Table II. % External water

Sample No.	Karl Fischer Extraction Time: 25 min Stirring in KF apparatus	Karl Fischer Extraction Time: 25 min Stirring on rotating shaft	Vacuum Distillation Method
1	0·008	0·005	0·008
2	0·010	0·006	0·011
3	0·017	0·015	0·015
4	0·034	0·035	0·043
5	0·038	0·041	0·046
6	0·049	0·050	0·050
7	0·052	0·054	0·057
8	0·060	0·065	0·070
9	0·108	0·109	0·114

atus. This was traced to a difference between the blank determinations for the two methods, the apparatus itself giving the higher figure. It is not clear why this should be so. That the titration vessel is quite airtight is shown by ingress of reagent causing a slight positive pressure to be built up. Passing dry nitrogen during the operation does not affect the blank.

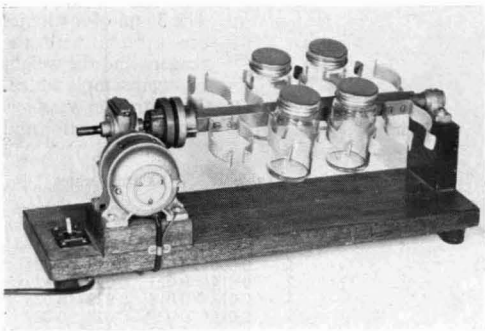


Fig. 5 Mixing apparatus

Table III shows the results of determining the external moisture in a stabilized white sugar (i.e. one which has stood sufficiently long after granulation for the whole of the external moisture to become available) of low water content by both methods.

Table III

Standardization of reagent

25 mg water, 4 min extraction time.

	Reagent strength	*Blank correction*
Titration Apparatus	1·83 mg water/ml.	0·30 ml.
Rotating shaft	1·87 mg water/ml.	0·20 ml.

Determination of water

50 g sugar, 25 min extraction time.

	% External water	*Blank correction*
Titration Apparatus	0·008	1·30 ml.
	0·010	
Rotating shaft	0·007	0·20 ml.
	0·007	
	0·008	
	0·007	

All blank corrections given are identical duplicate determinations.

If the blank correction determined on the apparatus had been applied to the titrations of the samples mixed on the rotating shaft, the results from the latter would have been reduced by about 0·004% of water. Hence, since the method of extraction affects the magnitude of the blank correction, it is necessary to determine the latter under the precise conditions obtaining during the extraction of the water from the sugar.

External Water of Freshly-Granulated White Sugars

In previous work during 1959 on the granulation process using the vacuum distillation method for the assessment of water, it was found that a freshly-granulated sugar would not immediately release the whole of the external moisture which ultimately became available after storage in a closed vessel. This observation has subsequently been confirmed by RODGERS and LEWIS[9]. This situation does not arise with the results given in Tables I and II since these sugars had been stored for about a month prior to analysis. However, it was considered useful to compare the Karl Fischer and vacuum distillation methods on freshly-granulated sugars since the removal of water from the sugar is effected by different processes in the two methods.

A refinery white massecuite was spun and granulated in the laboratory. After mixing well in a closed vessel on skewed bearings, 30 g samples for the Karl Fischer and 6 g samples for the vacuum distillation method were sealed into glass ampoules. Water was determined immediately and then at intervals over a period of 16 days. For the Karl Fischer estimation, stirring for 25 minutes was done on the apparatus itself. The results for the 7 sugars as originally prepared and after 8 and 16 days are shown in Table IV. Each successive pair of results are duplicate estimations on a single sugar.

Table IV. % External Water

Sugar	*Karl Fischer* Original	8 *days*	16 *days*	*Vacuum Distillation* Original	8 *days*	16 *days*
1	0·057	0·050	0·053	0·042	0·065	0·075
	0·053	0·057	0·059	0·042	0·060	0·065
2	0·044	0·065	0·063	0·048	0·068	0·069
	0·046	0·060	0·068	0·050	0·066	0·069
3	0·044	0·053	0·051	0·037	0·055	0·062
	0·049	0·053	0·051	0·034	0·056	0·062
4	0·065	0·082	0·087	0·053	0·072	0·077
	0·062	0·077	0·084	0·054	0·075	0·077
5	0·066	0·082	0·086	0·056	0·090	0·095
	0·071	0·085	0·087	0·063	0·087	0·094
6	0·041	0·050	0·055	0·039	0·058	0·059
	0·039	0·054	0·054	0·036	0·054	0·057
7	0·042	0·053	0·056	0·034	0·050	0·045
	0·046	0·051	0·060	0·034	0·050	0·051

Standard deviation between replicates:—
Karl Fischer 0·0043%
Vacuum Distillation 0·0036%

The moistures by the vacuum distillation method were determined by P. D. FIFE.

The Karl Fischer method confirms the findings from vacuum distillation in that the available external water increases over a period during storage. Since both methods of water estimation give similar results, it would seem unlikely that skin formation on the

[9] *I.S.J.*, 1962, **64**, 359.

syrup layer on the crystals caused by water removal at slightly elevated temperature in the vacuum distillation method is the sole cause since it would be expected that the Karl Fischer method, being a dissolution process, would not show this. It is to be noted that the latter generally gives a higher figure for the original water on the freshly-granulated sugar; this may be due to moisture in conglomerates being more readily available to methanol. The reason for this maturing effect is being investigated and also the application of the Karl Fischer method to other refinery materials.

Summary

The external or surface water of white sugars can be determined by direct titration of a slurry of sugar and dry methanol with Karl Fischer reagent. Results so obtained are in fair agreement with those estimated by the vacuum distillation method of HILL and DOBBS[4]. The Karl Fischer method is rapid, requiring about 30 minutes for a single determination, but, by using a separate apparatus for extraction of the surface water by methanol, 12 samples can be handled per hour.

Both the Karl Fischer and the vacuum distillation methods show that a freshly-granulated sugar will not release the whole of the available surface water[8]; this becomes available only after a maturing period of 8–16 days. The reason for this retention is being investigated.

HORIZONTAL VACUUM PAN
with plate-type heating element

By F. DAMBRINE and J. C. GIORGI (Centre de Recherche de la Société Fives Lille-Cail)

PART II

CONSTRUCTION AND TESTING OF THE COMMERCIAL PAN

(1) *Description:* The excellent results obtained with the pilot pan led us to build an industrial prototype of 250 hl nominal capacity. This pan (Figs. 4 and 5), which corresponds to the geometric conditions determined by dimensional analysis, is provided with heating plates fitted in a calandria of almost cylindrical form, presenting a vertical plane of symmetry. The walls of the calandria, together with the base of the heating plates, determine flow areas of controlled dimensions and shape which match the contour of the liquid stream.

For purposes of construction and in order to improve the flow of steam inside the plates, the pan is provided with two symmetrical heating elements composed of flat plates parallel with the plane of symmetry of

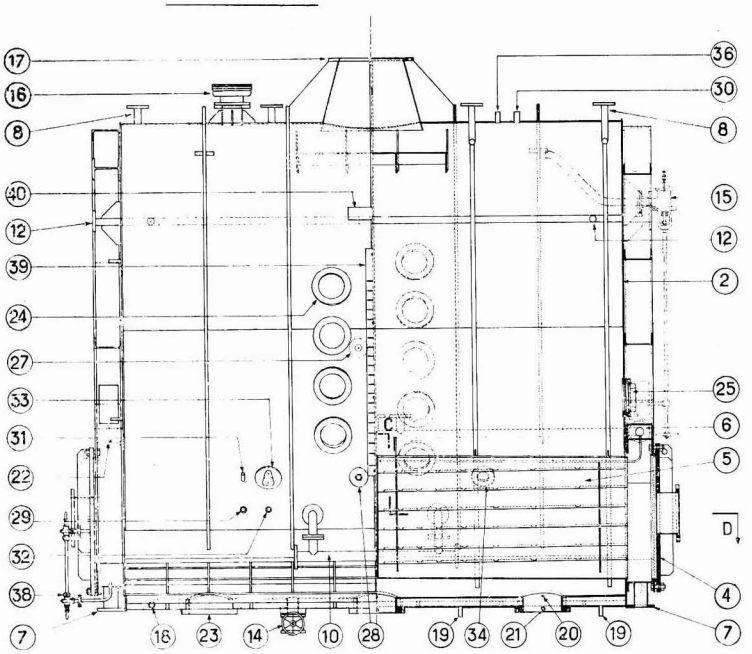


Fig. 4. Horizontal pan—side elevation and section

KEY TO FIGURES 4 AND 5

1—shell; 2—front cover plates; 4—steam chests; 5—heating plates; 6, 11, 22—incondensable gas vents; 7—steam condensate drains; 8, 9, 10—feed inlet; 12—spray pipe; 14—auxiliary discharge; 15—vacuum breaker; 16—atmospheric relief valve; 17—catch-all and vapour outlet; 18—dual wall for heating (if any); 19—steam condensate inlet to dual wall; 20, 23—massecuite discharge; 21—incondensable gas inlet; 24, 25—sight glasses; 27, 28—seeding connexion; 29—thermometer for automatic pan control; 30, 36—automatic control connexions; 32—massecuite temperature indicator; 33—proofstick; 34—pan microscope connexion; 38—condensate level connexions; 39—scale.

the pan; between the two elements there is a small gap sufficient to allow for expansion. On each end face of the pan a steam chamber distibutes steam to the individual plates forming each heating element.

To enable the plates to stand pressure, braces are necessary; these are made in such a manner as to break the water film formed by condensation of the steam; the result is a rise of about 10% in the coefficient of heat exchange in the bottom of the element, which gain is not negligible since it influences the density of the emulsion and thus the circulation velocity.

The braces are slightly inclined so as to conduct the condensed water in the direction of steam flow, and the bottoms of the two elements are inclined in the opposite direction so as to allow the water to flow off easily toward the outer chambers from which it is extracted.

At various places in the elements, the braces are interrupted to allow the incondensable gases to collect at the highest point of the element, from which they are removed through internal pipes of small section to a special compartment in the steam distribution chamber, which is provided with a drain cock.

The external surfaces of the end plates in each element are insulated by a double wall so as to favour the return circulation of the massecuite; if they were not, the vapour released at these surfaces would hinder the return.

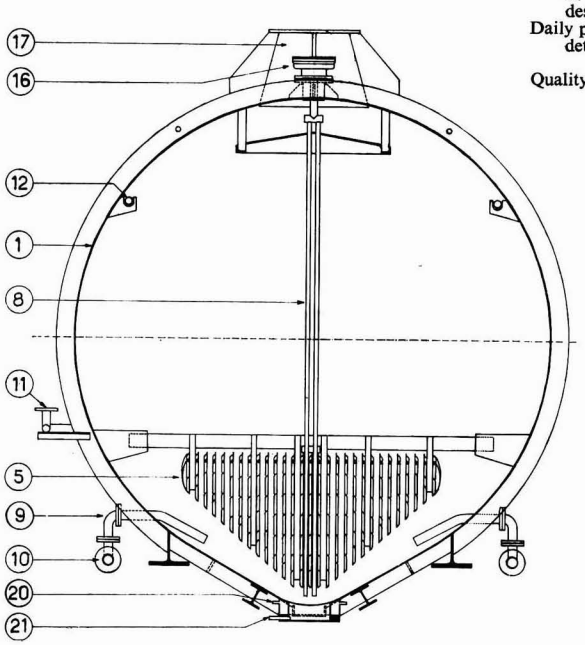


Fig. 5. Horizontal pan—End elevation

Table I

Comparison of results obtained with a horizontal pan and a conventional calandria pan (high remelt strikes)

	Horizontal pan	*Calandria pan with mechanical stirrer*
Nominal pan capacity	250 hl	200 hl
Effective pan capacity	250 hl	140 hl
Heating surface	150 sq.m.	100 sq.m.
Heating vapour pressure	0·6 atm	0·6 atm
Vacuum	57–60 cm Hg	56–58 cm Hg
Syrup average temperature	78°C	78°C
Syrup average Brix	71°	71°
Massecuite average Brix on discharge	89–91°	88°
Massecuite average temperature on discharge	72°C	76–78°C
Maximum superheating due to hydrostatic head	1–1·5°C	4–5°C
Supersaturation of mother liquor on discharge	1·03	1·08
Theoretical yield in crystal sugar % massecuite on discharge	about 53	about 44
Ratio of crystal sugar/sugar in massecuite	about 59	about 50
Average duration of boiling (40 strikes)	120 min	—
Average duration of boiling (50 strikes)	—	195 min
Duration of emptying and cleaning	10 min	30 min
State of pan after cleaning	very clean	variable
Syrup colour	4	7
Massecuite colour	10	40
Increase in colour (proportional in refinery boiling to sugar destruction)	6	33
Daily production of crystal sugar determined at pan discharge	185 metric tons	60 metric tons
Quality of massecuite crystals	Photographs (Figs. 7, 8) taken during two consecutive tests	Photographs (Figs. 9, 10)

The heating plates and the steam distribution chamber are assembled either by welding or by means of a bolted spigot joint.

Two or three holes of 300 mm dia. are provided for emptying the pan; syrup is admitted at a number of points under the heating element.

Alternatively, the incondensables extracted from the heating elements may be recycled in the massecuite through distribution tubes provided for this purpose: this return, made possible by reason of the pressure difference of which advantage is taken, is effected beneath the heating element so as to increase the force on which depends the circulation velocity as well as the stirring of the massecuite between the plates forming the heating element. This allows an appreciable increase in the overall heat transfer coefficient.

Since the Nassandres refinery intends to use the pan for high remelt strikes, it was constructed entirely of stainless steel, except

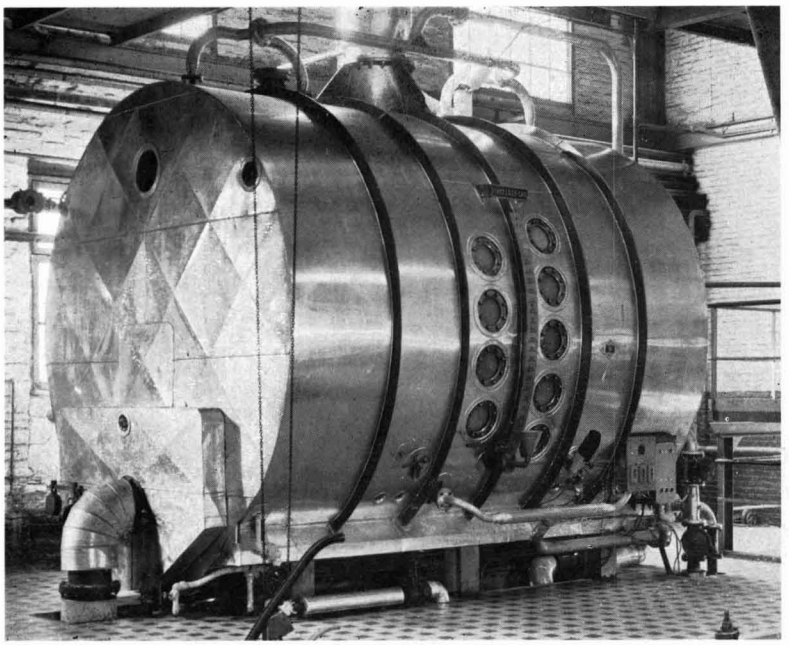


Fig. 6. Commercial horizontal pan at the Nassandres refinery

for the external reinforcing. The principal characteristics of the pan are as follows: nominal capacity 250 hl, footing capacity 65 hl, heating surface 146 sq.m., test pressure 0·987 atmosphere, head of massecuite above the heating element 1300 mm.

Fig. 7. Crystals obtained in a horizontal pan

(2) *Industrial tests:* This pan (Fig. 6) was put into service on the 27th August 1963. The results obtained are grouped in Table I.

This comparative table shows the superiority of the new pan over the conventional pan, from the viewpoint of crystal quality (Figs. 7, 8, 9, 10) as well as from the viewpoint of productivity.

In another connexion, the experiment has shown that the variation of temperature in the massecuite with the level of massecuite in the pan is very slight (1·5°C maximum) as compared with the elevation observed in conventional pans, all other conditions being equal; this is due to the high circulation velocity of the massecuite in the pan, which is of the order of 0·8–1·0 metre/sec during the first two-thirds of the duration of the strike.

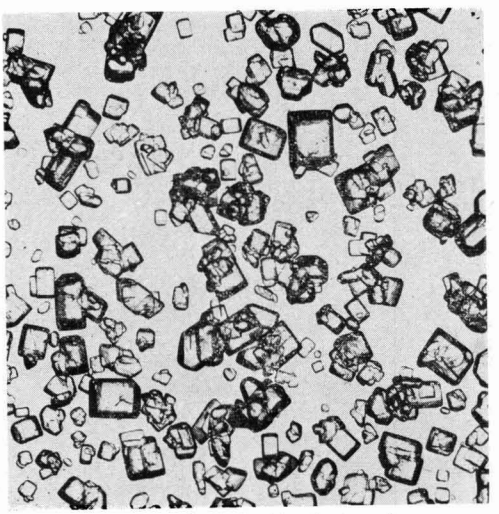


Fig. 8. Crystals obtained in a horizontal pan

As a consequence, automatic control of high purity strikes by regulating the syrup feed to the pan according to the temperature difference between massecuite and saturation vapour is facilitated.

Further, the vigorous circulation obtained in the pan permits a large increase in the rate of crystallization; thus, the supersaturation of the mother liquor at the end of the strike is only 1·03 as against 1·08 in the conventional calandria pan.

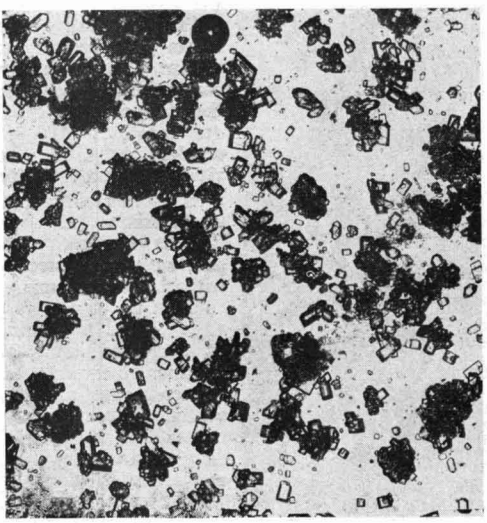


Fig. 9. Crystals obtained in a conventional calandria pan.

This stirring also permits perfect uniformity of the massecuite to be obtained, a uniformity which may be demonstrated by measuring the temperature of the massecuite at different points in the same horizontal plane; the differences in temperature found between these points are practically nil.

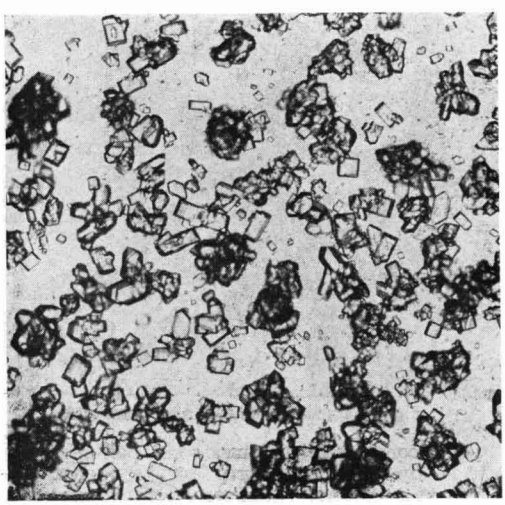


Fig. 10. Crystals obtained in a conventional calandria pan

Finally, the circulation permits constant steam consumption throughout the strike, even at constant vacuum inside the pan.

Also, the steam consumption of the pan during evaporation and tightening-up is slightly higher (about 20%) than during boiling. This characteristic is favourable both from the point of view of crystallization and progress of evaporation.

One would have thought that a horizontal pan of cylindrical shape would present difficulties in emptying and cleaning. This is not so, however, because inside the pan all the surfaces are vertical or strongly inclined, except, of course, the lower generatrix zone. Further, the brisk circulation of the massecuite does not permit crystals to settle out.

Emptying and cleaning the pan requires only 8 to 10 minutes, which is sufficient to obtain a very clean pan.

Conclusion

The results obtained with the first horizontal pan with heating plates are satisfactory and correspond to the aims sought—stirring, homogeneity of massecuite, low content of fines and conglomerates, high crystallization rate, low colour formation, rapid emptying and complete cleaning of the pan. Furthermore, the conclusions of the theoretical study carried out with hydraulic and pilot models were confirmed.

As far as crystallization is concerned, the properties of the pan are such that we have been able to boil strikes in less than 2 hours of steam in the heating elements. As it is technologically very easy to increase the heating surface without appreciably greater footing, the future will permit us to improve the results obtained from the point of view of the speed of boiling as well as colour formation.

Brevities

Hungary beet sugar crop, 1963/64[1].—During the 1963/64 sugar beet campaign in Hungary, 3,378,400 metric tons of roots were harvested from 292,520 acres and utilized for sugar production, according to Reuter. In the previous season, although the beet area amounted to some 310,000 acres, the tonnage of roots obtained for delivery to the factories totalled only 2,700,000 tons. Production of sugar in 1963/64 amounted to some 375,000 metric tons, as compared with 356,000 tons manufactured in the previous season[2].

* * *

Japanese sugar factory for Bolivia[3].—An agreement has been signed between the Corporación Boliviana de Fomento and C.Itoh & Co. Ltd., of Japan, for the construction of a cane sugar plant, to be located at Bermejo in northern Bolivia. The 1000-tons/day mill will produce plantation white sugar and there will be an auxiliary distillery producing 80 litres/day of alcohol. The plant will produce 12,000 tons of sugar per season and will cost $3,400,000.

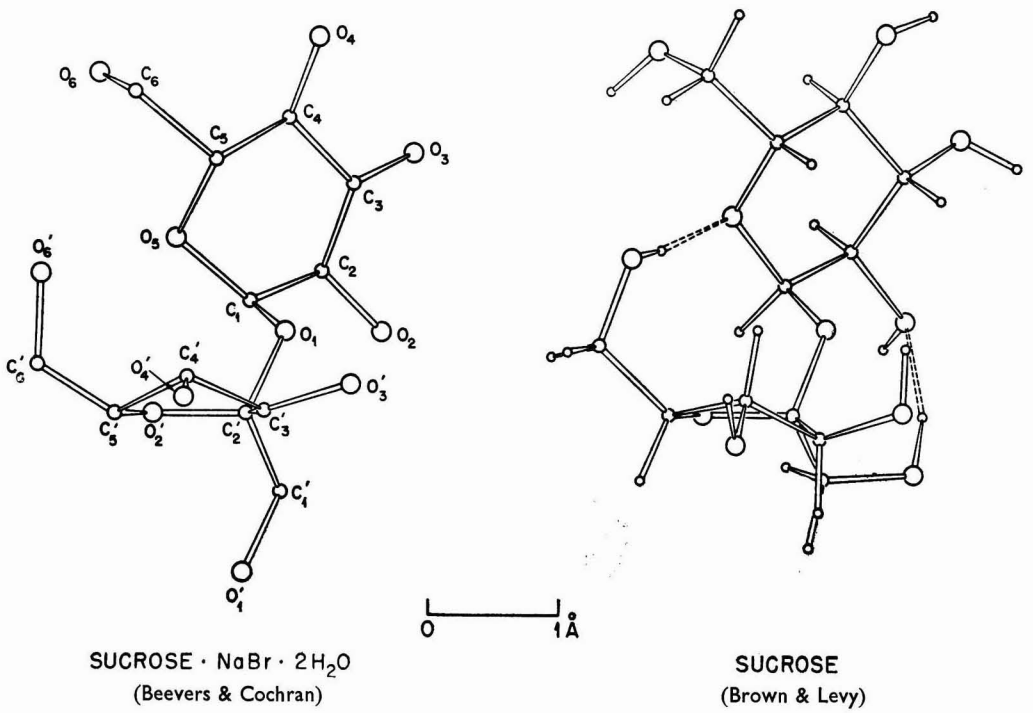
[1] C. Czarnikow Ltd., *Sugar Review*, 1964, (646), 31.
[2] *ibid.*, (647), 34.
[3] *Sugar y Azúcar*, 1964, **59**, (2), 72.

THE SUGAR CRYSTAL

By HAROLD E. C. POWERS

OUR knowledge and understanding of the sugar crystal continues to improve year by year. Quite understandably, this is often regarded as of interest to the specialist only. Nevertheless, today's discoveries lead to future industrial applications, and we should be conscious of how much the industry owes to earlier generations of investigators—botanists, biologists, chemists, engineers and all. These are days of ever-increasing intensity of research.

It was announced at the 6th Congress and Symposium of the International Union of Crystallography, held in Rome in September 1963, that sucrose had been the subject of an outstanding advance in the study of crystal structure. This was described in a paper "A neutron-diffraction study of sucrose" by G. M. BROWN and H. A. LEVY of the Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A., justly praised by the Rapporteur, R. MASON, as setting a new high standard of achievement in the accuracy of its mapping of the structure of so relatively complex an organic molecule. Some idea of the magnitude of the work entailed is given by the fact that 5800 individual observations had been carried out on three different crystal specimens weighing 80, 10 and 5 mg respectively. The interactions of more than 2800 independent reflections were determined, after which followed the intricate mathematical calculations.



SUCROSE · NaBr · $2H_2O$
(Beevers & Cochran)

SUCROSE
(Brown & Levy)

Fig. 1. Comparison of sucrose molecular structures in two crystals. View in each case is in the plane of C'_2, O'_2, and C'_5, perpendicular to bond O'_2-C'_2.

Crystallographic Data (after G. M. BROWN and H. A. LEVY)

Space Group p 2, Z = 2.

*Unit cell parameters**

$a = 10{\cdot}86$ A, $b = 8{\cdot}70$ A, $c = 7{\cdot}75$ A. $\beta = 103{\cdot}0°$. (BEEVERS data: a = 10·89A, b = 8·69 A, c = 7·77 A)

Neutron intensity data

$\lambda \simeq 1{\cdot}08$ A θ limit = 55·5°.

* Provisional values from neutron data, estimated standard errors about 1 part in 1000.

It will be remembered that Dr. BEEVERS of Edinburgh University[1] carried out a similar exploration of the sucrose molecule in 1947, using X-rays, and also studied the sucrose sodium bromide dihydrate crystal. One of the writer's treasured possessions is a space model, given him by Dr. BEEVERS, showing the structure according to these investigations. Unfortunately, only the carbon and oxygen atoms are so shown since X-rays are unable to reveal the positions of the much smaller hydrogen atoms.

It is pleasing to note that the present results, in addition to locating the hydrogen positions, also agree closely with the BEEVERS data for the carbon and oxygen atoms (see Fig. 1). Such agreement brings considerable added assurance to both techniques employed as well as endorsing the validity of the final results.

The essential feature which differentiates crystalline matter from all other is that of molecular order; in gases, most liquids and non-crystalline solids, the component molecules are in continuous random movement with respect to one another. In the act of crystallizing, the molecules become anchored to each other by molecular forces in such a way that all the molecules in the crystal are oriented the same way. Thus, if they could all act as tiny mirrors, one might apply a beam of light and obtain a similar reflected beam by the cumulative effect of the "molecule-mirrors," when the direction of the reflected beam would show in which direction the mirrors were facing.

The size of molecules is so small, however—of the order of a millimicron (10^{-9} metres)—as compared with the wavelength of light (400–700 millimicrons), that ordinary light rays are far too coarse for exploring the construction of molecules. The wavelength of X-rays is of the order of a millimicron and can be used, but can serve to indicate only the larger carbon and oxygen atoms. To locate the smaller hydrogen atoms it has proved necessary for Dr. BROWN to use neutron beams which are even finer than X-rays.

A parallel in the world around us is in the way that reflections by atmospheric water particles limit the effectiveness of light beams in fog, while the finer radar waves can be used to obtain reflections which permit us to locate and "see" objects even under the same foggy conditions. Similar freedom of movement is found by bats which use high-frequency sound to obtain similar reflections for their guidance.

As regards the potential importance of this work, not only is sucrose extremely important as a food; it is a vital molecule in the biological field and as a raw material in the synthesis of sucrochemicals. Its two components—the furanose and pyranose rings—also occur in many important biochemical molecules, and some of the most exciting investigations of our day are in the resolving of these complex molecules which hold the keys of heredity and of life itself. The new work by BROWN & LEVY holds promise of greater insight into the structure of such molecules and their success is an achievement of high merit; the writer recalls persuading another neutron specialist to attempt the objective several years ago but the latter found sucrose too difficult a subject, partly owing to its sensitivity to heat. Consequently the difficulty of the task can be appreciated, as can the importance of the results.

These were fully reported at the Congress and Symposium in Rome, and the writer has one copy of Dr. BROWN's paper which is available for loan should a reader wish to study the essential data in detail.

* * *

On a different topic, the writer was afforded considerable satisfaction when he was invited to show and discuss much of his filmed evidence on the crystallization of sucrose at the same Congress and Symposium of the International Union of Crystallography. Two films were shown, one a résumé of evidence gathered before retirement in 1962 *and the other a selection of time-lapse cinemicrography obtained subsequently. Evidence upon nucleation and early growth of the crystal continues to accumulate and to reveal completely new features, a description of which will be published in due course.*

Brevities

U.S. marketing restrictions to be removed for 1964[2].—On the 31st January, President JOHNSON announced his recommendation to remove all marketing restrictions on domestic produced cane and beet sugar in 1964 in order to allow mainland territories to market an additional 500,000 tons in excess of their current quotas. If this recommendation is put into force it might be possible for the United States to make do without allotting the balance of the global quota.

* * *

Sugar finance in Brazil[3].—The Board of the Banco do Brasil has approved new regulations for the financing of the growing and processing of sugar cane, because of the drought, increasing internal demand, and the possibility of increasing exports. For sugar manufacture the Bank will now finance up to 40% of the cost of maintaining and expanding sugar mills.

* * *

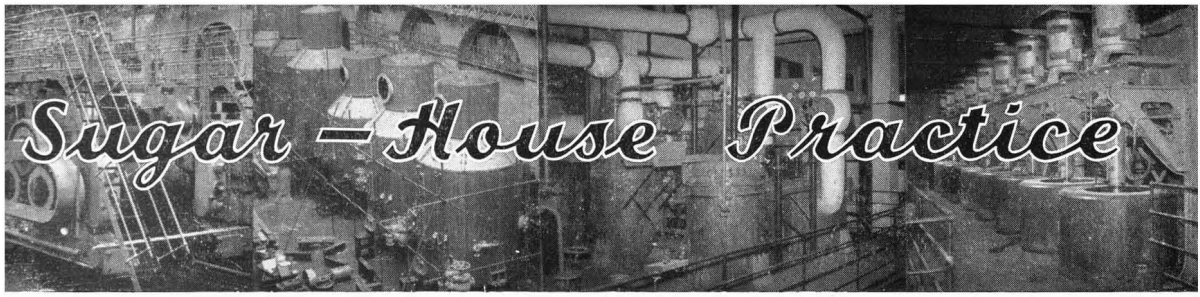
Ecuador sugar development[4].—The Minister of Development has announced that the Ecuador Government is to encourage further production of sugar which may become one of the country's principal sources of foreign exchange. He said that because of favourable soil conditions in the basin of the River Guyas the output of sugar cane is nearly 100 tons per hectare, considerably higher than the average yield in either Cuba or Puerto Rico. The Minister also announced that, as a result of a recent visit to the U.S.A. of CENDES officials, U.S. firms are to instal in Ecuador two new sugar mills with an annual output of 75,000 tons each.

[1] BEEVERS & COCHRAN: *Proc. Royal Soc.*, 1947, A190, 257.

[2] C. Czarnikow Ltd., *Sugar Review*, 1964, (647), 34.

[3] *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **29**, 87.

[4] *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **29**, 106.



Comparison of milling efficiency of different mill tandems. B. L. MITTAL. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1046–1052.—Mill extraction is the pol or sucrose extracted from cane expressed as a percentage of that present, under the actual milling conditions. The DEERR "reduced extraction" formula[1] was derived so that the efficiency of mills handling cane of different fibre content could be compared on a basis of cane of the same fibre content —12·5%. Defects in this formula led the author to derive a new one[2] which is quoted and values of reduced extraction calculated using both formulae are compared. But comparing results of two factories indicated that one which attained 2·3% pol in bagasse had lower milling efficiency than another which attained only 3%; the difference arose from the poor quality of cane crushed in the first case. To allow for this a new formula is derived for the "Whole Reduced Extraction" (e'') which reduces results to a basis of constant sugar % cane—also 12·5%: $e'' = 100\left(1 - \frac{Pbc}{f}\right)$, where Pbc = pol in bagasse % cane and f = fibre % cane. This is considered to be the most suitable formula for comparison of the milling efficiency of different mill tandems.

* * *

Novel ideas in cane mill design. P. M. GRANDJEAN. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1052–1062.—A description is given of the novel features of two Fives Lille-Cail mill designs. The first, type E 60, is that built for the 6000/8000-ton Ingenio Ledesma in Argentina. It is a three-roller unit with a small included angle and narrow turn-plate. The feed roller is slightly higher than the discharge roller so that the reaction of forces on the rollers is approximately vertical, i.e. directly opposed to the vertical hydraulic pressure. The narrow angle is permitted by having crown wheels on each side of the top roller with only one pinion each on the lower rollers, at opposite sides. A wedge-piece arrangement permits altering of the settings along the centre lines of the rollers concerned. Turn plate adjustment uses a hydraulic jack and gauges of given thicknesses, and can be made from outside the mill. The mill bearing slides for the top roller are of a hard-wearing synthetic material with good sliding properties. The boltless side caps are held with pins but pivot about the lower ones and act as supports for the side rollers when they are being removed; this is important because the Ledesma rollers weigh more than 20 tons! For the Ledesma tandem steam turbines are used to drive the mills through enclosed gearboxes, while Rivière-type intermediate carriers are also adopted. The F 62 mill design, in prototype stage, is reminiscent of the Helmer mill or Squier triangular stress mill[3], having a cap hinged at one side of the headstock and pivoting to cover the three rollers, the free end being closed with a hydraulic or pneumatic jack. When the top roller rises over the cane blanket it pivots about the cap hinge, describing an arc of a circle so that feed and discharge opening ratio remains constant. Advantages of the new design are discussed.

* * *

Experimental determinations of the pressure at a point on a roll surface. C. R. MURRY and J. E. HOLT. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1063–1073.—A $\frac{1}{8}$-in diameter pin was set in the tip of a tooth of the grooving of the upper roll of the two-roller experimental mill at Queensland University. The pin was free to move in a fine-clearance guide and the load on it was measured by wire-resistance strain gauges, the load being recorded after calibration of the assembly. The course of pressure on the pin during milling is discussed and an account given of its use in determining the effects of various factors: compression ratio and peak pressure were found to be related in an approximately linear manner while peak pressure fell as surface speed increased. Variation in cane preparation, however, had no effect on the peak pressure.

* * *

A graphical method for milling train volume calculations. D. J. MUIR and P. G. ATHERTON. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1087–1090.—A graphical method is described, and illustrated by an example, for calculation of the escribed volume, bagasse volume, reabsorption factor, compression ratio and volumetric efficiency of a mill.

* * *

The effects of roll diameter on the mechanics of crushing. C. R. MURRY and J. E. HOLT. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1074–1086. It was found that under conditions of the same compression ratio and work opening diameter when crushing cane of the same fineness of preparation, the crushing rate must be proportional to the product of roll speed and diameter. However, experimental results suggested that the extraction was not dependent on diameter at the same surface speed and, since roll load and torque are almost independent of speed, it seems that mill performance should be compared at the same surface speeds. On this basis it appears that the reabsorption factor is independent of roller diameter, that the roller load is proportional to roller

[1] *I.S.J.*, 1933, **35**, 214.
[2] *I.S.J.*, 1959, **61**, 273.
[3] *I.S.J.*, 1956, **58**, 13.

diameter and that the torque-load number is inversely proportional to the roller diameter. From this it may be deduced that the torque is proportional to the roll diameter. Also it is shown that the energy absorbed per ton of cane crushed is likely to be inversely proportional to the roll diameter and that, in this sense, larger rollers are more efficient.

* * *

A formula to determine the capacity of sugar mill tandems. J. J. GASPAR. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1091–1098.—A formula is derived for the tandem capacity, viz. T.C.H. = $D' \times L' \times G \times A \times N \times K \times n \times B \times F \times (e)$, where D' and L' are roller diameter and length, G is a factor to allow for the influence of the size of rollers, openings, grooves, grip, etc. (values are tabulated), N is a factor concerned with the number of rollers in the tandem, K is a factor allowing for cane preparatory devices, n is the number of turns per minute of the first mill and B the factor allowing for the non-linearity of capacity increase with increase in n. The values of factor F are to correct the effects that fibre produces on capacity, e is a factor depending on the extraction achieved, and A is a numerical factor to bring the product of the others in terms of t.c.h.

* * *

Automatic control of knifed cane conveyor. M. ROJAS. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1111—1115.—In the system adopted at Ingenio San Cristóbal, Mexico, the cane conductor operator in the mill yard can stop it in an emergency but normal control is from a central panel. Overloads at the knives give rise to current impulses the magnitude of which regulates the speed of the conveyor by increasing or decreasing the number of steam valves that are closed and altering the feed to the steam engine drive. A feeler arm suspended above the conveyor in advance of the knives detects any unusually large mass of cane and slows down the carrier before the mass reaches the knives. A system of warning lights is used and, should the electricity supply to the knives fail, the steam supply to the cane carrier engine is also closed and the carrier stops.

* * *

The selection of conveyor chains for the cane sugar industry. E. ANDREWS. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1099–1111.—The load on an average cane conductor of 100–120 t.c.h. capacity, running at 15–30 f.p.m., is calculated and this, with the assumed coefficient of rolling friction of the chain rollers both on the level and up the incline, gives the resultant pull on the chain. Chain is selected by reference to the pressure between bearing pin and bush bore, which must not exceed 4000 p.s.i., and by the pressure between bush outer diameter and roller bore, which should not exceed 2000 p.s.i. Under these limits the chain should have adequate wearing surfaces and also be strong enough. The working clearances necessary between chain parts are a controversial matter, complicated by the presence of trash, particularly where cane knives are used. The extra loading due to cane knife operation is not known but it appears that chain life is reduced. It is suggested that linkplate edges are supported by rollers when the chain is directly under the knives. Suggestions are made for the prevention of clogging, and information given on the "Norgren" oil-fog lubrication system. Chain detachability is discussed, and a design for an "ideal" chain described; this would be nearly three times the cost of present chains but it would do half as much more work and its other advantages might make it worth-while. Calculation of chain pull and chain strength required for a bagasse carrier is described as well as (briefly) for intermediate carriers; for these and for cush-cush elevators, stainless steel chains are recommended.

* * *

Mill gearing. A. W. P. MCNEE. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1125–1140.—A number of gearing layouts for connexion of steam turbines with cane mills are provided with information on the nature, manufacture, materials and design of spur gears and helical gears. Other factors discussed are lubrication, gear load carrying capacity, gear bearings, and various types of gear failure.

* * *

The continuous pressure feeder in Queensland. J. HOLLYWOOD and S. G. CLARKE. *Proc 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1140–1150.—Feeding devices for cane mills are briefly reviewed and the design and operation of continuous pressure feeders described. Operational results from 17 mills using the feeders are tabulated and discussed, with particular reference to fibre loadings at the feeder, feed roller and discharge roller openings, the pattern being relatively close for all the mills. The average ratio between pressure feeder and mill speeds is 1·5:1, and this is considered an acceptable standard. Precautions to avoid excessive internal pressures in the feeder chute are mentioned as are benefits in regard to capacity which result from the use of a feeder, and the maintenance required.

* * *

Fly-ash separation at St. Antoine sugar factory. S. N. COOMBES. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1150–1154.—The use of an expansion chamber at St. Antoine sugar factory resulted in a great improvement in fly-ash removal from the stack gases but had to be discontinued on account of the difficulties met in removing the accumulated ash. An improved chamber was built 24 × 15 × 44 ft into which 120,000 c.f.m. of hot flue gases enter through two ducts and are reduced in velocity from 33 to 6 ft/sec. Water is sprayed into the gas through 16 nozzles, at a rate of 130 g.p.m., and the ash-water slurry pumped out while the cleaned gases pass to the main chimney. The slurry is passed through a screen which removes the larger particles but still contains 1 g/litre of finer particles. Experiments have shown that these can be removed by treating

the suspension with 0·5 g/litre of lime and stirring, when the particles separate, leaving a clear supernatant. This treatment is to be further investigated.

* * *

Types of sugar from beet and cane. H. KITTLAUSS. *Zuckererzeugung*, 1963, **7**, 151–153, 161–162.—Descriptions are given of the various types of sugar produced from beet and cane in different parts of the world, and the production of liquid sugar is discussed in brief.

* * *

Glades Sugar House instrumentation. F. C. SCHAFFER and G. G. MOYER. *Sugar J.* (La.), 1963, **26**, (3), 18–20, 40.—Details are given of the controls at Glades Sugar House, particularly those of the evaporator station. The controls, with few exceptions, are pneumatically operated and have been supplied by Minneapolis-Honeywell Regulator Co. A central control room contains a 20 ft main panel with two 7-ft side panels. The main panel carries indicating level controllers and density, absolute pressure and steam recorder-controllers for the evaporators. Other instrumentation includes exhaust steam and vapour controllers, a crystallizer temperature recorder, a 12-point level alarm, a raw juice pH recorder-concontroller, temperature recorders for limed juice and condensate, and level recorder-controllers for the raw juice surge tank, limed juice tank and condensate tanks. Details are given of the alternative methods of operation of the nine evaporator bodies. The level in each body is controlled through butterfly valves, also manually adjustable. The evaporation rate is controlled in direct proportion to the level in the juice supply tank, steam flow being reduced or increased accordingly. The absolute pressure in the last body is controlled through a butterfly valve throttling water flow to the barometric condenser. The juice Brix is measured in a chamber to which a continuous sample stream flows from the discharge line of the last effect. At too low a Brix, juice is returned to the last effect for additional evaporation, whereas juice is discharged at a greater rate if the Brix rises. Other controls, including those for the vacuum pans, crystallizers and mills, are described.

* * *

The fully-continuous flow centrifugal. W. SIEPE. *Sugar J.* (La.), 1963, **26**, (3), 25–28.—The Hein, Lehmann conical centrifugal is described and some information is given on its handling abilities, together with some factory data.

* * *

A suitable device of sulphiting juice in open-pan sugar factories. S. N. PANDIT and K. S. SAXENA. *Indian J. Sugarcane Res. Dev.*, 1963, **7**, 235–237.—Tests conducted at the gur and khandsari factory of the Indian Institute of Sugarcane Research, Lucknow, showed that raw juice sulphitation was equally efficient whether a sulphur tower or sulphitation tank was used. The latter is considered preferable, however, as it is easier to clean and a tower can be a potential source of fermentation and souring of juice as a consequence of cush-cush accumulation in the crevices. The tank's efficiency may be increased by installing a conical bottom and a mechanical stirrer.

* * *

Improving a vibratory screen. P. S. MAKSIMUK. *Sakhar. Prom.*, 1963, (9), 36–37.—Information is given on a modified vibratory screen, the trough of which is suspended on multi-layer rubberized belts instead of on steel or wooden springs, which quickly wore out. The riddle has worked satisfactorily throughout two campaigns with reduced power consumption.

* * *

The mechanical loading and unloading of sugar beets, sugar cane, sugar, molasses and slices. H. J. DELAVIER. *F. O. Licht International Sugar Rpt.*, 1963, **95**, 119–123. An outline is given of the various methods and equipment used in the handling of the products mentioned in the title. The slices may be dried cossettes or beet pulp.

* * *

Acidic condensates in carbonatation sugar factories. S. C. SHARMA. *Indian Sugar*, 1963, **13**, 259–260.—The low pH of the condensate from a pre-evaporator used to heat juice was ascribed to the dissolving of free SO_2 liberated from clear juice. The sulphate content of an oxidized condensate sample was found to be 0·025 g/litre. Remedial measures are described.

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Design of a multi-pass tubular heater for (the) cane sugar industry. A. C. RAHA and S. K. GHOSH. *J. Sci. Eng. Res.*, 1962, **6**, 55–58; through *S.I.A.*, 1963, **25**, Abs. 684.—The combined resistance a to heat transfer (due to scale, tube thickness and steam film) of cane juice heaters was calculated from operational results obtained in Indian factories, by means of the empirical equation $\frac{1}{U} = a + \frac{1}{46V^{0.8}}$ where U is the overall heat transfer coefficient, and V is the juice velocity (ft/sec). The values of a were all in the range 0·00210–0·00285 for recently cleaned tubes. It is pointed out that the juice film resistance is higher in cane juice heaters than in heaters working at higher temperatures, so that a standard type of cane juice heater can also be used for heating clarified juice. A standard tube of 1·5–1·625 in dia. and 12 ft length is recommended in order to simplify store inventories.

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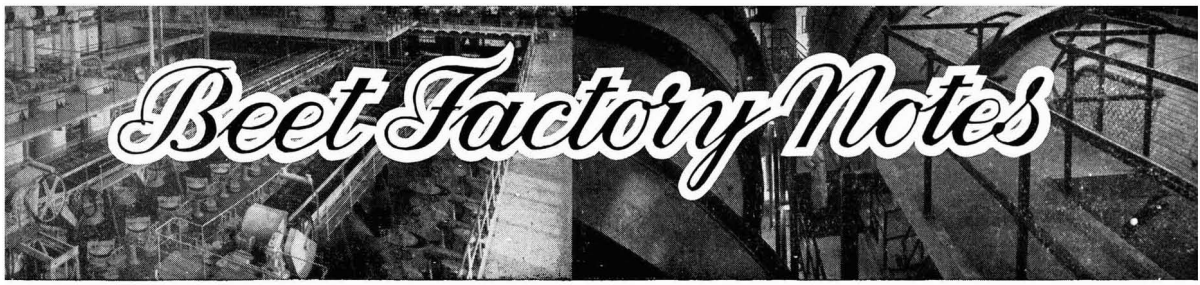
Sugar drying by means of the through-flow rotary dryer. H. HIGASHINO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **13**, 1–6.—On the basis of results obtained with a laboratory model, a "rotary-louvre" type of dryer-cooler has been designed for refined sugar of 1·7% moisture content. Specifications include a throughput of 5 tons/hr, 0·005% moisture content of the dried and cooled sugar, and a temperature drop from 40°C to 5°C above room temperature or lower.



Süddeutsche Zucker AG. Werk Zuckerfabrik Plattling. *Paper presented to the 16th Tech. Conf., British Sugar Corp. Ltd.*, 1963.—A detailed and illustrated description is given of the Plattling sugar factory[1] in Bavaria which started operations in October 1961, reaching the planned slice of 3000 tons/day in a week. In its second campaign (1962/63) this was raised to an average of 3625 tons/day during the 76-day campaign. The factory has a beet storage capacity of 55,000 tons, so that all the crop can be harvested before the onset of winter. Beets are wet-unloaded by Elfa water jet, and dirt and tails removed by high pressure washing. The tails are sent direct to process and the beets to storage, being flumed to the factory as required. The beets are transferred by a conveyor from the flume to the washer. The beet and tails are washed separately and sent to a Buckau-Wolf tower diffuser. Juice is prelimed, saturated, settled and the muds filtered; this is followed by liming and second carbonatation and the juice filtered using Schumacher ceramic candle filters. Proportional juice liming and automatic pH control are used. The clear juice is evaporated and the thick juice filtered and boiled to a first product (A) sugar. Two further products are boiled, the C sugar serving as seed for the B product which is melted, treated with carbon and kieselguhr and filtered before boiling as a refined sugar. This is mingled with the *A*-massecuite. The low grade pans have conductivity control and one refinery pan a Honeywell BPE instrument. Some molasses is mixed with pulp and dried, while some is sent to yeast plants. The sugar is stored in silos before sieving and packing in ½-kilo, 1-kilo and 50-kilo paper bags. Two oil-fired boilers are used and the excess power from the turbo-generator is sold.

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Automatic lime and juice purification plant at King's Lynn factory. R. M. J. WITHERS, T. RODGERS and J. E. A. RICH. *Paper presented to the 16th Tech. Conf., British Sugar Corp. Ltd.*, 1963.—The automatic lime production and juice purification plant installed at King's Lynn in 1962 incorporates techniques and experience acquired over a number of years by the British Sugar Corporation. The lime kiln is out-of-doors and is entirely automatic, needing no operator. Its only real innovations are the automatic tare on the limestone/coke strain gauge weigher and the control and presentation of all relevant operations on a main factory board. First carbonatation control is by conductivity, venting the gas, while 2nd carbonatation is controlled by gas throttling to give the desired pH. Milk-of-lime addition as a proportion of raw juice flow is governed by a magnetic flowmeter. At King's Lynn, the vacuum filters work completely automatically on a time cycle basis. The second carbonatation filters are of the Grand Pont type and are also operated automatically, while overall juice flow is regulated by simple computer control. The lime kiln, milk-of-lime production, carbonatation, Oliver vacuum filters, Grand Pont filters and control panel are each described in individual detailed sections.

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Pulp pressing—further developments. S. A. MORRISH. *Paper presented to the 16th Tech Conf., British Sugar Corp. Ltd.*, 1963.—The new BS64S Stord presses installed during 1962 in B.S.C. factories have a spindle of increased diameter at the feed end and for about ⅓ of the length; this increases the volume ratio to 1·7 as against 1·55 in the BS64 presses. The flights are also altered and the gearbox ratio changed. Experiments were made with the redesigned Rose, Downs & Thompson twin-screw press to overcome distortion of the screens by stones and such hard material passing through; use of a thicker screen with round-ended slots was unsuccessful, however, because of the increase in solids passing into the press water. Comparative tests of two adjacent Stord presses were made at King's Lynn; contrary to expectations, the BS64 gave a dry substance better, at 23·26%, than the BS64S at 22·64%, both being able to handle pulp from more than 1000 tons of beet/day. Woody beets resulting from the cold spring caused high power consumption by the presses (>75 h.p.) which fell to the usual 50 h.p. when the beets processed were normal. A system of speed control was found necessary, while steps are being taken to ensure correct loading of the presses. Average dry substance for the Stord presses was 21·79% as compared with 17·84% for the factories with vertical presses. The Rose, Downs & Thompson press is described and an account given of acceptance trials; with a slight pH disadvantage it handled 100 tons/day more than the Stord press but gave 0·8% less dry substance when run at the same speed of 3·75 r.p.m. When slowed to 3·4 r.p.m. it handled the same throughput and gave 1·24% better dry substance. Power requirements were probably lower than with the Stord press. Fitting a choke to the press improved its performance. An account is given of the end-of-campaign condition of the presses, gearboxes, etc.

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The development of fully-automatic centrifugals. H. LANGE. *Zucker*, 1963, **16**, 473–479.—Details are given of the "Kreisel 1000" fully-automatic flat-bottomed centrifugal manufactured by Selwig &

[1] *See also I.S.J.*, 1962, **64**, 272.

Lange which has undergone trials at the Heilbronn factory of Süddeutsche Zucker AG. The basket diameter is 1550 mm and its height 600 mm, so that at all speeds it rotates with great stability as a short-axle gyroscope with the centre of gravity as near as possible to the point of suspension. Maximum speed is 960 r.p.m. The energy requirements per ton of sugar were reduced to one-third of those of a 1500 r.p.m. machine and the maximum starting current was halved. The basket capacity is 850 kg of massecuite and the maximum number of charges per hr is 25. Charging is by means of a double slide valve without any dead space. The wide diameter of the basket ensures an optimum centrifugal force, and a greater and faster syrup separation than formerly is claimed. A discussion of the theoretical aspects of the machine, and particularly the significance of centrifugal force in their design, follows the article. The centrifugal force should be high for all massecuites, except large grained raffinade, in the opinion of H. EICHHORN. The question of relative basket diameter and comparison of centrifugals is considered by K. PAUSE as is the subject of optimum speed.

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Results of applying exclusively a method of acid fermentation to the purification of diffusion waste waters. S. KOLACZOWSKI and J. ZERBE. *Gaz. Cukr.*, 1963, **71**, 201–202.—Results of tests in which diffusion waste water was purified in lagoons by the Be-Ka acid fermentation method[1] are discussed. The BOD_5 was reduced by an average of 10% and the average oxidation rate by 56%. The pH rose to 7·0. The method permits a saving of 50 kg of lime per 50 tons of beet compared with the standard Nolte method.

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Results of the use of hydrocyclones in the sugar industry. S. GAWRYCH. *Gaz. Cukr.*, 1963, **71**, 196–200.—While hydrocyclones are particularly effective in purifying milk-of-lime (although many authors recommend the installation of at least one further hydrocyclone to treat the under-flow and reduce lime losses), their rôle in purifying flume water is less important. Provision should be made to separate the larger impurities (colloids and organic suspended matter) before the station and adequate space allotted after the station for the thick muds. One disadvantage of hydrocyclones is the need for an additional pumping station when flume water is being treated, with a pump to transfer the clear juice, whereas from a clarifier juice is usually gravity fed. Hydrocyclones can replace mud presses for 2nd carbonatation juice treatment, although bag filters must be retained. The clear juice still contains suspended matter after treatment. Addition of thick muds from hydrocyclones to main liming (3·5% on the amount of 1st carbonatation mud) results in only a slight improvement in the filtrability of 1st carbonatation juice. The throughput of a Polish hydrocyclone of 30 mm dia. has been found to be equivalent to 59·7 tons of beet processed per day. The performance of a hydrocyclone is limited by the size and s.g. of the suspended matter particles; the upper limit is determined by the diameter of the over-flow nozzle and the lower limit by the values of the parameters in the Stokes' equation for calculating the settling rate. As many authors give hydrocyclone performance data in the form of different factors, the formulae used should always be given to avoid ambiguity.

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Aspects of discontinuous filtration. P. FREUND. *Zeitsch. Zuckerind.*, 1963, **88**, 507–510.—Laboratory filtration tests to estimate the values of certain factors are discussed, particularly the suitability and otherwise of various methods and apparatus. Decisive factors in batch filtration are: filter running time, regeneration time and, in the case of pre-coat filtration, the optimum type of kieselguhr and its application. The effect of the regeneration time (cleaning, pre-coating and perhaps sweetening-off) on the daily volume of filtrate per sq.m. of filter surface is particularly noticeable with short running times. An example is given of the calculation of filter efficiencies at different running times under factory conditions from laboratory test data. Filter station parameters are determined for particular running times and the filtration costs, interest, maintenance costs and filter-aid costs are determined and the results discussed.

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Foam formation and certain other processes occurring in carbonatation juice settlers. P. S. MAKSIMUK. *Sakhar. Prom.*, 1969, (9), 22–25.—A rise in the settling rate of 1st carbonatation juice and a decrease in the mud volume when centrifugal pumps are used to transfer the juice to the settlers are ascribed to the breaking up of air bubbles in the juice by the pump which thus distributes foam throughout the juice. The bubbles absorb on their surfaces very small mud particles, which then rise to the top of the settler. The larger particles start to fall rapidly, but are hampered by the suspended smaller particles. Juice from which foam was removed after pumping settled faster and yielded less mud than did juice from which foam was separated, the bubbles extinguished and the residual juice returned. It is recommended that juice be retained 5 min in the receiving compartment of the settler for foam separation.

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Boiling *B*-massecuite of reduced Brix. Z. F. BULKA. *Sakhar. Prom.*, 1963, (9), 25.—From the experience of two Soviet sugar factories, it is recommended that factories equipped with old equipment, particularly pans, or where the pans are located too far from the crystallizers should boil 2nd product massecuite to no higher than 92–92·5°Bx. The massecuite should be cooled in mixers of which at least 7 should be available.

[1] Udoskonalenie techniczne pt., U.P.P.R.L., No. 11886.

Experimental investigation of the amount of water freezing out of beet and beet juice. V. Z. ZHADAN and M. Z. KHELEMSKII. *Sakhar. Prom.*, 1963, (9), 26–30.—Calorimetric studies in which (1) beet portions were immersed in an ice-salt mixture and (2) in which juice of various concentrations (diluted with distilled water) was cooled with solid CO_2 to between —30°C and +5°C and then heated, failed to establish any constant relationship between beet dry solids and its freezing point. It was found that the higher the freezing point, the greater was the volume of water freezing out of the beet. A simple formula has been derived for calculation of this volume, which is of use in calculations of the amount of cold air needed to freeze stored beet. Calculated and experimental values agreed satisfactorily.

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Experience in receiving, storing and processing beet harvested mechanically in Kirgiziya. F. N. DOBRONRAVOV and B. S. BESPALOVA. *Sakhar. Prom.*, 1963, (9), 46–48.—Comparative tests showed that mechanically-harvested beet suffered greater losses as a result of damage and storage, whereas in processing the spoilage content was somewhat lower than in beet harvested manually. However, the molasses yield and sugar content were higher than with manually harvested beet, and the juice and syrups were of a darker colour. Diffusion losses were higher because of a high occurrence of spoilage in the cossettes.

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The behaviour of non-sugars during sugar extraction. F. SCHNEIDER and D. SCHLIEPHAKE. *Zucker*, 1963, **16**, 503–509.—Diffusion tests were carried out in a laboratory apparatus and pilot-scale diffuser to determine the extent and rate of extraction of certain non-sugars from cossettes. Potassium extraction was found to be non-uniform, i.e. it cannot be expressed as one straight line of log relative concentration of K *vs.* log diffusion time, but is demonstrated by two straight lines with a transition region between, this region occurring at lower concentrations, with increased temperatures. The rate of K extraction was only slightly higher than that of sucrose in the initial stages. Sodium was found to have the same behaviour pattern, with an extraction rate lower than that of K and always lower than the sucrose extraction rate. Mg was extracted at a still lower rate and the transition region was considerably less apparent than with the other two cations. Phosphate was extracted first at a higher rate than sucrose, but this fell later to only a very low level. Thus, the size of the cations and of the accompanying anions are decisive for the extraction rate, the smaller molecules being extracted faster than the larger molecules, Cl^- for instance being 99% extractable. The substances remaining at the end of diffusion contain therefore more alkaline earths and higher molecular anions, which are however more easily removed in carbonatation. The cell wall was found to exert significant influence on the extraction rate of cations, acting as a cation exchanger through its carboxylic and partly esterified phosphate groups. Plasmolysis of the beet tissue produced yet other adsorbents. Measurement of the conductivity ash content of the juice confirmed the generally faster rate of sucrose extraction and also revealed that a rise in the diffusion temperature from 70 to 80°C has less effect on the increase in the juice conductivity than increase in the diffusion period from 70 to 126 min. Flame photometric measurements confirmed these findings. However, a temperature rise was found to have greater effect on increase in the pectin content of the juice than did increase in the diffusion time. While the pectin is easily removed by carbonatation, at a diffusion temperature above 80°C it is broken down and the fragments cannot be removed to the same extent in carbonatation. The albumin content of an alcohol precipitate from the juice fell in relation to the pectin content with increase in diffusion temperature. Reducing sugars extraction reached a maximum early during diffusion, falling to a lower level in the later stages.

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Measuring and control techniques in the sugar factory. A. JOSEPH. *Zucker*, 1963, **16**, 528–534.—A survey is presented of measuring and control methods used in sugar factories. Each section of a factory is briefly dealt with and examples are given from German sugar factories. The article is accompanied by illustrations and diagrams.

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Basic relations of physico-chemical parameters of 1st carbonatation muddy juice. R. OSVALD and H. KRATOCHVÍLOVÁ. *Listy Cukr.*, 1963, **79**, 218–223. In a statistical and experimental study, a linear relationship was established between S (settling rate) and V (mud volume after 25 minutes' settling) irrespective of the amount of milk-of-lime added at defecation. The correlation coefficient was —0·42 to to —0·59. With juices to which the same amount of milk-of-lime had been added, almost complete correlation was established between S and V (correlation coefficients of —0·72 to —0·89). No relationship was found between F_k (filtration coefficient) and S. The optimum milk-of-lime dosage proved to be 1·25% CaO, amounts greater or smaller than this causing a drop in the value of S and an increase in the value of V. Increase in the milk-of-lime dosage caused an increase in F_k and in the carbonatation efficiency. If a smaller amount of lime is used to obtain efficient settling, it may be necessary to add a further amount of lime after decanting to ensure maximum purification of carbonatation juice.

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Application of ion exchange resins in sugar manufacture. D. RAMONDT. *Listy Cukr.*, 1963, **79**, 228–230.—This is the subject of a lecture given by a representative of the Dutch firm of Imacti N.V. and deals with the use of resins for deliming, deionization and decolorizing. Mention is also made of the Assalini "A" and "B", the Vajna, Moebes and Quentin processes as well as the Imacti process of molasses exhaustion.

NEW BOOKS AND BULLETINS

Zuckerwirtschaftliches Taschenbuch 1963. (Economic Sugar Pocket Book.) W. SCHUBERT and G. BRUHNS. 182 pp.; 4 × 5¾ in. (Verlag Dr. Albert Bartens, Lückhoffstr. 16, Berlin-Nikolassee, Germany.) 1963. Price: DM 12.—; 22s 0d.

The layout of this pocket book of sugar statistics has been developed in its 10th edition by a number of additions and rearrangements. The most obvious innovation is the introduction of French sub-titles to bring the book into line with EEC policy. The international section has been expanded and the sub-section on Germany now includes both East and West Germany. The book is divided into three main sections: statistics, market provisions, and addresses of international and German sugar organizations (the latter also includes addresses of U.S. sugar companies). The first section contains details of world, European and German beet, cane, molasses and sugar production, sugar consumption, sugar and molasses imports and exports, sugar balances, and prices; details of West German freight costs and sugar duties are also given. The data relate to 1961/62 and in some cases 1962/63 estimates are given. The second section contains information on the International Sugar Agreement and world market prices, and on West German laws governing sugar sales, prices, delivery and payment, etc. The work contains 73 tables and 10 graphs and is a very useful source book, the more so in view of its compactness.

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The Story of Czarnikow. H. JANES and H. J. SAYERS. 176 pp.; 6 × 8¾ in. (Harley Publishing Co. Ltd., 18 Charing Cross Rd., London W.C.2.) 1964.

It goes without saying that a history of C. Czarnikow Ltd. will contain an abundance of material on the development of sugar trading in the U.K. and on the various events that have had a marked influence on sugar production and sales.

Basically, of course, the book is the story of the creation, by Julius Caesar Czarnikow, of the company and of its development into one of the largest and best known international firms of sugar brokers, which celebrated its centenary in 1961. The story is unfolded against the background of two world wars as well as other local wars and international incidents. The earlier history includes many fragments that pieced together give an excellent insight into the character of the founder. While it is mentioned that "it was said that nobody was really on the permanent staff until he had been sacked a number of times," examples of Caesar Czarnikow's generosity are cited, thus completing the picture of a talented businessman of "erratic temperament". Great emphasis seems to have been laid in the early days on the need for employees with linguistic ability, so that many of those joining the firm were of continental origin.

Much light is thrown on the activities of the market during the wars and during the inter-war period of depression. Other features covered include the passing of the Sugar Act in 1956, the threat of nationalization of the refining industry, and the effect of the Cuban revolution on the world market.

Many well-known names in sugar trading circles are mentioned, and many photographic portraits of the senior employees of Czarnikow are presented.

What is particularly intriguing is that Caesar Czarnikow should have founded a firm of sugar brokers in England, where the sugar trade was rather limited, compared to that in Germany, where he was born. Since then, the interests of the firm have covered rubber and cocoa as well as other products, although sugar is still the product for which they are best known.

Congratulations are due to the authors for their work, which was somewhat complicated by the fact that many of the firm's records were lost when the offices were destroyed during the 1941 air raids on London and by the fact that the founder was born and spent his very early life in Central Europe.

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Bestimmungsgründe für die Elastizität des Zuckerverbrauchs in der Bundesrepublik seit 1952. (Bases for determination of the elasticity in sugar consumption in the German Federal Republic since 1952.) W. WIENS. 129 pp.; 5¾ × 8¼ in. (Verlag Dr. Albert Bartens, Berlin-Nikolassee, Lückhoffstr. 16, Germany.) 1963. Price: DM 12.—; 22s 0d.

This, No. 37 in the series of reports published under the auspices of the Marktforschungsstelle Zucker, Bonn, is a statistical survey of the trends in sugar consumption in West Germany from 1952 to 1961 inclusive. It has been found that all sugar-consuming sectors (confectionery, mineral water, breweries, vineyards, ice cream and domestic) are subject to seasonal fluctuations in their sugar consumption. The sharp rise in per caput consumption over the nine years surveyed was due mainly to the demands in industrial sugar, while sugar consumption for the manufacture of synthetic honey actually fell. The decisive factor in domestic consumption is the extent of the fruit harvest. Good agreement has been found between the extents of both the early and the late fruit harvests and the domestic sugar consumption in the respective periods (May–July and August–September). Thus, while trends in sugar consumption have been estimated for each group of consumers, these cannot allow for such factors as variations in the wine must harvest, which could result in a 30,000 ton difference in sugar consumption, or fluctuations in the fruit harvest (a difference of 100 tons in the late fruit harvest can mean a rise or fall of 4·1 tons of sugar consumed). During the period examined fluctuations of 670,000 tons were observed in the late fruit harvest, equivalent to about 27,000 tons of sugar.

The report contains 28 graphs and 25 tables and makes very interesting reading, even if it is only of local value.

Changes in beet after freezing and storage. A. ATTERSON, A.[3] CARRUTHERS, J. V. DUTTON, D. HIBBERT, J. F. T. OLDFIELD, M. SHORE and H. J. TEAGUE. *Paper presented to the 16th Tech. Conf., British Sugar Corp. Ltd.*, 1963.—Examination of undeteriorated frozen beets showed that internal portions contained *Leuconostoc mesenteroides* and rapidly produced levan and dextran on incubation. The literature as to the presence or absence of micro-organisms in living beets is reviewed and it is recommended that studies be made to resolve the uncertainty. Young greenhouse-grown beets were examined using sterile equipment and shown to contain bacteria and yeasts. Results are quoted of yeast counts in expressed juices from commercially harvested beets over several years; although obtained with washed and sterile equipment, yeast counts of $0{\cdot}1$–$0{\cdot}2 \times 10^5$ per ml were obtained, while under normal working conditions these rose to $0{\cdot}2$—10×10^5. The yeasts were mostly found in the outer top portion of the root and three identified as *Hansenula anomala*, *Saccharomyces rosei* and *Debaryomyces kloeckeri*, the last not having been reported previously in beets. Slightly deteriorated frozen beets have often a "fruity" odour; by steam distillation, ether extraction and distillation, the cause was identified as *iso*-amyl acetate, produced by the yeasts present. Evidence indicates that raffinose in beet increases during the campaign while the beets are still in the ground as well as when they are being stored in clamps after harvesting. With beet stored at 12°C under non-wilting conditions, the raffinose content was unchanged; under wilting conditions at 6°C and 23°C the raffinose in g/100 sucrose fell with time of storage. Under the same conditions, invert and kestose both increased; this also happened with frost-damaged beet, parallel with levan and "fruity" odour production. Separation of polysaccharide gums by thin layer chromatography is discussed (and the technique described in an appendix), and their content (as dextran equivalent) in molasses discussed with respect to its significance as an indication of sucrose loss through microbial action. Sugar losses from frost-damaged beet by diffusion in flume and wash water are also discussed.

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An investigation into discoloration during the boiling of clear sweets. R. CAROLAN. *Paper presented to the 16th Tech. Conf., British Sugar Corp. Ltd.*, 1963.—An investigation was made into the circumstances whereby sugars having a low colour gave too highly coloured a boiled sweet when heated with glucose; it was found that the trouble is mainly associated with traces of amino-nitrogen and insufficient acidity. This was shown by the fact that traces of a strong amino acid such as glutamic acid caused high colour, while addition of large quantities did not. Slower cooking gives better results than the usual rate, perhaps owing to a slower loss of acidity during boiling. Sugar for sweet manufacture should be of low colour (<30 Spekker) and of low ash (to avoid excessive buffering).

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Crystallization of sugar during exhaustion of low-grade products. D. AHARI and J. GENOTELLE. *Paper presented to the 16th Tech. Conf., British Sugar Corp. Ltd.*, 1963.—When molasses was mixed with 40% w/w white sugar and kept at 40°C for 24 hr, the molasses purity was reduced further than when it was mixed with raw sugar under the same conditions. The raw sugar is from low-grade strikes, twice washed by mingling with pure saturated sugar solution and centrifuged, and dried and screened; it is in fact nearly white. The phenomenon was noted in all cases when a number of molasses samples were examined, using several samples of sugar. White sugar was grown successively in low purity syrup and samples at each stage used to examine the behaviour of a single molasses; the white sugar produced the lowest purity with the purity drop decreasing progressively with "deterioration" of the white sugar. Correspondingly, raw sugar had a greater effect as its surface was washed away, but it never achieved the effect of white sugar. It also improved when raw sugar was coated with white sugar by crystallizing in a pure sugar syrup. Equilibration experiments with white and raw sugar in molasses further indicated that the latter had a higher solubility, melting faster and crystallizing slower than white sugar.

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Sugar crystallization and the formation of molasses from normal and de-limed juices. S. ZAGRODZKI and J. MARCZYNSKI. *Gaz. Cukr.*, 1963, **71**, 158–160. See *I.S.J.*, 1963, **65**, 24.

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Mutual Milling Control Project. Progress Report No. 1. A. VAN HENGEL, E. J. BUCHANAN and K. DOUWES DEKKER. *Proc. 36th Congr. S. African Sugar Tech. Assoc.*, 1962, 56–60.—During the first year of the project, five South African factories have submitted data to the Sugar Milling Research Institute. An outline is given of the preparatory organization. During the initial stages, fourteen factories were equipped with instruments, including a cyclometer and four lift integrators with accessories for each mill tandem, and an efficient method of calculating specific performance figures from the data supplied was devised. Some general difficulties have occurred

and these are discussed. They concern sampling of primary and secondary mill juices, measurement of the set opening and of the roller diameters, and rather rapid wear of the roller bearings on the followers of the lift integrators. Some preliminary observations are made on the basis of the data already supplied and typical data for the 1961/62 season are tabulated for four factories.

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Possibilities of improving the quality and evaluation methods of beet raw sugar. M. RIEDEL and H. BROSE. *Zuckererzeugung*, 1963, **7**, 142–151.—A study was made by the Institut für Zucker-und Stärkeindustrie Halle-Trotha of various problems connected with the refining of *A* and *B* beet raw sugars, including the working out of new standards and colour scales for raw sugar and the creation of a new basis of payment, as well as modifications of the methods of loss control to a basis of polarization instead of rendement. The disadvantages of using Monnier's rendement (Rdt = pol — 5A, where A is the ash content) for evaluation and payment of raw sugar as well as loss calculations are discussed. Statistical analyses of raw sugar data from the three campaigns ending in 1961 were carried out and the following nominal values suggested for both sugars: *A* raw sugar should have a minimum pol of 95·5, a maximum ash content of 0·90%, a maximum moisture content of 2%, a maximum reducing sugars content of 0·05%, and a minimum pH of 8·2. Details are given of the new colour code. *B* raw sugar should have a minimum pol of 89·0, a maximum ash content of 2·80%, a maximum moisture content of 4·0%, a maximum reducing sugars content of 0·10% and a minimum pH of 8·1. Details are given of the adjustments to be made to the price of both sugars for any values outside the specified limits, with a scale of surcharges for pol variation in the case of *A* sugar only.

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Conductimetric determination of ash in cane molasses. S. Y. CHEN. *Taiwan Sugar Quarterly*, 1963, **10**, (2), 18–19.—An empirical formula is derived for calculation of the ash content of cane molasses. This takes the form: sulphated ash % = specific conductivity $\times 10^6 \times 0{\cdot}018779 - 1{\cdot}014$. It is valid for a concentration of 0·5%, and percentage differences between calculated values and values determined by double sulphation ranged from +0·33 to —0·34 at an ash content of approximately 6·9% – 15%.

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Chromatographic and electrophoretic evidence of the presence of α-amino-adipic acid and colamine in sugar juices. P. PAVLAS. *Listy Cukr.*, 1963, **79**, 209–213.—Paper chromatography and electrophoresis of amino acid isolates from raw and thick juice revealed a stain very close to glutamic acid. This was found to be α-amino-adipic acid, a crystalline substance of b.p. 206°C (anhydrous) which is only slightly water-soluble (1 part in 450 parts water at 40°C) and moderately soluble in ethanol and ethyl ether. Probably as a result of heating in alkaline medium with the loss of a molecule of water, α-amino-adipic acid converts to piperidone-2-carboxylic acid in the same way that glutamic acid converts to pyrrolidone-carboxylic acid. Acid hydrolysis causes the original acid to be reformed completely. Electrophoresis also revealed the presence of colamine (ethanolamine) which migrates towards the cathode more rapidly than basic amino acids.

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The viscosity of pure sucrose solutions. F. SCHNEIDER, D. SCHLIEPHAKE and A. KLIMMEK. *Zucker*, 1963, **16**, 465–473.—The measurement of the viscosity of sucrose solutions as a function of the rate of shear is discussed with 23 references to the literature. Methods and instruments are described. It has been found that at high concentrations and low temperatures sucrose solutions behave as Newtonian liquids. The viscosities of highly supersaturated solutions have been measured and are tabulated; these include an upper concentration level of 86% (by weight) and cover a temperature range of 5–80°C. Specific (intrinsic) viscosities have also been calculated on the basis of volumetric concentration. It was found that in the range 30–40% by weight the sucrose molecules, which at lower concentrations are present predominantly as hydrates, are transformed into associates. Since sucrose solution acts as a Newtonian liquid and therefore does not exhibit anomalous viscosity relationships, the associates are formed isotropically. This was confirmed by a theoretical calculation of viscosity and comparison of this with experimental data.

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Density tables for aqueous sucrose solution. F. SCHNEIDER, D. SCHLIEPHAKE and A. KLIMMEK. *Zucker Suppt.*, 1963, (17), 1–19.—The tables of sucrose solution densities given earlier[1] contain incorrect values for the temperature range 88–99°C. These resulted from a fault in the electronic computer's operations. The values have been corrected, and the complete tables are given for a temperature range of 10–100°C at unit intervals and a concentration range of 0·69% by weight.

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Crystallization rate. C. MOLLER and N. O. SCHMIDT. *Zeitsch. Zuckerind.*, 1963, **88**, 501–504.—Details are given of a laboratory method for determination of the crystallization rate of sugar in a given solution under conditions closely approximating those in the factory. A suspension of milled sugar crystals in *iso*propanol and a surface-active agent (to prevent agglomeration) is stirred in a sugar solution, samples being taken at intervals and examined microscopically. The arithmetic mean of the greatest length of at least 100 crystals is thus determined. The greatest extent of conglomerates is also determined, each conglomerate being considered as one crystal. The crystallization rate is defined as the average increase in length

[1] *I.S.J.*, 1963, **65**, 376.

per min. A graph of grain size *vs.* time is a straight line up to about 120μ. The reproducibility is better than about 20% up to a crystallization rate of about 15μ/min. At constant supersaturation, temperature was found to have quite a pronounced effect on the crystallization rate, the latter rising by about 20% at 1·25 supersaturation when the temperature rises from 75 to 80°C. Sugar solutions of 79–100 purity were tested, and no difference was found between the crystallization rate of Danish sugar solutions of the same purity and supersaturation from the 1960–1962 campaigns.

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Transfer of sucrose through ion exchange membranes during electrodialysis purification of its solutions. D. M. LEIBOVICH and I. F. ZELIKMAN. *Sakhar. Prom.*, 1963, (9), 30–36.—Experiments were carried out to determine the amount of sugar diffusing through the membranes during electrodialysis. The tests were conducted, under dynamic conditions approaching those of factory practice, in a 5-cell dialyser. Sulphuric acid (0·1N) was fed to cells 1 and 5, 0·1N sodium chloride solution to cells 2 and 4, and a 60% sucrose solution containing 40% NaCl to cell 3. The membranes were alternately cationic and anionic, three different cation and four different anion membranes of Soviet manufacture being used. While the amount of sugar penetrating the membranes was usually small, it was increased by electro-osmosis, the order in which the membranes resisted sucrose penetration when a small current was passed through being almost the same (two membranes adjacent in order changed places) as without any current. The amount of sugar lost through electro-osmosis decreased with increase in the concentration of the electrolyte, the fall being particularly marked at an increase from 0·1N to 0·3N NaCl. At 0·05–0·1N and a current density of i = 10mA/sq.cm., electro-osmosis increased the sucrose transfer by up to 38 times; the loss fell with decrease in the current density. Thus, high purity sugar solutions will suffer high losses in electrodialysis. Recommendations are offered as regards choice of membrane for diffusion resistance.

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Making production control more precise. I. Determination of 1st carbonatation juice natural alkalinity. II. Titrimetric method of controlling the work of settlers and thickeners. N. A. ARKHIPOVICH, L. M. ZELENINA and S. N. KVITA. *Sakhar. Prom.*, 1963, (9), 42–45.

I. Since the method generally used to determine the natural alkalinity of 1st carbonatation juice gives a lower value than the true value, a new method has been devised: 100 ml of filtered 1st carbonatation juice is heated to boiling point and the Ca and Mg content precipitated with 10 ml alkaline ammonium oxalate solution. After cooling, 2 ml ammonium oxalate is added to complete the precipitation and the juice filtered. Twenty ml of the filtrate are transferred to a flask and evaporated, charred (to avoid swelling) and finally calcined. The ammonium salts and volatile chlorides sublime, leaving only K and Na as oxides or carbonates. The ash is dissolved in 10 ml 0·1N acid and the excess acid titrated with 0·1N alkali with methyl orange as indicator. The natural alkalinity is given by: $\frac{1{\cdot}12 \times 0{\cdot}0028\ (A - B)\ 100}{20}$

where 1·12 is the dilution coefficient when 12 ml ammonium oxalate solution is added to 100 ml juice; 0·0028 is the titre of 0·1N acid against calcium oxide; A is the amount of acid needed to dissolve the ash (ml); B is the amount of alkali required for back-titration (ml); 20 ml is the amount of filtered juice used for ashing. Some experimental data are tabulated, showing that whereas results obtained by existing methods are negative, those derived using the new method are positive. The optimum alkalinity of 2nd carbonatation juice is equal to approximately half the natural alkalinity as determined.

II. Evaluation of clarifier performance is possible from the determination of the proportions of mud suspension and pure juice in unfiltered 1st carbonatation juice. The alkalinity (amount of acid for titration/weight of sample) of the unfiltered juice + mud is determined by accurately weighing and titrating with 1N acid, and that of pure juice by titrating with 0·1N acid, both using methyl orange as indicator. The thickened mud is calculated from an alkalinity balance: $\frac{(A_1 - A_p)\ 100}{A_m - A_p}$ % where A_1, A_p and A_m are respectively the alkalinities of the unfiltered juice, pure juice and mud. The solids content of the mud suspension is determined by titrating with 1N acid using two indicators (phenolphthalein followed by methyl orange); metal hydroxides are titrated first, then calcium carbonate. The CaO% is given by the amount of acid used to titrate against methyl orange divided by the weight of the suspension.

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Determination of the white sugar yield and molasses sugar which can be obtained from sugar beet. K. VUKOV and L. BARAN. *Cukoripari Kutatóintézet Közleményei*, 1962, **7**, 18–25; through *S.I.A.*, 1963, **25**, Abs. 625.—The molasses sugar yield C_m from healthy beets was found to be well correlated with the ash in beet, h, by the equation: $C_m = 1{\cdot}61h + 1{\cdot}35$. The amino-nitrogen content of the beet was not found to have any detectable influence. With deteriorated beets, the equation becomes: $C_m = 0{\cdot}65h + 1{\cdot}71i + 1{\cdot}71$, where i = invert content. For more exact determinations, the purity q of the purified beet juice and the % sugar (m) in molasses on 1 part of non-sugar for "standard" molasses prepared in the manner defined by Silin (saturated at 40°C, and 44 poises viscosity) are required. The value $m = 0{\cdot}028a + 0{\cdot}080$, where $a = (h - 1{\cdot}8\ \text{CaO})/(100 - q)$, h = conductimetric ash, and q = juice purity. The CaO value is g of Ca/100°Brix.

BY-PRODUCTS

Sugar cane bagasse—blackstrap molasses rations for beef cattle. P. B. BROWN. *Proc. 11th Congr. Int. Soc. Sugar Cane Tech.*, 1962, 1216–1224.—Experimental trials with varying proportions showed that 20% bagasse, 50% molasses and 30% of other feeds supplying protein, energy, vitamins and minerals, was the most desirable. Further trials showed that addition to the feed of 10 mg of diethylstilbestrol per day per steer increased feed efficiency and daily gains.

* * *

The development of the by-product industries by Taiwan Sugar Corporation. H. S. WU. *Sugar J.* (La.), 1963, **26**, (2), 26–31.—Descriptions are given of four factories (and their processes) belonging to Taiwan Sugar Corporation, which manufacture products other than sugar. The factories are: Hsinying yeast plant, Changhwa bagasse board factory, Kaohsiung particle bagasse board plant, and Taitung pineapple cannery (pineapple growing supplements cane cultivation on the east coast of Taiwan). The advantages for the sugar industry of manufacturing these products are discussed.

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Properties of hardboard from sugar cane bagasse. ANON. *Philippine Agriculturist*, 1963, **46**, 716–728. The physical and mechanical properties of hardboard from depithed and undepithed bagasse were compared. The hardboards from depithed bagasse gave higher values of modulus of rupture and modulus of elasticity, and lower water absorption values. These indicate greater load-carrying capacity and stiffness and lower water-absorbing capacity of boards from depithed bagasse. The cold soda process was employed for both kinds of bagasse. Depithed bagasse gave higher yields of pulp and consumed less chemical than undepithed bagasse. Varying the pressure periods from 10–12 to 15 minutes did not seem to have an effect upon the moduli of rupture and elasticity but had marked effects on the water absorption values of the boards.

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Molasses utilization in VEB Gärungschemie Dessau (Dessau fermentation plant). M. WEHMANN. *Zuckererzeugung*, 1963, **7**, 159–161.—Details are given of the processes for ethanol, CO_2 (liquid and solid), fodder yeast, betaine hydrochloride and sodium cyanide production from molasses at Dessau, which processes almost two-thirds of East Germany's molasses yield.

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New detergents on sugar as a raw material base. H. SIMONIS. *Zeitsch. Zuckerind.*, 1963, **88**, 461–463. The production of detergents by reacting sucrose with castor oil fatty acids, olive oil fatty acids or fatty acids of other oils is discussed with reference to the official demands for high "biodegradable" detergents and with reference to production costs[1].

Comparative tests on the fermentation processes of citric acid, acetone-butanol and alcohol in sugar beet molasses from various sources. J. KOVATS. *Zeitsch. Zuckerind.*, 1963, **88**, 504–506.—Fermentation tests with molasses solutions from different Polish sugar factories revealed a relationship between the fermentation process and (i) the colour of the molasses and (ii) the volatile acids content. The process deteriorates as the molasses colour deepens and the volatile acids content increases. These factors have a particularly noticeable effect on citric acid fermentation, only two of the eight samples fermenting satisfactorily and two of the samples not at all. The influence of the two factors on alcohol fermentation was less pronounced, while in the case of acetone-butanol fermentation a high volatile acids content is not only not harmful but even desirable. This is explained by the fact that during acetone-butanol fermentation volatile acids are formed (acetic and butyric acids) which finally are converted to butanol, acetone and ethyl alcohol, so that the higher content of these acids is harmless for the butyl bacteria. Thus, while molasses suitable for citric acid fermentation is also suitable for alcohol fermentation, it may be less so for acetone-butanol fermentation. Twenty-one references are given to the literature.

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Definitions of blackstrap molasses as produced by the sugar industry and of cane feeding molasses and/or cane molasses. S. L. CROCHET. *Sugar J.* (La.), 1963, **26**, (4), 14–26.—The author emphasizes the need for new definitions of the terms "blackstrap molasses" and "cane molasses" in order to avoid misunderstanding among customers. The essential difference between them is that, commercially, cane molasses is blackstrap molasses with water added to adjust the Brix to 79·5°. Moisture and sugar content are considered to be unsuitable guides to the feeding value of the molasses, and reasons for this are discussed. The advantages of molasses as livestock fodder are given together with the experiences of the author's company in producing molasses, feeding it to cattle and selling it as animal feed.

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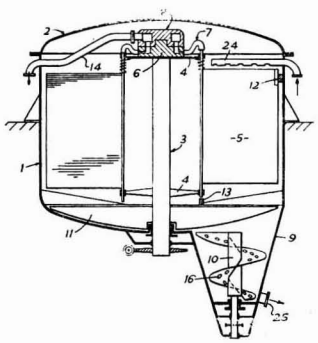
Molasses feeding in Europe. J. VAN GINNEKEN. *Sugar J.* (La.), 1963, **26**, (4), 28–30.—The level of molasses utilization as fodder in Europe is discussed and compared with the situation in the U.S. Molasses mixers are described, in particular the vertical type which consists of a cylinder with an inner shaft carrying special knives rotating at about 3000 r.p.m. This operates very well with unheated viscous molasses and the meal is kept dry and free-running. While this and new methods of proportioning have stimulated greater use of molasses, the consumption in Europe is still considered low. The use of urea is not permitted in several countries, so that the use of molasses-urea mixtures is restricted at present to Denmark.

[1] *Cf. I.S.J.*, 1963, **65**, 309.

PATENTS

UNITED KINGDOM

Thickener for carbonatated sugar juices. G. GAUDFRIN, of Paris 8e, France. **934,180.** 2nd September 1959; 14th August 1963.—The thickener is in the form of a continuously operating pressure bag filter. The cylindrical tank 1 has a domed cover 2 and a rotating vertical central shaft 3. Supports 4 on the shaft carry radial corrugated plates 5 and also a collector plate 6 at its upper end. The machined face of plate 6 matches that of a fixed distributor head 8 which serves as the upper bearing of shaft 3. The plates 5 are covered with filter cloth and are provided with flexible ducts 7 connecting their collector tubes with collector plate 6. Ports in the head 8 connect with outlet pipes 14. Juice to be



filtered is admitted through distributor 24 and is filtered, the filtrate leaving via pipes 14. The solids held by the cloths may be dislodged in a number of ways: the collector tubes may be located in turn opposite a "blowing" port in the collector plate 6 whereby a back-pressure greater than the filter operating pressure expands the bag, removing its cake; in addition, the plate may be spring-held at one position on the collector so that during rotation of shaft 3 it meets a cam or obstruction 12 or 13 whereby the plate is pivoted or raised and then released suddenly, the jolt dislodging the cake. Alternatively the cam-induced motion may be of a frame, relative to the plate, whereby strings attached to the frame scrape across the surface of the plate, removing the cake. The latter falls into hopper 9 and is homogenized by helix 10 before discharge through pipe 25.

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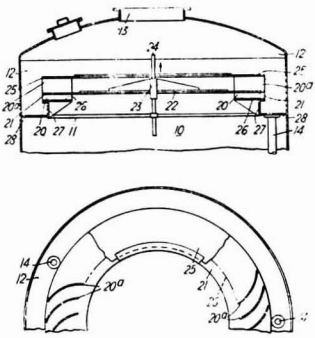
Removal of entrained liquid in vapours. GEORGE FLETCHER & CO. LTD., of Masson Works, Litchurch Lane, Derby. **935,360.** 5th May 1962; 28th August 1963.—Vapour from the evaporator body 10 passes through aperture 11 to vapour space 12 and so to exit port 13 by way of the entrainment separator which is in the form of a ring of curved plates 20, 20a covered by a flat circular plate. The vapour thus follows a curved path and entrained liquid is separated by centrifugal force and returns to the boiling juice by way of drain tubes 14. Plate 22 mounted on boss 23 which slides along vertical shaft 24 alters the proportion between the areas of plates 20 and 20a, i.e. the proportion of the total area



exposed to the vapours. This adjustment permits variation in the duty performed by the separator and by the body, i.e. from the first to last effect of a multiple-effect evaporator. Alternatively the variation in area may be achieved by altering the position of arcuate plates which thus cover varying proportions of the ring of plates. The same effect may be achieved by using a series of hinged doors, or by raising and lowering the upper circular plate and assembly of plates 20, the latter passing through slots in plate 26. Plates 20 may be in two overlapping portions so that alteration of the height of the circular plate varies the overall height (and surface) of the plates 20. The plates may also move about vertical pivots at each end, attached to plates 25 and 26, respectively, so that relative rotation of the latter varies the vapour path between plates 20, having the same effect as altering their area.

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Purification of sugar (beet) juice. DORR-OLIVER INC., of Stamford, Conn., U.S.A. **935,848.** 30th September 1960; 4th September 1963.—Raw juice is limed and carbonatated and settled in a thickener which produces a clear overflow and a thickened mud. The latter is washed and filtered on a continuous filter to produce sweet water and a largely sugar-free cake. The cake is mixed with wash liquid to form a suspension which is subjected to centrifugal classification in one or more hydrocyclones to give a fine fraction, containing the fine calcium carbonate and impurities in the form of slimes which are sent to waste, and a coarse fraction comprising clean, relatively coarse $CaCO_3$; this fraction is at least partly recycled to the juice before the thickener. At least part of the sweet water is used to slake the lime used as milk-of-lime.

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).

Sugar manufacture. ROSE, DOWNS & THOMPSON LTD., of Hull, Yorkshire. **934,395.** 7th October, 1959; 21st August 1963.—See U.S.P. 3,100,725[1].

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Filtration process. ROHM & HAAS CO., of Philadelphia, Pa., U.S.A. **935,909.** 24th December 1959; 4th September 1963.—See U.S.P. 3,078,188[2].

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Process for purifying sugar juices. ROHM & HAAS CO., of Philadelphia, Pa., U.S.A. **935,910.** 24th December 1959; 4th September 1963.—Impure sugar solution (raw juice, diluted molasses) is treated with a strongly basic anion-exchange resin carrying exchangeable OH^- ions which give the effluent juice a high pH. This highly alkaline juice is treated with $CaSO_4$ and/or $CaCl_2$ and any solid material resulting from this treatment is removed from the juice. The resin may be one component of a mixed bed of anion- and cation-exchange resins or may be one of two beds, the solids-free juice being treated further with an anion and cation-exchange resin in separate columns or a mixed bed.

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Beet harvester. J. D. DYSON and C. R. DYSON, of Peterborough, Northants. **936,384.**—23rd December 1959; 18th September 1963.

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Cane harvesters. MASSEY-FERGUSON (AUSTRALIA) LTD., of Sunshine, Victoria, Australia. **937,065–7.** 21st December 1959; 18th September 1963.

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Beet toppers. H. C. OPPEL, of Boise, Idaho, U.S.A. **937,089.** 13th June 1962; 18th September 1963.

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Filter presses. SUCRERIES ET DISTILLERIES DU SOISSONAIS, of Soissons (Aisne), France. **937,958.** 28th February 1962; 25th September 1963.—The device is designed to open the press and to separate the individual plates for removal of the cake. Rotary motion of a motor-reducer set is transferred to a crank wheel, of which the pin is connected by a crank to one of a series (giving varying eccentricity) on the lever of a crankpin, and thus the motion converted to linear reciprocation. The crankpin is mounted on a shaft through a pawl and ratchet free-wheel mechanism so that the shaft is rotated in steps. A controllable finger and socket device permits engagement and disengagement of the escapement. At the other end the shaft is a gear coupled through a force limiter in the form of a spring-loaded clutch. The gear drives an axle at the end of which are cogs connected to cogs at the end of a freely rotating axle by means to two endless chains. The chains are located on either side of the filter press and each includes one link with a side plate carrying a pivoting catch which engages with the lugs of the filter plates. The mobile bearer is moved to its furthest extent when the press is to be opened and the finger engaged in the socket so as to set the chains in motion. The eccentricity of the crank pin is so chosen that the pivoting catch moves towards the bearer by the same distance that that latter has moved, *plus* a distance equal to the thickness of a filter plate plus cloth. At the end of its stroke towards the bearer it is held by the latter so that the clutch slips; on its return journey the catch then passes beyond its original position and engages with the lugs of a plate. This it brings against the bearer, when the resistance causes the clutch to slip again, after which the catch returns to engage the lugs of another plate. As each plate is moved the cake separates (if it does not, the mechanism may be stopped manually to clean the plate and then restarted). After all have been moved the finger is disengaged and the chains driven only in the direction whereby the plates and bearer are moved into the closed position. A limit switch then stops the motor reducer.

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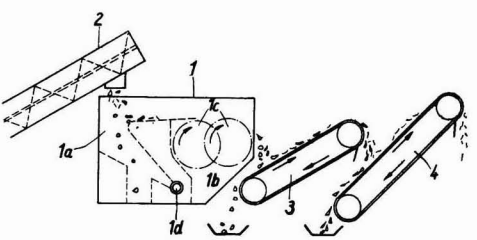
Beet cleaners. ELFA-APPARATE-VERTRIEBS-G.m.b.H., of Muelheim/Ruhr, Germany. (A) **938,525.** 8th March 1962; 2nd October 1963. (B) **938,526.** 13th March 1962; 2nd October 1963.

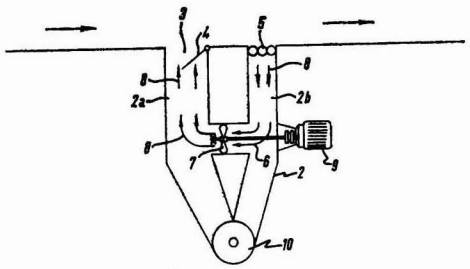
(A) Beet tails, fragments, leaves, straw, etc., are delivered by the screw conveyor 2 to the tank 1 which contains water supplied through pipe 1d. Heavy stones fall into the drain chamber 1a and are discharged while lighter sand and mud are partly suspended by the upflowing water and carried to a further section leading to a mud discharge, not shown. The beet tails and light impurities are carried



over to the two rollers 1c which comprise rows of toothed discs. The teeth catch most of the weeds, leaves, etc., taking them down to the discharge chamber 1b while the beet fragments and tails, with the remainder of the light impurities overflow onto the inclined belt conveyor 3. The larger beet pieces fall down the conveyor while the smaller pieces and impurities are carried up by the conveyor and discharged onto conveyor 4. The remaining beet pieces fall down this conveyor while the leaves, grass, etc. are discharged over the top.

[1] *I.S.J.*, 1964, **66**, 95.
[2] *I.S.J.*, 1963, **65**, 280.

(B) Beet and stones travel along flume 1 under which is a stone trap 2. Stones fall into the upstream chamber 2a while the beets pass over. The size of the



opening 3 is adjustable by means of the grid or rake 4, and an upflow of water is achieved by drawing water through the roller grid 5 by means of the motor-driven propellor 7. The stones are removed by scroll 10.

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Food products from sugar beet vinasses. SOC. CIVILES D'ETUDES ET DE RECHERCHES PHARMACOTECHNIQUES, of Fontvieille, Monaco. **939,545.** 29th September 1961; 16th October 1963.—Vinasse is hydrolysed by boiling with HCl and the product brought to pH 4·5–7 (5–7) by either distilling off the acid, treating with a cation exchange resin, or neutralizing (in the cold) with NaOH, Na_2CO_3, $NaHCO_3$, Na_2SO_3, $NaHSO_3$, $Na_2S_2O_5$, optionally mixed with corresponding salts of another non-toxic alkali metal or alkaline earth. The product may be further purified by adding ethanol, separating any precipitated material, and subsequently removing the ethanol. The product, containing proteins and amino-acids, possesses dietetic value.

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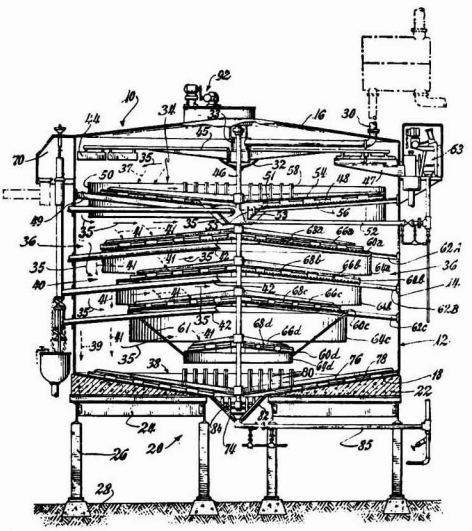
Clarifying liquids (cane juice). UNION TANK CAR COMPANY, of Chicago 1, Ill., U.S.A. **939,831.** 3rd November 1961; 16th October 1963.—Juice enters the clarifier 12 through pipe 30 and is directed radially by deflection plate 32 to primary sedimentation area 34. Here the heaviest solids separate and are removed. The partially purified juice overflows into the zone 36 and thence to a secondary sedimentation zone 38 and a final zone 40. Clear juice is removed through pipes 42. The deflection plate 32 is concaved upwardly to impart gentle turbulence to the juice, and foam separating is collected by skimmers mounted on arms 45 of drive shaft 46 and is collected in canal 47. The primary sedimentation chamber comprises an upwardly concave settling tray 48 supported from wall 14 by spokes 49 and having a peripheral apron 50 and a conical sump 51 from which the solids are withdrawn through conduit 52. The solids are conducted to the sump by scrapers 54 attached to shaft 46, while pickets 58 pass through the collected particles, freeing trapped pockets of liquid. Similar scrapers 53 and pickets 55 operate in the sump 51.

The final sedimentation zone 40 includes a series of downwardly concave settling trays 60a, 60b, 60c and 60d, the first three supported by spokes 62a, 62b and 62c and the last by rods 61. The trays are fitted with skirts 64a, 64b, 64c and 64d and with scrapers 66a, 66b, 66c and 66d, the blades of which



(68a, 68b, 68c and 68d) push settled solids to the outer edge. The solids being pushed away from the centre, juice withdrawn through pipes 42 is as clear as possible. The solids fall onto the bottom 18 of the tank and are moved by blades 78 of scraper 76 into the sump 74, thickened by pickets 80, 84 and guided by scraper 82 into the outlet conduit 85.

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Beet thinner. G. H. PALM, of Halsingborg, Sweden. **941,890.** 21st April 1961; 13th November 1963.

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Ethers of sugars. MONSANTO CHEMICAL CO., of St. Louis 66, Mo., U.S.A. **941,950.** 27th June 1960; 20th November 1963.—Carboxyvinyl ethers of sugars (glucose) are prepared by treating either (a) a salt of the sugar and a strongly basic hydroxide or (b) a sugar and aqueous solution of the hydroxide, with a propiolic acid ester of general formula $R'C \equiv C.COOR$ where R is an alkyl group of 1–22 C atoms and R' is H or an aromatic hydrocarbon group of 1–6 C atoms. Excess of the ester may be used as the solvent. The product may be acidified to give a carboxyvinyl ether and may be converted to the alkali metal (Na, K, Li) or quaternary ammonium salt.

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.

Link-Belt equipment at Moore Haven. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

The Glades County Sugar Growers' Co-operative Association mill at Moore Haven, Florida, has a 3000 tons per day cane capacity and produces raw sugar which is either refined immediately or stored in the 12,000-ton warehouse for subsequent refining. After the initial trial campaign the Association plans to harvest about 10,000 acres, producing and milling a crop of more than 330,000 tons of cane to give 33,000 tons of sugar. The cane is brought to the mill in open-top semi-trailers or trains of field wagons. Either type is dumped by hoisting one side when it empties through the hinged other side onto one of two feeder tables (Fig. 1). The base of these consists of ten strands of

Fig. 1

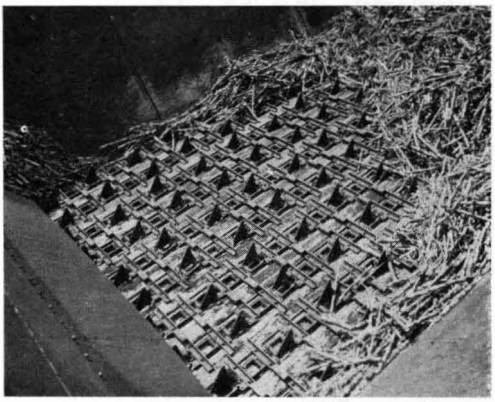

Fig. 2

Link-Belt C132 chain with 8-inch high spur attachments (Fig. 2) which aid in moving cane to the central carrier feeding the mill tandem (Fig. 3).

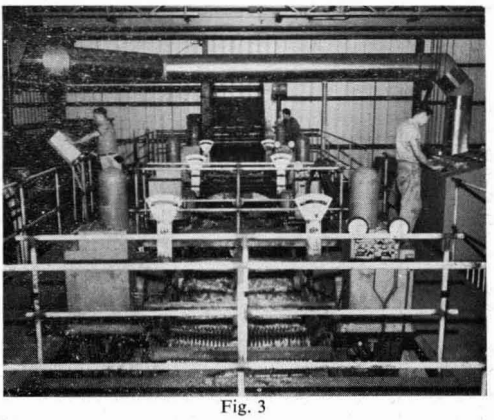

Fig. 3

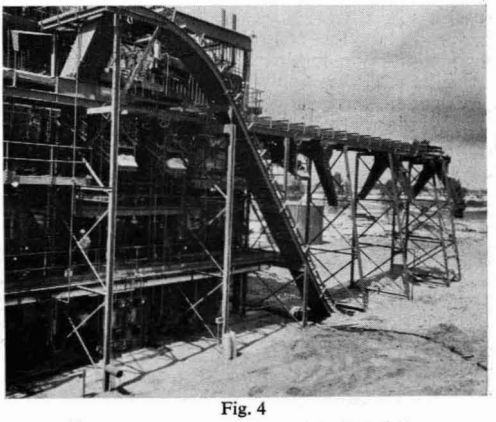

Fig. 4

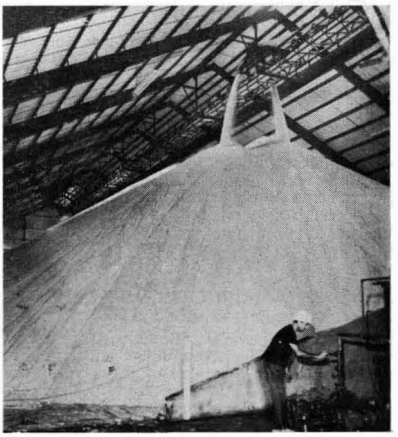

Fig. 5

Bagasse from the mill is carried by a horizontal Link-Belt conveyor to the feed chutes for the boilers, the surplus being stored on the ground from which it is reclaimed through a pit which feeds the inclined conveyor returning it to the horizontal conveyor (Fig. 4).

Raw sugar is distributed in the warehouse by the motor-propelled tripper which travels along the overhead belt conveyor, discharging the sugar onto the pile (Fig. 5). Other Link-Belt equipment used in the plant includes four centrifugal discharge bucket elevators, three further belt conveyors, six screw feeders, and a ribbon flight screw conveyor.

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Lock-in level control. Elcontrol Ltd., Wilbury Way, Hitchin, Herts.

The level control LR-20 is designed on similar lines to the normal high-low type with two level probes on an earthed metal tank or using a third earth probe on an insulated tank. The new control uses a special relay device so that in the event of a mains failure the control relay is locked into its condition prior to the supply failure, at which it remains until the supply is restored. Being a simple AC circuit there is no polarization and the unit recovers instantly, there being no warm-up period.

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PUBLICATIONS RECEIVED

BMA INFORMATIONS. Braunschweigische Maschinenbauanstalt A.G., P.O. Box 295, 33 Braunschweig, Germany.

This new booklet is to be published twice a year and will contain information on current problems in the sugar industry as well as the latest technical developments by BMA. The first issue, dated November 1963, provides a great deal of historical information on the Company which has been in existence for more than 100 years (originally as Friedrich Seele & Co.) and has built no less than 385 sugar factories in all parts of the world. Desugaring of molasses is reviewed with an account of the new BMA process for sugar production without molasses formation (inorganic ions and some non-ionic matter such as colour substances are removed by ion exchangers, and the reducing substances collected in a liquid sugar fraction). An account is given of present construction work including two factories in Pakistan (Bannu and Badin), one in the Sudan (Kashm-el-Girba), one in Egypt (Kous), three factories in the U.S.S.R., two in Argentina, and one each in Greece (Larissa) and Iran (Hamadan). Information is given on the Habib Sugar Mills factory in construction at Nawabshah, West Pakistan, on an alcohol distillery built in Brazil, and on the help given by German sugar factories in the development of BMA equipment. The booklet is to be published in German, English, French and Spanish.

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FARREL PROFIT-MAKING IDEAS FOR INDUSTRY. Farrel Corporation, Ansonia, Conn., U.S.A.

This new 40-page booklet, Bulletin 63, printed in full colour, describes innovations in design and production techniques as adopted for a number of industries including the sugar industry. For the latter there are illustrations of a milling tandem with rubber belt carriers and air clutches as well as a view of the Bryant Sugar House in Florida.

SHAW PIPE AND CABLE TRACER. Shaw Moisture Meters, Rawson Rd., Bradford, Yorks.

The tracer has three components: a pulse generator which applied to a pipe or cable causes the transmission of the pulses along its length so that the course can be traced by a portable detector unit above ground. For detecting the course of an earthenware or plastic pipe which may be blocked, a rod transmitter is attached to flexible cane or steel rods and pushed along the pipe, generating pulses which can be detected by the portable unit above ground.

* * *

"DURAPIPE" ALL-PLASTIC STOP VALVES. Durapipe & Fittings Ltd., 25/28 Buckingham Gate, London S.W.1.

Advantages of this new all-plastic stop valve, which incorporates a spherical plug with a central bore, include compactness, simplicity, speed of operation, unrestricted through-flow, and ease of dismantling for cleaning and of adjustment to take up wear of the seat rings. The range is available either plain for solvent welding or threaded, and is intended for use with plastic pipe systems.

* * *

COMPLETE VALVE ACTUATION. Jones, Tate & Co. Ltd., Great Dover St., Sondon S.E.1.

Publication 747, a new 34-page booklet, illustrates and describes the Jones Tate ranges of valve actuation equipment. These include the S.D. (standard design) series and W.D. (worm design) both of which operate electrically and are of weather- and flame-proof construction and adapted to be fitted to any size of valve in any position. The booklet gives details of operation, components, specifications and dimensions, applications, etc.

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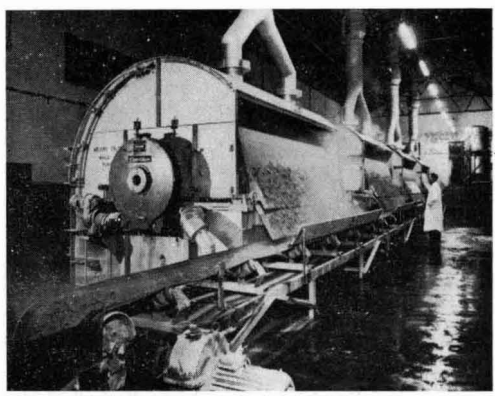
Dorr-Oliver filters for Ireland.—The filters illustrated were supplied by Dorr-Oliver Co. Ltd. to the Irish Sugar Company sugar factory at Mallow for the 1963/64 campaign. They



handle the first carbonatation mud corresponding to 3000 tons of beet per day. Other equipment supplied to this factory includes a 27-ft dia. thickener. A thickener and filters have also been supplied to the 5000-ton Carlow factory, and similar equipment is to be supplied for the Thurles factory for the 1964/65 campaign.

* * *

Mechanical Handling Exhibition.—New developments in time-, cost- and labour-saving equipment from many of the world's major manufacturing countries will be shown by more than 300 firms at the 1964 Mechanical Handling Exhibition at Earls Court, London from the 5th to 15th May.

U.K. Sugar Imports and Exports[1]

IMPORTS

	1963	1962
REFINED	*tons*	*tons*
Belgium	2,556	142
British Guiana	1,915	—
Canada	3,406	2,482
Cuba	14,122	4,252
Czechoslovakia	32,868	37,802
Denmark	6,742	—
France	8,640	2,917
Germany (East)	21,407	5,474
Germany (West)	3,603	1,372
Holland	2,352	99
Hungary	—	2,027
Ireland	17,086	12,238
Poland	4,611	20,043
Trinidad	1,938	150
Uganda	1,000	—
U.S.A.	15	12
U.S.S.R.	17,450	13,143
Other Countries	1,945	66
	141,656	102,219
RAWS—CANE AND BEET		
Australia	416,194	436,342
British Guiana	137,476	144,702
B.W.I.	641,437	516,072
Canada	245	248
Fiji	145,047	96,246
India	29,468	3
Mauritius	446,345	401,310
Rhodesia/Nyasaland	14,964	—
South Africa	186,556	185,354
Brazil	15,314	—
Cuba	180,323	127,556*
Czechoslovakia	4,312	—
Dominican Republic	19,776	7,992
Germany (East)	1,058	—
Germany (West)	33,188**	1,961
Holland	2,020	—
Indonesia	10,300	—
Mexico	—	5
Peru	18,912	—
Poland	34,864	109,798
U.S.A.	—	1
U.S.S.R	26,941	—
Other Countries	3,842	14,574†
	2,368,582	2,042.164

EXPORTS

	1963	1962
	tons	*tons*
Belgium	26	26
Burma	70	35
Denmark	11	9
Egypt	17	18
Finland	1	1
France	384	444
Fr. Pacific Possessions	703	1,460
Germany (West)	61,323	19,936
Greece	6,617	20
Holland	36,410	22,453
Iceland	413	202
Iran	98	116
Iraq	9,841	1,304
Ireland	452	114
Israel	77	267
Italy	13,392	12
Lebanon	4,865	1,550
Libya	2,033	403
Muscat and Oman	22	20
Morocco	30	3
Norway	69,288	57,186
Saudi Arabia	20,764	414
Sudan	19,758	—
Sweden	8,830	262
Switzerland	52,499	36,212
Tunisia	3,138	19,676
Turkey	1	1
U.S.A.	4	3,054
Other Countries	14,344‡	12,972
TOTAL FOREIGN	325,411	178,170
Aden	109	657
Bahrein, Kuwait, etc.	425	1,243
Bermuda	403	763
B.W.I./Bahamas	944	2,516
Canada	15	1,299
Ceylon	971	810
Cyprus	4,541	9,659
Gambia	376	589
Ghana	5,302	21,048
Gibraltar	1,098	1,070
Kenya	7,890	21,823
Malaya	16,411	18,507
Malta/Gozo	1,301	1,388
Nigeria	20,885	31,668
Rhodesia/Nyasaland	23	365
Sierra Leone	7,205	12,249
Singapore	1,554	1,136
Tanganyika	6,001	3,549
Other Countries	1,097	4,151
TOTAL BRITISH	76,551	134,490
GRAND TOTAL	401,962	312,660

West Germany beet sugar campaign, 1963/64[2].—Although the sugar beet area in West Germany, at 303,081 hectares, was only slightly greater than in 1962/63 (296,683 ha), deliveries of beet totalled 12,927,590 metric tons, compared with 9,190,918 tons, although these figures included 270,993 and 34,446 tons of imported foreign beets, respectively. The sugar content was fractionally less at 16·68% compared with 16·95% in 1962/63, and total sugar production was 1,880,928 tons, refined value, as against 1,352,288 tons.

* * *

Yugoslavia sugar crop, 1963/64[3].—During the 1963/64 sugar beet campaign in Yugoslavia, 2·4 million tons of roots were delivered to the factories for sugar manufacture yielding 307,410 tons, according to Reuter. In the previous season sugar production totalled 240,000 tons.

* * *

Hawaiian mill consolidation and expansion[4].—A $6,000,000 programme has been approved for Laupahoehoe Sugar Company, where over two years, the Papaaloe factory is to be dismantled and the Ookala factory expanded and modernized so that by 1966 it can handle all Laupahoehoe's cane. The mill is to be virtually rebuilt, nearly $4,000,000 being earmarked for new equipment for the mill yard, cane cleaning plant, mill house, boilers, boiling house, clarification plant and power plant.

* Including 10,197 tons originating in Cuba but shipped from Portugal.

** Including sugar originating in Cuba and the Dominican Republic and entering the U.K. for in-transit refining

† Including 9,366 tons from Roumania and 5,206 tons from France.

‡ Including 11,050 tons exported to Spain and 1,526 tons to Chile.

[1] C. Czarnikow Ltd., *Sugar Review*, 1964, (649), 45.

[2] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (4), 5.

[3] C. Czarnikow Ltd., *Sugar Review*, 1964, (645), 26.

[4] *Sugar y Azúcar*, 1964, **59**, (1), 41.

BREVITIES

U.S.S.R. sugar production[1].—According to official Soviet statistics the 1963 sugar production from beets amounted to 5,500,000 metric tons of white sugar, equivalent to 6,100,000 tons raw value. Last campaign production amounted to 5,983,000 metric tons of white sugar, or 6,648,000 metric tons raw value. Deliveries of beets in 1963 amounted to 41·4 million metric tons, as compared with 43·9 million tons in 1962. The increase in the area devoted to beet during the past decade may be observed from the following figures[2]: Russian S.F.S.R.—1,535,000 hectares in 1963 (422,000 ha in 1953); Ukraine—1,499,000 ha in 1963 (958,000 in 1953); Byelorussia—41,000 (13,000); Kazakhstan—57,000 (24,000) Georgia—4,000 (5,000); Lithuania—34,000 (32,000); Moldavia—86,000 (51,000); Latvia—19,000 (20,000); Kirghiz—43,000 (23,000) and Armenia —4000 (4000). The totals are 3,322,000 ha in 1963, compared with 1,552,000 ha in 1953. Target production of beets for 1964 is 70,210,000 tons and for 1965 is 75,935,000 tons[3]. In order to achieve these targets the beet acreage is to be raised 4,325,000 ha in 1964 and to 4,450,000 ha in 1965. Mechanization of beet cultivation and lifting will be increased from 23% of the acreage in 1964 to 50% in 1965, and a higher average yield is forecast.

* * *

Czechoslovakian sugar crop, 1963/64[4].—On January 20th the eighty-four Czechoslovakian sugar factories finished their 1963/64 campaign. According to a report from the Sugar Factories' Association, the total sugar production amounted to 850,000 metric tons of white sugar, which would be about 945,000 in terms of raw value. Last year's production amounted to only 881,700 tons. Up to the 18th January, 250,000 tons of sugar from the 1963/64 crop had already been exported to the U.S.S.R., West Germany, Switzerland, the U.K., Holland, Sweden and other countries.

Stock Exchange Quotations

London Stocks (*at 17th March* 1964)	CLOSING MIDDLE s d
Anglo-Ceylon (5s)	25/1½
Antigua Sugar Factory (£1)	12/6
Booker Bros. (10s)	22/9
British Sugar Corp. Ltd. (£1)	32/–
Caroni Ord. (2s)	4/–
Caroni 6% Cum. Pref. (£1)	15/9
Demerara Co. (Holdings) Ltd.	8/4½
Distillers Co. Ltd. (10s units)	26/6
Gledhow Chaka's Kraal (R1)	36/–
Hulett & Sons (R1)	92/–
Jamaica Sugar Estates Ltd. (5s units)	5/–
Leach's Argentine (10s units)	16/10½
Manbré & Garton Ltd. (10s)	55/3
Reynolds Bros. (R1)	35/–
St. Kitts (London) Ltd. (£1)	21/6
Sena Sugar Estates Ltd. (10s)	9/–
Tate & Lyle Ltd.*(£1)	53/10½
Trinidad Sugar (5s stock units)	3/9
United Molasses (10s stock units)	38/–
West Indies Sugar Co. Ltd. (£1)	28/9

New York Stocks (*at 16th March* 1964)	CLOSING MIDDLE $
American Crystal ($10)	70¾
Amer. Sugar Ref. Co. ($12.50)	23¾
Central Aguirre ($5)	30¾
North American Ind. ($10)	16¾
Great Western Sugar Co.	40½
South P.R. Sugar Co.	34¾
United Fruit Co.	23¼

* Cum 2 for 5 capitalization

Cuban sugar plans[5].—The Cuban Government has stopped its Agrarian Reform programme in order to obtain an increase in sugar cane production. Dr. FIDEL CASTRO has declared that in 1970 Cuba will produce 10 million tons of sugar. In order to achieve this target, factories would operate for 190 days in the year instead of 90 days. Before the revolution, Cuban sugar production averaged about 6 million tons per annum but in 1963 only 3,128,000 tons were produced, the lowest figure for 30 years.

* * *

Indian sugar capacity.—The licensed capacity of the sugar industry has risen from 1,640,000 tons per annum at the beginning of the First Plan to 3,360,000 tons in 1962/63. The establishment of 72 new factories and expansion of 120 existing units were licensed during the period but, out of this, only 49 new factories were set up and the expansion schemes completed in an equal number of existing units. Three more factories have completed their expansion schemes, involving an additional installed capacity of about 100,000 tons per annum. By the beginning of 1964 three new factories had gone into production since the new sugar season began on the 1st November 1963 and four more were expected to go into production later in the season. A number of existing units were also expected to complete their expansion plans, and an additional capacity of 180,000 tons per annum was expected to be established. The Government has decided to license a further 500,000 tons additional capacity in the form of new units and expansion of existing factories. The country's requirements in 1970 have been estimated at 4,500,000 tons of white sugar (including 500,000 tons for export), 678,000 tons of gur and 400,000 tons of khandsari. Sugar cane requirements have been worked out at about 135 million tons.

* * *

Sugar plans for Western Australia[6].—A new sugar industry is reportedly to be set up on the north-west coast of Western Australia. The Colonial Sugar Refining Co. Ltd. will help the State Government to establish a sugar industry on the Ord River, where an extensive irrigation project is being developed. The Company will lend experts to help investigate the proposal. Mr. BRAND, the Premier of Western Australia, announced that it was hoped to produce about 120,000 tons of sugar a year on the Ord River project.

Swiss Sugar Imports, 1963[7]

	(*Metric tons, tel quel*) 1963	1962
Austria	10	—
Belgium/Luxembourg	150	609
Cuba	42,487	35,527
Czechoslovakia	12,013	31,096
Denmark	17,854	—
Dominican Republic	—	771
France	72,893	109,626
East Germany	4,741	6,032
West Germany	1,021	241
Holland	415	—
Hungary	2,960	3,825
Italy	20	81
Mexico	—	260
Poland	—	2,037
U.K.	40,321	37,081
	194,885	227,186

[1] F. O. Licht, *International Sugar Rpt.*, 1964, 96, (3), 16.
[2] C. Czarnikow Ltd., *Sugar Review*, 1964, (647) 34.
[3] *Sakhar. Prom.*, 1964, **38**, 1–5.
[4] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (3), 8.
[5] *Zeitsch. Zuckerind.*, 1964, **89**, 96.
[6] *Chemistry and Industry*, 1964, 380.
[7] C. Czarnikow Ltd., *Sugar Review*, 1964, (647), 34.