International Sugar Journal

VOL 65 — *June, 1963* — No. 774

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

THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXV JUNE, 1963 No. 774

NOTES AND COMMENTS

European sugar beet area, 1963.

The first estimates of the sugar beet area in Europe in 1963 were published by F. O. Licht K.G. on the 19th April, and are reproduced below. It had been anticipated that the total area would have been at least 500,000 hectares more than in 1962 but Licht's forecast is for a rise of only 213,000 ha. Most of this is expected in the U.S.S.R. alone, only minor increases being expected in the other countries although the rise is considerable in proportion to the previous figure in the smaller countries such as Denmark, Greece and Switzerland. A notable decrease of 30,000 ha is forecast for Spain.

	1961/62	1962/63	1963/64
		(*hectares*)	
Western Europe			
Austria	37,102	47,900	48,000
Belgium	68,000	62,000	65,000
Denmark	36,113	39,494	59,000
Finland	17,700	19,050	18,000
France	320,270	313,594	320,000
Germany, West	268,467*	296,486	308,000
Greece	2,000	6,500	9,500
Holland	84,792	77,439	70,000
Ireland	31,414	31,418	34,800
Italy	226,584	238,000	240,000
Spain	180,000	180,000	150,000
Sweden	49,828	46,850	40,000
Switzerland	5,052	4,978	7,570
Turkey	134,263	127,939	136,000
U.K.	165,921	165,456	167,000
Yugoslavia	70,000	75,000	95,000
	1,692,506	1,732,104	1,767,870
Eastern Europe			
Albania	5,400	5,500	5,500
Bulgaria	75,000	70,000	72,000
Czechoslovakia	252,000	255,000	258,000
Germany, East	217,856	240,000	245,000
Hungary	132,100	126,000	130,000
Poland	419,788	433,962	440,000
Roumania	172,000	154,500	162,000
U.S.S.R.	3,100,000	3,300,000	3,450,000
	4,374,144	4,584,962	4,762,500
Total Europe	6,066,650	6,317,066	6,530,370

* Including estimated area corresponding to imported beets.

* * *

U.S. 1963 sugar quotas.

The U.S. Dept. of Agriculture announced on the 6th May an increase of 600,000 short tons in the 1963 domestic sugar requirements, bringing the total to 10,400,000 tons. The U.S. beet area, Puerto Rico and the Philippines would not be able to supply all the sugar to which they were entitled under the quota increase, however, and the global quota was increased accordingly to cover the quota increase and the deficit reallocations. Of the foreign countries, the Netherlands quota was also withheld because she is a net importer. The Philippines was granted a reallocation of 49,704 tons—sufficient to cover the quantity available—while 100,000 tons of the deficits was transferred to global quota. This amount, together with the global quota portion of the 600,000-ton increase, (121,317 tons), brings the overall global quota for 1963 to 1,725,658 tons. A total of 87,948 tons was allocated to 21 countries having permanent quotas, while the balance of the quota increase, less global quota and allowing for shortfalls and the reallocation to the Philippines, remains as 192,568 tons still to be allocated in addition to the unallocated global quota.

The inability of the U.S. beet sugar industry to take up the increased quota is of interest since restrictions have already been lifted on the acreage that could be planted to sugar beets in 1964 and the Department has now extended this to the 1965 crop area.

It was known that the U.S. Administration was perturbed by the rising domestic price of sugar and the quota increase is seen as an attempt to check this. C. Czarnikow Ltd. comment[1]: "The dilemma facing the U.S. Government as a consequence of the tightness of the world supply position was very evident, for any increase in the quota would naturally draw off supplies from an already sugar hungry world, thus adding further strength to the world market with all its repercussions on the American domestic situation. With these considerations in mind the market was not looking for such a substantial addition to the supply quota. The size of the quota increase no doubt reflects the Administration's determination to facilitate the flow of foreign sugar into the country and does not necessarily indicate official ideas of actual requirements."

On the 5th April the Dept. had expressed concern for sugar to be supplied by foreign countries holding basic quotas. Of a total 2,409,486 tons they had officially scheduled for shipment only 936,559 tons.

Methods for encouraging such countries to speed up their deliveries under their basic quotas are under consideration, and a suggestion has been made for the establishment of quarterly import quotas.

* * *

Queensland sugar fire.

Fire at the bulk sugar terminal in Townsville, North Queensland, on the 9th May destroyed 77,000 tons of sugar valued unofficially at £A3 million and caused damage to the terminal estimated at £A2 million. The fire was described by the Secretary to the Queensland Sugar Board as a crippling blow to the Queensland sugar industry. All the sugar burnt had been bought by Japan and was awaiting shipment.

* * *

World sugar price.

The increase in the U.S. Quota, the sugar lost in the Queensland fire, Licht's forecast of only a small increase in European beet area, and reports that the Cuban sugar crop would be no more than 3,500,000 tons, have combined to strengthen the world market so that the price of sugar has reached a post-war record level. The U.K. Terminal Association price had risen to £101 per ton, c.i.f. London, by the 23rd May, and may go higher, while sugar bought on the futures market for December delivery was fetching £97 and even £86 for shipment in August 1964.

* * *

Brazil sugar production, 1961/62[1].

The Brazilian Sugar and Alcohol Institute gives production of usina sugar in the 1961/62 season as 3,720,086 short tons, 4·3% more than in 1960/61. Apparent consumption rose by 5·4% from 2,840,132 to 2,994,137 tons, while exports dropped from 962,925 tons to 488,763 tons. Production of cane in 1961 reached a total of 64,631,600 short tons, 58% being contributed by Sao Paulo, Pernambuco and Minas Gerais.

Production in 1962/63 is estimated at 3,724,600 short tons, although production in the first part of the crop was at a lower level than the previous year as a result of climatic vagaries. The President of the Institute predicts that production will increase three-fold within the next three years; consumption is increasing at the rate of 132,000 tons annually, and a number of mills are undergoing modernization. A mill is to be installed at Coelho Neto in Maranham which will supply Maranham's needs and absorb cane grown there and in Para, Piaui and Ceara.

* * *

U.S. beet sugar crop, 1962/63[2].

The 1962/63 domestic beet sugar crop totalled 2,580,277 short tons, raw value, as against 2,422,472 tons in the previous season, according to the U.S. Beet Sugar Association. The 1962/63 crop was the largest on record ; the previous highest was made in 1960/61 when 2,475,261 tons were produced.

* * *

Long-term prospects for the sugar industry.

Contending that in the next 25 years the world sugar industry will be hard-pressed to keep up with the rapidly growing demands for sugar, Mr. ODY H. LAMBORN, President of Lamborn & Co. Inc., international sugar brokers, pointed out at a luncheon given by B. W. Dyer & Co., where he received the Dyer "Sugar Man of the Year" award, that in the past quarter century, the sugar consumption of the United States has increased from 6,600,000 short tons to almost 10,000,000 tons, a gain of about 50%, and that the sugar consumption of the world has jumped from 31,000,000 short tons to 57,000,000 tons, a gain of 84%, while the world's annual per capita consumption has increased from 32 pounds to 38 pounds.

As to the future potential, Mr. LAMBORN stated that at present world consumption of sugar is growing at the rate of about 4% per annum. If that rate continues, the sugar industry of the world has a tremendous job before it. "However", he observed, "if world *per capita* consumption should not increase one iota, we shall still need, by 1975, a sugar production of 75,000,000 short tons. Putting it another way, based *solely* on population increase we shall need, in thirteen short years, 18 million more tons than are presently being consumed in order to maintain only the *current* level of the *per capita* consumption figure. And if we consider this matter on a 25-year basis, the world should require in 1987—assuming an unchanging per capita—95 millions of tons, or approximately 67% more than the current world consumption of 57,000,000 tons."

Mr. LAMBORN said that it is reasonable to assume that the world per capita consumption of sugar will continue to increase as the standards of living improve throughout the world, and that if we were to assume a constant increase in consumption of 4% per annum, the world's sugar requirements for 1975 would be 95,000,000 short tons and for 1987, a startling 152,000,000 tons.

* * *

California & Hawaiian Sugar Refining Corporation Ltd. 1962 results.

During 1962 Crockett refinery melted 773,810 tons and Aiea refinery 44,796 tons of raws. Crockett's daily melt averaged 3366 tons—its highest on record. Loadings in bulk and liquid sugars also reached record levels. New projects included installation of a dribble-feed check-weigher; bowl feeders on wrapped sugar units, a Sveen-Pederson clarifier, two new packet units, a Silver continuous centrifugal, etc.

[1] *Sugar y Azúcar*, 1963, **58**, (2), 28.
[2] *Lamborn*, 1963, **41**, 35.

A REVIEW OF RECENT DEVELOPMENTS AND TRENDS IN SUGAR CANE AGRICULTURE

Chairman's Address to the Agricultural Section, International Society of Sugar Cane Technologists, 11th Congress, Mauritius, September-October 1962

By Dr. H. EVANS, O.B.E., D.Sc. (Agricultural Director, Bookers Sugar Estates Ltd.)

PART I

THE purview of this address includes the more outstanding developments in sugar cane agriculture during the last three years. It is, of course, impracticable within the time available to make more than passing reference to the painstaking agronomical work patiently carried out in numerous sugar cane growing areas to solve local problems of cultivation, fertilization and soil improvement except insofar as such research activities are of more general interest to sugar cane agriculturists all over the world. The review does not include the field of varieties, pests or diseases as these will presumably be covered by other sectional Chairmen.

PLANTING AND PLANTING MATERIAL

There has been a renewed interest in the factors associated with germination, or rather sprouting, of buds, particularly in India and in Taiwan, and the effect of fungicidal dressings and such factors as number of buds per cutting and their orientation have been re-examined. In British Guiana more use has been made of a modified "Beauchamp" system using whole young canes showing a few fully developed internodes at the base and wherein the growing point is left intact, the leaves being trimmed and the canes planted at an angle of some 30° to the horizontal. It is particularly useful for filling blanks and is economical because material is available in close vicinity and sometimes even in the same field. The use of an organo-mercurial disinfectant as a stimulant to root emergence is sometimes practised.

In Taiwan the necessity of exploiting land to the maximum possible extent has led to a programme of research on the interplanting of rice with sugar cane. The best system appears to be 4 rows of pre-grown rice seedlings interplanted in each cane interrow and placed in position one month before the cane is due to be planted.

A United States commercial firm has announced the discovery of a class of plant growth substances which is said greatly to stimulate rooting of sugar cane and to decrease losses from frost damage in sub-tropical areas.

HERBICIDES

Research on herbicides has continued at a fast tempo in many countries. A large number of the newer herbicides are under test particularly the substituted triazines, e.g. "Simazine," "Atrazine," the substituted chlorobenzoic and chlorophenoxyacetic acids, the quaternary ammonium compounds and several other experimental synthetic materials.

In field practice, ROCHECOUSTE (1960–61) in Mauritius found the chloromethyl urea herbicides valuable in the wetter areas, but more recently finds mixtures of 2·4-D, or MCPA with sodium chlorate and trichloroacetate equally effective to CMU, "Atrazine" and "Simazine", and economic considerations become dominant.

The dichloropropionates ("Dalapon") have generally been found valuable against gramineous weeds, sometimes in combination with 2,4-D and trichloracetates (TCA). For example, HANSON in Hawaii finds a 1 to 3 "Dalapon"-TCA mixture with or without 2,4-D and the addition of 5% CADE very useful in Hawaii, whilst "Dalapon" + 2,4-D is widely used in irrigation ditch weed control in Australia.

Combinations of DCMU and 2,4-D have been found particularly effective in Trinidad both as post- and pre-emergence weedicides. In British Guiana, "Dalapon" or TCA for gramineous weeds and "Dalapon" in combination with 2·4-D amine sometimes incorporated in a Hawaiian-type CADE is dominantly used as a general purpose weedicide.

Methods of application resulting in cheaper operating costs have been studied in several countries. In Australia an elevated side boom spray unit has been successfully used, according to MYATT (1961), particularly for field edges where late germinating vines may be troublesome. In British Guiana pre- and post-emergence weedicides in young cane are applied by air where the areas are large and by hand-carried booms consisting of 3–5 sections each 12 ft long and supplied by pressure hose from the field edge. This latter development has raised the area sprayed per man-day to 9 acres.

For the spot application of "Dalapon" and materials such as "Gramoxone" ("Paraquat") in growing cane, plastic shields similar to large lamp shades have been developed to prevent spray from reaching cane leaves.

Specific weedicides—often from the range of materials tested in the past and of limited value as general purpose herbicides—have lately been found to be valuable against specific weed species and the number of resistant species which succumb to one or other of these materials is increasing annually.

The full evaluation of the numerous chemical compounds available with respect to specific weeds and in relation to their interaction with soils, climate and economic considerations will take some considerable time.

It is thus heartening to note that very considerable advances have been made in understanding the mode of action of certain herbicides in the plant.

Thus, it has been established that the maize plant possesses an enzymatic mechanism for breaking down "Simazine" into harmless derivatives, whilst "Dalapon" apparently exerts its herbicidal properties by inhibiting the enzymatic synthesis of the B-vitamin, pantothenic acid. Whether this mechanism accounts for the varying susceptibility to "Dalapon" damage in sugar cane varieties does not appear to have been investigated, however.

The control of witch weed (*Striga sp.*) in the Southern U.S.A. has required methyl bromide fumigation, but the increase in yield of cane following destruction of this parasitic weed has been from 40 to 200%. The use of biological adjuncts to chemical weed control has been well exemplified by the mobilization of a white clover fallow in the control of Johnson grass in Louisiana.

Although interchange of information on weedicides is very valuable, experience has been that each country will need to carry on its own basic applied research, since insufficient is known to extrapolate results from one country to another and materials which may be highly effective in one environment may be almost worthless in another. Costs and economic considerations may preclude the use of some chemicals which might otherwise be highly satisfactory.

It has also been established that strains of various weed species exist which differ greatly in their reaction to specific herbicides. In fact, in certain cases such strains have first been identified by differential weedicide reactions and have often been substantiated later by differences in chromosome numbers.

Cultivation

Many sugar cane growing areas have been re-assessing the value of cultivation treatments. In India, there has understandably been a considerable number of experiments designed to test light mechanical equipment against standard methods and to determine the optimum cultivation practices in relation to other cultural operations. There have been no surprising results, e.g. no differences between 4 inches, 6 inches and 10 inches depth of cultivation and no interactions between these and three levels of nitrogen and three irrigation intervals. On a Jamaican estate the effect of deep tillage varied with the soil; clays and peats responded to deep cultivation, but the other soils tested did not, whereas in Taiwan subsoiling and subsoil fertilization were ineffective on clay and on sandy loams.

A series of cultivation trials run by the Sugar Research Dept. in Jamaica indicated that a certain optimum cultivation could be achieved by devious routes. Deep cultivation of wet heavy clays did not appear advantageous and a higher number of disc harrowings gave as good a tilth. Under dry conditions tillage down to 20 in was beneficial and it would appear that 3 or 4 disc harrowings and 2 to 3 knifings should be optimal. Trials are also in progress in Jamaica on resuscitating ratoons by mechanical operations—particularly interrow knifing and moulding.

In Hawaii cultivation treatments have been largely concerned with correcting unfavourable bulk densities in the soil caused by mechanical compaction. The critical bulk densities for healthy growth of roots have been established for Hawaiian soils and there is a marked decrease in rooting efficiency with increasing soil density. The use of mill waste organic matter in the improvement of Hawaiian soils, particularly the gray hydromorphic and dark magnesium clays, has been found economical, the costs being usually recovered in the increased yield of the plant crop.

In British Guiana it has been established that there are advantages in carrying out mechanical cultivation before flood-fallowing but the total gain from mechanical cultivation over flood fallowing alone is about 10% in plant cane and 2% in first ratoons, after which the effect disappears. Here again, the full cultivation effect can be achieved by devious implements—indicating that there is an optimal effect beyond which there are no further advantages.

Soils which have a naturally poor or unstable structure, e.g. silty clays, require and benefit more from mechanical cultivation, whilst in stable clays the effect is much less; here the important factors are a reasonable seed bed and the choice of suitable moisture content to start off the crop.

The impact of soil properties on the choice of tillage methods is adequately treated for Hawaii by Trouse (1960) and aids to scouring of soil over the mould-boards have been further investigated.

Mulching has been under renewed investigation in South Africa where its advantages were confirmed by yield responses except when excessive amounts (over 25 tons/acre) were used. In Louisiana yields were increased when organic plant residues were returned to the soil on light well drained soils, but on heavy, poorly-drained soils organic matter was highest when cane residues were burnt. Yields were unaffected after 17 years.

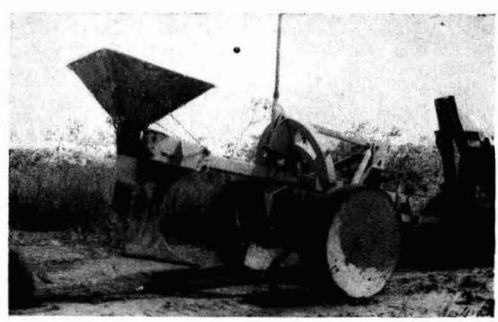

Fig. 1. Implement devised for vertical mulching (*Courtesy Mr. H. N. Parsons, Field Supt., Enmore Estates Ltd.*)

In British Guiana, the writer has devised a system of "vertical mulching" which on an experimental scale has shown considerable promise. The machine which was constructed at Enmore Estate consists of two old subsoiler blades welded in parallel with a steel strip (Fig. 1) and mounted on the body of a Cuthbertson drain digger—this cuts a slit in the heavy clay 2–3 in wide and 2 ft 6 in deep (Fig. 2). In the experimental trials the slit was filled with various

Fig. 2. Slit 2½ ft deep being made
(*Courtesy Mr. H. N. Parsons, Field Supt., Enmore Estates Ltd.*)

cheaply available porous fillers (marine mollusc shells, Oliver filter mud, furnace-ash, and bagasse).

The former two materials gave a yield increase of 10 tons cane/acre in plant cane and there is a visible residual effect in ratoons.

The operation provides a favourable environment for rapid root penetration to moist soil layers (Fig. 3) and also enables quick uptake of fertilizers which may normally be difficult of uptake.

An adaptation of this system in which the filling agent is top soil specially treated with fertilizer is to be tried experimentally in Barbados.

Fertilizers

In this account it is proposed to treat fertilizer usage separately from mineral nutrition. A very large proportion of the literature on fertilizers is concerned with usage and dosage in different countries and as such—although of paramount economic interest to the territories concerned and even more so to individual plantations—is of limited general interest.

Investigations on fertilizers have been mainly concerned with the utilization and efficacy of different amounts and forms of fertilizer. In the case of synthetic nitrogen fertilizers, growers now have the choice between ammonium sulphate, ammonium sulphate-nitrate, ammonium chloride, ammonium nitrate, calcium ammonium nitrate, diammonium phosphate ("Ammophos"), urea, gaseous ammonia (NH_3), aqueous ammonia (NH_4OH), without mentioning the nitro-phosphates, the slow release nitrogen materials such as urea-formaldehyde formulations, etc. The use of these materials is subject as much to economic considerations as to their physiological efficacy and the best all-round performance of a given material must be worked out independently in each sugar cane growing territory. In Taiwan it has been established that ammonium chloride uptake is better than that of sulphate of ammonia up to 126 lb nitrogen per acre, but less at higher levels. In India, ammonium chloride has been somewhat less satisfactory than the sulphate, but under certain conditions, it may well be that the former is more economical.

Fig. 3. Root development in the slit filled with porous materials
(*Courtesy Mr. H. N. Parsons, Field Supt., Enmore Estates Ltd.*)

In almost all countries urea has been less efficient as a nitrogen carrier than ammonium sulphate—e.g. Mauritius, Taiwan, British Guiana. In Jamaica although generally less efficacious there have been areas where its performance was reasonably close to the sulphate.

In British Guiana, calcium ammonium nitrate and calcium carbonate-urea mixtures of equal nitrogen

content were inferior to the sulphate by approximately 1 ton of cane per acre. It is possible that methods of application designed to avoid losses of nitrogen may increase the efficiency of these carriers as compared with the sulphate—but since such methods are frequently additional to normal cultivation practices the economics of using them is doubtful.

The margin of difference in price between ammonium hydroxide and other sources of nitrogen is certainly large enough to benefit the former in countries like Hawaii, but in countries far removed from the zones of production and where no cheap transport is available, this is not the case. Like urea, losses of ammonia by volatilization make the material less efficient per unit of nitrogen than the sulphate, unless stringent precautions to avoid volatilization are taken.

In the case of potassium, other than the potassium-rich-molasses which are now mostly disposed of for industrial purposes, there are four main sources of potassium in fertilizers, viz., the cheaper muriate (potassium chloride) or the slightly more expensive sulphate and bicarbonate and the traditional nitrate of potash.

Potassium bicarbonate, which has not long been on the commercial fertilizer market, may have advantages on very acid high sulphate soils. Both the sulphate and bicarbonate of potash are less liable to leaching than the muriate, and the economic evaluation of potassium carriers from this point of view requires much close attention.

In British Guiana no demonstrable difference in efficacy between the various forms of potash in terms of the immediate yield response could be established. Further work on the relative efficiency of phosphate carriers has been carried out in several countries. Other than the utilization of filter muds or scums, which is universally practised, the main sources of phosphate used in sugar cane are superphosphates, particularly the "double" or "triple" superphosphate, the finely ground rock phosphates from various sources of which the best appears to be of North African origin, dicalcium phosphate with low water but high ammonium citrate availability, phosphatic guanos and "Ammophos" (mono or diammonium phosphate). All results point to the higher efficiency of the water-soluble phosphate carriers in general, but excellent results have been obtained from less soluble forms when they are intimately mixed with the soil, confirming SCHROO's results in Trinidad some years ago. Thus in Hawaii AYRES has shown that raw rock phosphate mixed with the soil in tubs of 8 cubic feet was as efficient as superphosphate but less efficient when banded. The availability of rock phosphate was affected chiefly by the pH and by the calcium status of the soil—being more effective in acid, low calcium soils. There is little doubt that for rapid correction of a phosphate deficiency in growing cane the water soluble phosphates, e.g. high phosphorus superphosphates and ammonium phosphate, are quicker-acting, whilst the general raising of phosphate fertility may be more economically achieved with rock phosphate incorporated into the soil. There has been a considerable increase in aerial application of fertilizers and problems of distribution have been under study. On micronutrients a large number of trials on "shot gun" applications of mixed micronutrient formulations have been carried out particularly in India where responses, principally to manganese, were obtained. In Australia, copper deficiency was controlled completely by applications of 28 lb per acre and more of copper sulphate and a substantial response even with as little as 14 lb per acre was obtained. The economical dressing appeared to be about 20 lb per acre.

(*To be continued*)

AGRICULTURAL ABSTRACTS

External morphology of the moth-borer, *Raphimetopus ablutellus*. P. N. AVASTHY and J. P. CHAUDHARY. *Indian J. Sugar Cane Res. & Dev.*, 1962, **7**, 30–35.—A very detailed description of the larval stage is given.

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Leaf spot caused by *Curvularia lunata*. B. S. AGNIHOTRI and V. P. BHIDE. *Indian J. Sugar Cane Res. & Dev.*, 1962, **7**, 36–40.—A description is given of the morphological characters of, and appropriate cultural conditions for, this leaf spot which was first identified on cane in 1959. A wide range of host plants is noted.

* * *

Cultural studies on *Ustilago scitaminea*. K. SINGH and T. R. BUDHRAJA. *Indian J. Sugar Cane Res. & Dev.*, 1962, **7**, 41–42.—Trials are recorded using various nutrient media of which the best was asparagine yeast-extract agar.

* * *

A comparison between cultural methods for weed control in the Piracicaba Region, Brazil. H. DE ALMEIDA LEME *et al. Brasil Açuc.*, 1961, **59**, 211–218. Relative costs are worked out for 5 methods ranging from hand-hoeing, through mechanical cultivation to chemical control. Under the local conditions mechanical cultivation proved the cheapest.

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Studies on time of planting and harvesting sugar cane. I. Eksali. S. K. SASTRY *et al. Indian J. Sugar Cane Res. & Dev.*, 1962, **7**, 43–52.—Comparisons are drawn between plantings made at monthly intervals, November to February inclusive, November proving the best. January and February were the best months for harvesting. Net income will be improved if the standard long-season paddy be replaced by a short-season paddy, enabling cane to be planted in November instead of February.

THE SUGAR CANE IN MAURITIUS

Annual Report, 1961, Mauritius Sugar Industry Research Institute

TWO sections of the Introduction, written by the Director, deal, respectively, with the main characteristics of the 1961 season as affecting the island's commercial crop and with the varietal position on plantations. Excessive rain and high temperatures over the latter part of the growth season, following early drought, led to a partial recovery of yield, but quality suffered heavily owing to prolongation of the rainfall into the harvest season.

Any summary of the varietal position covering the whole island has little meaning, owing to the diversity of the regional climatic factors, though M 147/44 shows the largest increase of acreage while the acreage under M 134/32 diminishes. A useful tabular statement of the characteristics of the commercial varieties is followed by a more detailed account of each.

Details of the research activities themselves are given in the six sectional reports that follow.

Cane Breeding

The degree of arrowing in 1961 was the lowest since records were established in 1956, a fact which naturally interfered with some of the experiments designed to induce flowering. This shortage of arrowing shoots enforced selecting shoots after they were seen to arrow in the field. Shoots marcotted after severance and placed in SO_2 solution yielded over twice as many seedlings as did shoots placed directly in the same solution but un-marcotted. Brief references are made to comparisons between bunch-planting and single-planted seedlings as also to randomized experiments of six crosses at 4 stations; but the promised detailed report on both may be awaited.

The most promising varieties in the pre-release trials are M 305/49, M 442/51, M 658/51 and M 117/55. Two varieties have been released, Ebène 50/47 and M 253/48, and the parentage, characteristics and yield results of both are given.

Nutrition and Soils

Increased knowledge of the soils of the island from the pedogenic aspect has been obtained from X-ray analyses carried out at Rothamsted. Briefly, the results show a rapid decline in silica with increasing rainfall, associated with which is a decrease in the silica/aluminium oxide ratio. There is, too, an accompanying marked increase of aluminium oxide and, to a lesser extent, of iron oxide. To the reparation of this loss of silica is attributed the rejuvenation of the soils of the super-humid regions by the application of basalt up to 100 tons/acre[1].

[1] *I.S.J.*, 1961, **63**, 363; 1962, **64**, 3.

Three other subjects are noted. A weekly stalk elongation of 10 cm in the hot and wet period had been accepted as proof that leaves were not subject to water-stress and could be sampled. A correlation of +0·85 between stalk elongation and rainfall has, however, been found and the labour of measuring elongation removed. Total rainfall over the last 3 weeks is used with the proviso that any excess over 50 mm in one week is written off. To meet the fact that the critical nutrient levels in ratoon crops vary with age in a regular manner, correction factors have been worked out; by the use of these a wider latitude in sampling age is obtained.

Cane Diseases

The two major diseases of the island are ratoon stunting and chlorotic streak. Regarding the first, the varietal resistance trials covering plant, 1st and 3rd ratoons (no results are recorded for 2nd ratoons owing to cyclone damage) give no clear indication of the existence of any variety with strongly marked resistance. Varietal percentage reductions due to the disease are tabulated. Previous observation that the disease is more damaging in the super-humid region was confirmed.

Chlorotic streak appears to be transmitted through the soil and efforts are being made to trace the factors involved including, among these, nematodes. The view is expressed that the only real solution appears to lie in finding a resistant variety or varieties.

The position relative to red rot, leaf scald—including a method for inoculating—and gumming disease is briefly described, and the section concludes with a review of the Fiji disease trials being conducted in Madagascar. The only variety, of commercial importance in Mauritius, which has proved highly resistant is M 31/45.

Cane Pests

The Mauritian stalk borer is *Proceras sacchariphagus* which appears to be immune to the American Tachinid flies which attack *Diatraea*. It is, however, attacked by the Tachinid, *Diatraeophaga*, as far as is known peculiar to Java. From puparia imported, over 800 flies have emerged and survived. The biology of this little-known Tachinid and the attempts to breed it are described in some detail. Six hundred and sixty four flies, approximately half females, were released in June-July in a heavily infested field, but more were recovered at the end of the year. The opportunity of having to collect *Proceras* larvae was taken to check local parasitism. The only larval parasite of importance was *Apanteles flavipes*.

Brief notes are given on the pink borer *Sesamia calamistis* and Army worms.

Weed Control

The results obtained with substituted ureas in comparison with other herbicides in the humid and sub-humid regions appear to make the decisive factor one of costs. A number of herbicides was included in a post-emergence experiment using the logarithmic spraying technique. The comparative effectiveness of "Urox," "Atratone" and DCMU is noted.

Cultivation, Irrigation, Climate

The section, in its practical aspect, is devoted to a comparative study of surface and overhead irrigation on two classes of soil defined as gravelly and free. Though growth under spray irrigation was greater on the gravelly soils, the final results over the 3 years, 1958, '59 and '61, showed little difference in yield of cane/acre. The decisive factor is that of cost and, in this, spray irrigation comes out a bad second. Where water economy is essential, however, it has much to commend it.

The climatic conditions over the last 13 years, and their effects on growth and maturity of the cane crop, are briefly analysed.

H. M.-L.

AGRICULTURAL ABSTRACTS

Ecology and distribution of the white fly, *Aleurolobus Barodensis* in Madras State. A. LEELA DAVID *et al. Indian J. Sugar Cane Res. & Dev.*, 1962, **6**, 212–215.—The fly is active under water-logged conditions and in certain semi-dry, nitrogen-deficient areas. A complex formula for spraying is noted.

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Preliminary studies on the incidence of smut on important varieties. K. M. VIJAYAN. *Indian J. Sugar Cane Res. & Dev.*, 1962, **6**, 217–220.—The observations were made at the Research Sub-Station, Sirugamani, Trichy District. The outbreak occurs in September and lasts till January–February, with a peak in October. Co. 758, Co. 658 and Co. 449 are the most resistant varieties.

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Varietal census of sugar cane in India (1959–60). N. R. BHAT and J. T. RAO. *Indian J. Sugar Cane Res. & Dev.*, 1962, **6**, 228–235.—Detailed tabulated statements of area are given for each tract followed by a note on the varietal changes in the last two decades and a brief comment on promising varieties.

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A review of Indian research on phosphatic manuring. S. C. SEN and A. P. GUPTA. *Indian J. Sugar Cane Res. & Dev.*, 1962, **6**, 236–239.—The subject has been discussed in two earlier papers[1] and a brief general review is given here.

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A review of cytogenetics of sugar cane. N. R. BHAT. *Indian J. Sugar Cane Res. & Dev.*, 1962, **7**, 1–18.—This richly documented article covers not only the genus *Saccharum* but all those allied genera with which species of *Saccharum* have been successfully crossed. The respective chromosome numbers are recorded and the probable parental contribution under crossing is discussed as also the question of parthenogenesis. Other subjects discussed are the origin and distribution of the various species of *Saccharum* and the inter-relationship between these and related species and genera. A tabular statement covering 5 pages lists the type of, and actual gametic contribution of a large number of crosses together with the authority.

[1] *I.S.J.*, 1962, **64**, 319.

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Fertilizer experiments in South India. I. NPK trials at Nellikuppam. R. D. REGE *et al. Indian J. Sugar Cane Res. & Dev.*, 1962, **7**, 19–29.—A typical NPK experiment with statistical layout is described. Among the comparisons given are the responses of plant and *adsali* crops.

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Legumes for cane lands. ANON. *Producers' Rev.*, 1962, **52**, (11), 93.—A brief note is given of the present position with regard to arrangements for the local production of seed of the recently bred cowpea varieties carrying resistance to *Phytophthora* wilt.

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Leaf scald. E. FRANCO. *Brasil Açuc.*, 1962, **60**, 100–108.—Leaf scald (*Pseudomonas albilineans*) was first identified in 1954. Varietal resistance appears best developed in CB 45–6 and CB 48–12. Planting resistant varieties, "Aldrin" dressings to control the vector *Tomaspis liturata* and drainage of wet areas are recommended.

* * *

New developments in windrow composting. A. LIVSHUTZ. *Compost Science*, 1962, **3**, (3), 26–28.—Disposal of refuse by composting has made steady but slow progress mainly on account of cost. Major progress has been made in the handling of town garbage and refuse, but agricultural wastes are even more abundant and the possibility of composting these by some simple process as here suggested seems worth considering.

* * *

Mineral elements in plant nutrition and consumption of fertilizers. I. S. BODKE and E. WARREN. *Fertiliser News* (India), 1962, **7**, (12), 7–12.— The article is an exposition of the value of fertilizers as seen from that industry's point of view and records world and Indian consumption.

THE FATE OF CANE JUICE SIMPLE SUGARS DURING MOLASSES FORMATION

V. Detection and Estimation of Mannose and Psicose in and the Isolation of Mannose from Final Molasses

By W. W. BINKLEY[1]
with E. J. ROBERTS, J. T. JACKSON and L. F. MARTIN[2]

REARRANGEMENT of glucose and fructose to form mannose, as predicted by LOBRY DE BRUYN and ALBERDA VAN EKENSTEIN[3], has been shown to occur when limed cane juice is heated under conditions approximating those to which juices and syrups are subjected in commercial processing[4]. The early investigations produced certain evidence for the presence of mannose in molasses, and both the formation and estimates of the concentration of a fourth isomer termed "glutose" were recorded[5], but they neglected to publish the results of their quantitative determinations of mannose*.

Soon after the publication of LOBRY DE BRUYN's prediction, PELLET[6] analysed numerous samples of molasses by a method that had been developed by BOURQUELOT and HERISSEY[7] for determination of mannose as its phenylhydrazone. He found concentrations of this sugar ranging from traces to as much as 0·9% of the weight of the molasses, the maximum being equivalent to more than 1% of the molasses solids. Application of this method of analysis to cane juices showed that, within the limits of detection possible, mannose was not present, substantiating the conclusion reached by LOBRY DE BRUYN that action of lime and heat in the production of sugar led to its formation from the naturally occurring invert sugars.

The extent of reaction and concentrations of the products formed under normal processing conditions, rather than qualitative occurrence of the rearrangement, are important because additional reducing sugars affect processing and crystallization of sugar in proportion to the relative amounts present. The possibility existed that the high percentages of mannose found in some molasses by PELLET[6] resulted from impurity of the phenylhydrazone, although corrections were applied for its ash content and solubility in the solutions from which it was precipitated. Another possibility is that some of the samples were obtained from "open kettle" sugar production widely used at the turn of the century, in which more extensive rearrangement would occur during evaporation of over-limed juices at high temperatures. This investigation, undertaken to establish the quantitative importance of the rearrangement products in sugar manufacturing, provides evidence that a molasses produced under modern processing conditions does contain as much mannose as PELLET found in his sample having the maximum concentration of this sugar.

Our independent investigations of limed and heated juice, and of molasses by chromatography had shown that both mannose and psicose are present, and this collaborative report summarizes results of the work. The effectiveness of ionophoresis[8] for the separation of mannose from fructose, which is not accomplished readily by most of the solvent systems used in paper partition chromatography, has been noted[4]. Analytical methods now available provide better estimates of the concentration of mannose in syrups from which sucrose is crystallized and in the exhausted molasses. The dual purpose of this research has been to prepare the pure phenylhydrazone for definite characterization of mannose obtained from molasses, and to determine the amount of mannose formed during the sugar manufacturing process. The first objective was attained by macro-scale chromatography for isolation and purification of a concentrate of the sugar suitable for preparation of a pure derivative; the second required application of ionophoretic methods for separation and quantitative determination of the mannose content of molasses. The determinations were facilitated by separation of the reducing sugars from sucrose and other polysaccharides by chromatography on carbon-"Celite" columns as described by ROBERTS *et al.*[9]

Chromatographic analyses of Australian molasses by FOSTER and MARSH[10] yielded evidence of an additional sugar which they assumed to be psicose, and estimated to be present in concentrations of approximately 0·5% by colorimetric determinations as equivalent fructose. Detection of psicose in all of the samples

[1] New York Sugar Trade Laboratory, New York, N.Y.
[2] Southern Regional Research Laboratory, New Orleans, Louisiana; one of the laboratories of the Southern Utilization Research and Development Division, Agricultural Research Service, U.S. Dept. of Agriculture.
[3] *Rec. Trav. Chim.*, 1895, **14**, 203; 1896, **15**, 92.
[4] BINKLEY: Part III, *I.S.J.*, 1962, **64**, 365–366.
[5] *Rec. Trav. Chim.*, 1897, **16**, 280.
[6] *Bull. Assoc. Chim. Sucr. Dist.*, (a) 1898–99, **16**, 1181; (b) 1900–01, **18**, 758; (c) 1902, **19**, 834.
[7] *Compt. Rend.*, 1899, **129**, 339.
[8] GROSS: *Nature*, 1955, **176**, 362.
[9] *I.S.J.*, 1962, **64**, 197.
[10] *I.S.J.*, 1958, **60**, 8.

* PELLET (6b) cites values of 0·3–0·8% found in molasses by ALBERDA VAN EKENSTEIN, presumably communicated to him personally. The precipitate obtained on treating cane juice with phenylhydrazine was examined by ALBERDA VAN EKENSTEIN who verified PELLET's conclusion that it did not contain mannose phenylhydrazone.

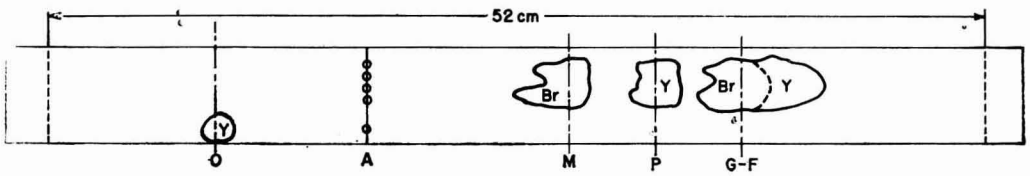

Fig. 1. Separation of reducing sugars from Louisiana molasses. A, sample; eluate of reducing sugars from 2 g molasses in 25 ml, four 25λ applications, with 7λ HMF solution as zero mobility marker, O. Conditions of electrophoresis, 2000 V (38·5 V/cm), 3 hr, 12°C; 0·05M borate-NaCl[17] pH 8·6. Migration distances marked at maximum colour densities: Y, bright yellow (ketose); Br, brown (aldose) with anisidine phosphate[13]; M, mannose; P, psicose; G-F, glucose and fructose.

of molasses examined by us is not surprising in view of the extent to which the transformation of the naturally occurring reducing sugars takes place, as shown by the determinations of mannose. Application of paper partition chromatography to Florida molasses along with the anthrone colorimetric method showed that psicose was present in approximately the same concentration as that found in the Australian samples.

Experimental

Materials

A sample of final molasses obtained from the United States Sugar Corporation, Clewiston, Florida, U.S.A., was used for the macro-scale qualitative, and all of the quantitative analyses to be described. Qualitative experiments for detection of both mannose and psicose ware carried out with samples of commercial final molasses from Central Mercedita, Ponce, Puerto Rico, and from the Houma factory of Southdown, Inc., in Louisiana, U.S.A. The earliest preliminary isolations of the rearrangement products by chromatography were from molasses produced in pilot plant experiments with ion-exchange purified Louisiana cane juices. The Florida molasses contained 79·2% solids, of which 42·8% was sucrose, 26·8% reducing sugars (as invert), and 15·0% ash. It had a pH of 5·4. The Puerto Rican molasses contained 85·5% solids, and Louisiana molasses 79·6% solids, of comparable composition. The 73·6% solids of ion-exchange molasses was composed of 41·6% sucrose, 48·8% reducing sugars, and 13·6% ash.

Isolation and Identification of Mannose

Qualitative Ionophoresis

Both mannose and psicose had been identified tentatively as constituents of the ion-exchange molasses by one-and two- dimensional paper partition chromatography of a fraction of reducing sugars separated on clay columns by the methods described by Binkley & Wolfrom[11]. The mannose was not clearly separated from fructose by either triple development with 1-butanol:acetic acid:water (4:1:5 v/v/v) or two-dimensional development by this solvent system, followed by phenol saturated with water[12], but the colour specific spray of Mukherjee and Srivastava[13] indicated the presence of an aldose mixture with fructose, as well as a ketose having greater mobility, tentatively identified as psicose. The ion-exchange molasses, having relatively higher concentrations of reducing sugars, was used initially for qualitative isolation and identification of mannose by low-voltage ionophoresis. An eluate from the clay column[11] was further fractionated by chromatography on a "Celite" column[14], and an appropriate fraction was applied on Whatman 3 MM paper and separated by electrophoresis for 19 hr at 7·5 V/cm in 0·05 M borate buffer of pH 9·2.

When apparatus became available for ionophoresis at high voltages[15]† the reducing sugars were separated from the Puerto Rican molasses by elution from heated carbon-"Celite" columns[9], 25–50λ of the eluate was applied on approximately 53 cm long Whatman 3 MM paper, and the sugars were separated by electrophoresis at 3000 volts. At this gradient of 60 V/cm, mannose was clearly separated from other reducing sugars in 2·5 hr in the pH 9·2 borate buffer. Both high and low voltage ionophoregrams were sprayed with the aniline phosphate reagent of Hough *et al.*[16] Samples of mannose applied adjacent to the eluates of both the ion-exchange and Puerto Rican molasses had electrophoretic mobilities identical with those of the monosaccharide in the molasses fractions. The absence of mannose as a natural constituent of raw juice was established by separation of the total reducing sugars from 5 g of lyophilized raw juice solids, and analysis by high voltage ionophoresis under the conditions applied to molasses. Aniline phosphate spray reagent[16] revealed no sugars with the electrophoretic mobilities of mannose or psicose.

The presence of the hexoses from rearrangement of the naturally occurring sugars in the Louisiana molasses was established definitely by application of aniline phosphate spray reagent to a tracer strip from an ionophoregram of the reducing sugars

[11] *J. Amer. Chem. Soc.*, 1947, **69**, 664.
[12] Block, Durrum, & Zweig: "A Manual of Paper Chromatography and Paper Electrophoresis." (Academic Press, N.Y.) 1955, pp. 150, 152.
[13] *Nature*, 1952, **169**, 330.
[14] Lemieux *et al.*: *Canad. J. Chem.*, 1956, **34**, 1365.
[15] Gross: *Nature*, 1956, **178**, 29.
[16] *J. Chem. Soc.*, 1950, 1702.
[17] *Nature*, 1954, **169**, 783.

† We are indebted to Dr. Gross for advice and assistance in construction of the apparatus.

separated from this molasses by the heated carbon-"Celite" column technique[9], with the results illustrated in Fig. 1. Eluates of reducing sugars from two 1 g samples, containing a total of 1·6 g solids, were combined and concentrated to 25 ml under reduced pressure below 50°C. Of this concentrate 0·1 ml was applied in four 25 λ spots as shown at *A*, with a spot of hydroxymethyl furfural (HMF) serving as a zero mobility marker. Using the position of the HMF after electrophoresis in this way, the mobilities (cm^2/V-sec × 10^5) were mannose, 4·6; psicose, 5·7; and approximately 6·9 for both glucose and fructose. The Mg of mannose is 0·67; in good agreement with a value of 0·68 calculated from mobilities reported by CONSDEN & STANIER[17] for low voltage electrophoresis of the sugars.

Fractionation of Molasses by Membrane Diffusion

One hundred grams of Florida final molasses were diluted with an equal weight of demineralized water and the resulting mixture was allowed to stand under toluene for 16 to 18 hrs at 5°C. One hundred grams of the supernatant liquid were diluted with 350 ml of demineralized water and the resulting solution was saturated with toluene. This mixture was poured into a membrane bag made from a 26 inches length of cellulosic tubing 2·25 inches in diameter, and 0·0023 inches in wall thickness (Central Scientific Co., Chicago, Illinois, U.S.A.) and the contents of this bag, continuously stirred mechanically, were dialysed against 1800 ml of toluene-saturated demineralized water for 22 hours at 20°C. The solution of diffusates was concentrated under reduced pressure at 60°C to a volume of 400 ml. This concentrate (A), pH 5·5 at 20°C, was found to contain 8·37 g sucrose, 6·38 g reducing sugars (as invert sugar), 20·4 g solids and 3·13 g ash. Paper chromatography of this concentrate (*A*) is shown in Fig. 2.

Column Chromatography on Carbon of Molasses Diffusates

A 30 × 6 cm (dia.) column of granular carbon ("Nuchar", C-Unground grade, West Virginia Pulp and Paper Co., New York, N.Y., U.S.A.) was formed in a percolator containing demineralized water. The column was conditioned by allowing in succession 1 litre of 5% hydrochloric acid, 5 litres of demineralized water and 1 litre of 5% ammonium hydroxide to pass through it followed by 10 litres of demineralized water. A 200 ml aliquot of the concentrate (*A*) of the Florida molasses diffusates was added at the top of the column which was developed with 3 litres of demineralized water. The first 800 ml of effluent was free of solids and was discarded, the remaining 2200 ml of effluent was concentrated under reduced pressure at 60°C to a volume of 200 ml. This concentrate (*B*), pH 5·7 at 20°C possessed 0·0 g sucrose, 2·62 g reducing sugars (as invert sugar), 4·51 g solids and 1·25 g ash; its chromatography on paper is depicted in Fig. 2. The concentrate of the molasses monosaccharides (*B*) was dewatered further by freeze-drying and by phosphoric anhydride at 20°C under vacuum, yield 4·63 g. This residue was shaken for 60 minutes at 25°C with 50 ml of methanol ; a

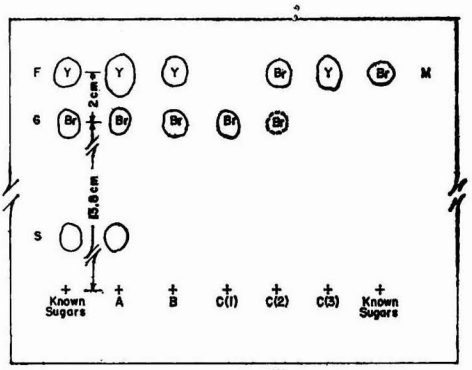

Fig. 2. Paper chromatography of fractions from Florida molasses: C(1), cuts 1–12; C(2), cuts 13–19; C(3), cut 20. Foreshortened tracing shows relative positions of sugars. R_g values: sucrose (*S*), 0·67; fructose (*F*) and mannose (*M*), 1·15.

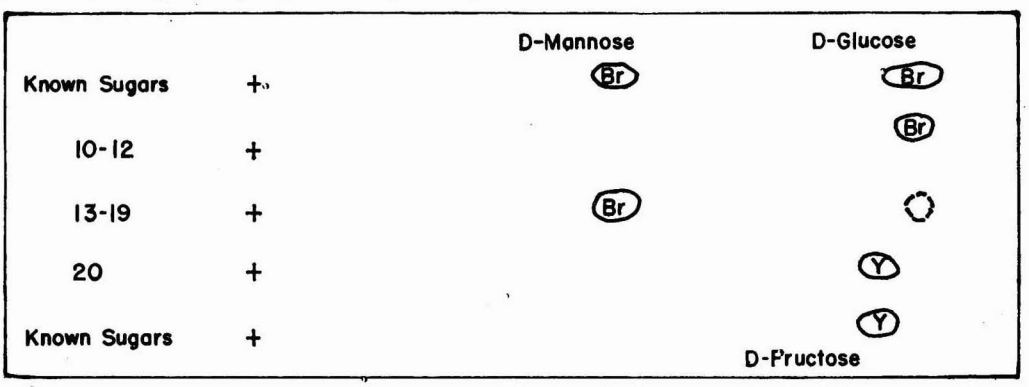

Fig. 3. Ionophoregram of cuts from chromatography on clay of Florida molasses monosaccharides.

granular solid formed. This solid was collected on a filter, washed with 50 ml of methanol and allowed to dry in air at 25°C, yield 1·09 g. This substance will be the subject of a future article. The solids content of the filtrate (C), volume about 90 ml. was found to be 3·58 g.

Column Chromatography on Fuller's Earth Clay of a Monosaccharide-containing Fraction from Florida Final Molasses

A 190 × 107 mm (dia.) adsorbent column was prepared from 900 g of a 5:1 mixture (by weight) of fuller's earth clay and filter-aid and was prewet with 1500 ml of ethanol:water (90:10 v/v) followed by 50 ml methanol. A portion of the monosaccharides-containing fraction (C) in methanol, reducing sugars content about 290 mg, was added at the top of the column which was developed with 5 litres of ethanol/water (90:10 v/v) followed by 1 litre of ethanol/water (85:15 v/v). The column effluent was collected in the following manner: cuts 1, 2 and 3, 500 ml each; 4 and 5, 250 ml each; 6–19, 200 ml each; 20, 880 ml. Benedict's reagent indicated that cuts 1–4 possessed no reducing sugars and that the remaining cuts should be grouped as follows: 5–9; 10, 11 and 12; 13–19, 20 alone. The volume of each of the grouped effluent cuts was reduced to 2 ml by solvent removal at 50°C under reduced pressure. The paper chromatography and ionophoresis on paper of these concentrates are reported in Figs. 2 and 3, respectively.

Isolation from Florida Final Molasses of a D-Mannose Concentrate and the Formation of D-Mannose Phenylhydrazone

One gram of glucoseoxidase ("DeeO" powder, Miles Chemical Co., Elkhart, Ind., U.S.A.) was admixed with a separate molasses monosaccharide concentrate (*B*) and air at the rate of 12 litres/hr was passed through the resulting mixture for 5 hr at 25°C. Foam formation was depressed by the addition of 1 ml of cyclohexanol. The reaction mixture was then heated for 3 minutes at 80°C to deactivate the enzyme, dewatered partially by freeze-drying and dried further at 25°C over phosphoric anhydride under vacuum. The dried residue was treated with methanol as described already and the granular solid collected on a filter. Paper chromatography of the filtrate (*D*) indicated the apparent removal of the D-glucose. A portion of this filtrate (equivalent to 45% of concentrate *B* before the removal of D-glucose) was chromatographed on a 150 × 107 mm (dia.) adsorbent column of 700 g of a 5:1 mixture (by wt.) of fuller's earth clay and filter-aid as described already herein. The effluent cuts were grouped as determined by Benedict's reagent and the probable presence of D-mannose in certain cuts of the column effluent was established by paper electrophoresis as described previously in this article. The D-mannose concentrates from four such chromatograms were combined and the solvent removed at 50°C under reduced pressure. The residue in 100 ml of distilled water was demineralized by passage through a column of mixed cation and anion exchange resins ("Rexyn RG 501", Fisher Scientific Co., New York, N.Y., U.S.A.), partially dewatered at 50°C under reduced pressure and dried at 25–27°C with phosphoric anhydride under vacuum, yield 0·29 g.

The demineralized D-mannose concentrate (0·29 g) in 5 ml of 95% ethanol was allowed to react with 0·3 g of phenylhydrazine (freshly distilled) for 2 hours at 25–27°C and then 18 hours at 6°C. The nearly colourless crystals were collected on a filter, washed successively with 5 ml of water, 3 ml of 95% ethanol and 2 ml of ethyl ether, all at 0°C, and dried at 25–27°C over phosphoric anhydride, yield 51 mg. These crystals melted at 197–198°C; mixed m.p. with an authentic specimen of D-mannose phenylhydrazone was unaltered.

QUANTITATIVE CHROMATOGRAPHIC DETERMINATION OF MANNOSE AND PSICOSE

Conditions had been established for separation of the total reducing sugars, free of interfering non-sugar reducing substances, by chromatography on heated carbon-"Celite" columns[9]. This technique, followed by chromatographic separation of individual reducing sugars for determination by colorimetric methods provides a direct method of analysis, minimizing the loss of sugars being determined. Eluates of the reducing sugars from 1 g of molasses in 300 ml of water containing 0·7 per cent 1-propanol were concentrated to a volume of 10 ml under reduced pressure at 40°C. It was determined that no rearrangement of the glucose and fructose occurs under these conditions.

Aliquots of 0·1 ml of the concentrated solution were spotted in streaks of six approximately 15 λ applications to 53 cm long strips of prewashed Whatman 3 MM paper. Separation was effected in 3 hours at 40 V/cm in 0·05M borate buffer of pH 9·2. The mannose was located on tracer strips with aniline phosphate spray reagent, and portions of the paper containing other sugars were cut out and sprayed to confirm the effectiveness of the separations. Unsprayed areas of the paper, approximately 4 × 7 cm, containing the mannose were cut out and eluted with water. Equal areas of sugar-free paper were eluted as blanks. The eluates were restricted to a volume of exactly 2 ml and were filtered through sintered glass filters to eliminate fragments of paper. Mannose was determined colorimetrically in the eluates by the anthrone method, with reference to an absorptiometric curve established for this sugar. The absorption follows Beer's Law in the range of 0·01–0·10 mg/ml. Results of three determinations gave values of 0·83, 1·03 and 1·06% mannose on solids.

Psicose was determined quantitatively in 100 λ aliquots of the same concentrated solutions of reducing sugars prepared from Florida molasses for determination of mannnose. It was separated effect-

ively by ascending development of the chromatograms with the top layer of 1-butanol:acetic acid: water (4:1:5), and areas containing this sugar were located by spraying tracer strips and eluted as described previously. The colorimetric determinations with anthrone were referred to the absorptiometric curve for fructose, and are estimates on the same basis as those of FOSTER and MARSH[10]. The three individual samples of the molasses were found to contain 0·58, 0·58 and 0·59% psicose on solids.

SUMMARY AND CONCLUSIONS

Chromatographic analyses of molasses produced by modern processing methods have confirmed the observations made 70 years ago by LOBRY DE BRUYN and ALBERDA VAN EKENSTEIN that rearrangement of the naturally occurring reducing sugars takes place during the heating of limed sugar cane juice in the evaporation and crystallization of sugar, resulting in the formation of mannose and psicose. The reaction proceeds to the same extent in vacuum evaporation and with automatic control of liming, as it did in cruder methods of sugar boiling practiced at the turn of the century. The mannose content of a sample of final molasses from the largest sugar mill in the United States was found to contain approximately 1% mannose on solids, as high as the concentration in the sample of maximum mannose content analysed by PELLET in 1895. The psicose content of this molasses was shown to be about 0·58%. These reducing sugars account for part of the excess of fructose over glucose in molasses, determined by methods used by FOSTER and MARSH[10], and in our earlier analyses[9]. The rearrangement products may reach a total concentration of 1·5–2·0%, or 6–8% of the reducing sugar content of molasses, which affects significantly the solubility of sucrose and the recoverability of this sugar.

THICK LIQUOR FILTRATION IN THE SUGAR INDUSTRY

By LUCIEN HERSSENS

(Raffinerie et Sucreries du Grand-Pont, Hougaerde)

Condensed from Sucr. Belge, 1963, **82**, 281–292

OVER the last six years at Gembloux we have successfully used four different filters. At the beginning, we had closed mechanical filters which were replaced by the filter-presses made available by installing continuous 1st carbonatation mud filters. In 1959, we introduced Enzinger filters from Sombreffe.

During the 1961 campaign we used specifically for syrup a 17 sq.m. Funda filter on a factory trial scale and carried out some pilot-scale tests for remelt with a 2 sq.m. filter of the same type.

Two 25 sq.m. Funda filters were installed on a permanent basis in 1962 for syrup filtration. The 17 sq.m. filter was used during the second half of this campaign for full-scale remelt filtration tests.

From the manpower aspect of operation, the various stages that we have covered have constituted each time a step towards reduction: two men were needed for the mechanical filters, and two for the filter-presses. These men were under-employed, moreover, and would have been able to do other jobs had moving away from the station not constitituted a handicap.

One man was sufficient for the Enzinger filter station, while now, with the Funda filters, there is no one assigned to the station, attendance and operation being done by a supervisor and by the man responsible for the evaporators.

This evolution does not yield millions but it is worth mentioning. It should be added that those in charge of more modern filters or those who help to run them should be workers endowed with a certain amount of intelligence and who understand the multiple operations involved in cleaning and charging.

If not, the filters must be provided with semi- or fully-automatic controls; these do exist, although we have not adopted them. Because of the large number of valves and cocks with which filters are usually equipped, such automation roughly doubles the installation costs.

I will mention the mechanical filters only for the sake of memory: we used them until 1956. Three 36 sq.m. filters were in service for a daily throughput of 1800 tons. Equipped with cotton cloths, they filtered syrup of 60°Bx on average, rarely exceeding 65°Bx. The cycles were short and it was often necessary to dismantle 5 and sometimes 6 filters per day. Several times we have found 4–5 kg of syrup remaining in the bottom of the bags. The supervisor was torn between his professional conscience ordering him to replace the torn pockets and his wish for comparative peace which would have been bought at the sake of somewhat less care in filtration.

This must not be taken as a positive condemnation of this type of filter: their performance can perhaps be greatly improved by a better choice of filter cloths, or by improving the backing so as to avoid one cloth sticking to another and consequently reducing considerably the effective filtration surface. Increasing the temperature of the liquor to be filtered and using suitable filter-aids, as pre-coat or with continuous addition, helps to recreate interest in this old servant of the sugar industry. I think I may mention here the happy experience of Oreye sugar factory, which has obtained excellent results with mechanical filters treating at a pressure of 200–300 g a mixture of syrup and refinery run-off of 70–74°Bx and at a temperature of 90–95°C; these filters receive 23 kg of filter-aid as pre-coat and 10 kg of filter-aid is added continuously during the 36-hour cycle.

Filter-presses have been widely used in the sugar factories of the British Sugar Corporation and we were inspired by their example to put them into our own factories. Using them as they were, only covering the plates with a double cotton cloth, we first of all encountered failure. We then recovered the grooves with a perforated plate, but this did not result in any noticeable improvement. We met success first by replacing the perforated plates with a fine mesh and managed to treat all the syrup from 2000–2200 tons of beet on two Kroog filters containing 40 frames. The length of the cycles was rather irregular—from 8 to 20 hr—but it should be added that neither the Brix nor the temperature was particularly constant. The need to remove the cloths for washing after each cycle and especially to replace them very carefully is a definite handicap. Moreover, a whole department of the factory is transformed into a skating rink during this operation. We have been able to simplify this work to some extent, without however eliminating the necessary inconveniences, by replacing the double cotton cloth with a single nylon cloth. But the risk of mechanical damage with frequent washing is rather high for these expensive materials. The men looking after the press not generally being the same ones who put it into operation, we have had many false starts, the filter not being sealed. This is particularly annoying for anyone who likes filtering his syrup; it becomes disastrous for anyone, like ourselves, who has added 12 kg of "Celite" to the unfiltered syrup to form a pre-coat, since then the unfiltered syrup cannot even overflow into the filtered syrup.

At this stage, and not very satisfied in spite of everything, we had an opportunity of installing Enzinger filters. We thus used for the first time equipment of modern design characterized essentially by the obligatory use of filter-aids and by the elimination of dismantling and repairs after each cycle. We have sufficient information from our own experience on Enzinger filters and Funda filters and information gathered through numerous visits to sugar factories on other types of candle, frame or plate filters, to be able to make a thorough examination of this equipment. Most of the problems encountered are common to all filters.

In the first place, since this equipment is generally costly, the required effective surfaces should be calculated accurately.

Now, the syrup flow after evaporation is very irregular. After starting the boiling of a 1st massecuite, evaporation is sharply reduced in the 3rd and 4th effects and these bodies have a tendency to fill with syrup. At this time there is practically no syrup drawn-off. The flow is restored gradually and at its maximum greatly exceeds the average throughput of the factory and does not become normal again until just before starting the next boiling. These fluctuations occur at about hourly intervals; the flow at any instant can be anywhere between 10 and 50 cu.m./hr for an average flow of 20–22 cu.m. This phenomenon is not restricted to Gembloux; its existence has been confirmed at other factories. In order to buffer the effect, we installed a 125 hectolitre surge tank before the filters, corresponding to a production of 35 min. Then, although this contradicts the principles of good filtration, we controlled the opening of the valve after the pump in accordance with the syrup level in this tank, in order to increase the flow between the peaks.

Let us now examine, separately, the various phases in filtration.

Pre-coat must still be applied carefully: the life of the cycle will only be good if this pre-coat is uniform and well anchored. Deposition must be slow; the volume recycled for its application must not exceed that in filtration; a slight pressure must be maintained as much as possible below the filter elements. Deposition can be with hot water, filtered juice of filtered syrup, Hot water deposition passes some water to the cystallization station, while juice charging passes not much less; some prefer syrup charging, the syrup having to be filtered in this case. They claim that they obtain more regular distribution and a more suitable porosity for subsequent filtration.

We had Enzinger filters and, because of their large volume, we used syrup for pre-coating. Since the filter has a capacity of 2500 litres, we would have fed 7500 litres of water daily into the supply tanks of the vacuum pans, involving a coal consumption of approximately 750 kg.

During the factory test, we used the Funda filter in the same way.

The Funda filter is smaller, it contains only 1800 litres and needs only two start-ups per day in syrup filtration. Consequently, the effect of dilution is less important by a half and we preferred using water for the pre-coating in order to avoid small quantities of syrup being left and cooling in the pre-coat tank, pumps and pipelines over a long period. We have been particularly afraid of blockages and crystallization, but this technique can also be defended, we believe, from the bacteriological point of view.

When buying or testing a filter, the manufacturer gives us a golden rule to follow: filter at a constant flow rate and gradually increase the pressure from zero to maximum. Unless one is an expert in filtration, it is quite difficult to satisfy this condition. Apart from the irregularity of flow from evaporation, we are unfortunately subject to some variations in Brix and, as a natural consequence of the law of universal cussedness, these variations are accompanied by inversely proportional variations in temperature.

It is obviously necessary for all candle or vertical frame filters to ensure that the flow rate, or rather the pressure at which the pre-coat is applied, does not fall too low, in order to avoid partial separation, for this shortens the cycle life and accelerates choking of the filter. There is no fear of this happening in horizontal disc filters such as the Funda. When there is insufficient liquor to be filtered, one can guard against this risk by recirculating filtered syrup.

The addition of kieselguhr or of perlite in the feed during filtration is generally carried out by means of metering pumps or sometimes micro-screws. The dosing, made on a time basis, is minimal and correct at the same time only for one single flow value. It is thus of interest, if there is no wish to waste expensive filter-aids, to maintain the throughput within certain limits of variation, let us say 20–25%.

When two or more filters are used in parallel for the same product, it is generally advisable to use a separate pump for each filter. We have confirmed this necessity in the use of two Enzinger filters in parallel: it becomes practically impossible to control manually the distribution of liquor to be filtered; the newly started filter has a tendency, difficult to overcome, of short-circuiting the other.

The individual pump can be replaced by a flow regulator on each filter; in this case, constant throughput can be achieved.

The filter being choked, it is fitting to examine the cleaning operation, which is certainly the most delicate of all.

All filters are cylindrical, so that it is not difficult to make them highly resistant; moreover, they almost always carry the qualification of "high pressure filter."

Using the filters at up to pressures of 4, 5 and 6 kg obviously increases the cycle life but we have generally found that the pressure, slow to start with, rises very rapidly at the end of the cycle if the flow has not been kept very constant.

With the Funda filters we have average figures of:

Pressure rise from	0 to 1 kg	in 11½ hr
	1 to 2 ,,	,, 4 ,,
	2 to 3 ,,	,, 1½ ,,
	3 to 4 ,,	,, ½ ,,

For Enzinger filters these increases have an identical trend.

However, we have found that the washing efficiency was clearly hampered after a cycle continued to high pressure, and it is far better to aim at a good average cycle rather than a "champion" cycle.

Certain candle filter users have come to the same conclusions. The Funda filter, which is cleaned by centrifuging, is perhaps less sensitive than the others, but is subject as the others to detaching of the kieselguhr on the cloth or when passing through the cloth.

In practice, all users of modern filters claim that after a given number of cycles, there is a noticeable drop in performance: incrustation is deposited between the candle wires and between the treads of the cloth. The cycle life has been considerably improved in each case by washing filters with 2% dilute acid. It seems that this operation, carried out without opening the filter, should be repeated approximately every 15 days at Gembloux. It is advisable to bear this in mind when buying and to provide for materials and paints that are resistant to this treatment.

If the acid treatment is not carried out in good time, there is a risk that the filter will have to be completely dismantled to immerse the filter cloths in a concentrated descaling solution.

However, it is possible to delay, or eliminate, this acid treatment by recovering the candles or replacing the metal cloths with a single fibre nylon material. We carried out this change with a certain amount of success on Enzinger filters; dismantling is still easy and treatment of the frames outside the tank is permissible where necessary.

What happens to the filter-cake during discharge? On this point, the techniques used are innumerable. In fact, we all wish to prevent dilution and prevent the introduction of this cake into the juice and to recover the sugar in it.

To avoid diluting, the filter can be emptied slowly; in this case, even with candle and vertical frame filters, practically all the cake will remain adhering to the filter surface. The usual cleaning process can then be used, after filling the filter with water, i.e. autopack, air bubbling, rotation. But the sugar is lost. This is nevertheless the method we have used with the Funda filters at Gembloux and it leads to a daily loss of 200 kg of sugar for a single syrup filtration. This loss would be roughly trebled if we filtered standard liquor and we are trying to remedy it.

We could possibly return the filter-cake with the discharged syrup, or diluted with water, after we have pre-heated it. But we hesitate to run this risk to the balance of our clarification and juice filtration system.

We refill the filter slowly with water, after syrup discharge, and then recommence filtration to displace and recover the majority of the sugar: this filtrate may then be returned to the juice or sweet water.

All the filters are more or less directly connected to the drain or the mud diluter by way of their wash water discharge or cake discharge circuit. Any looseness in the cocks and valves and any wrong

operation by the servicing personnel can lead to very significant losses, which come under "unknown losses." On this point, it is advisable to adopt precautionary measures and to facilitate control and checking as much as possible.

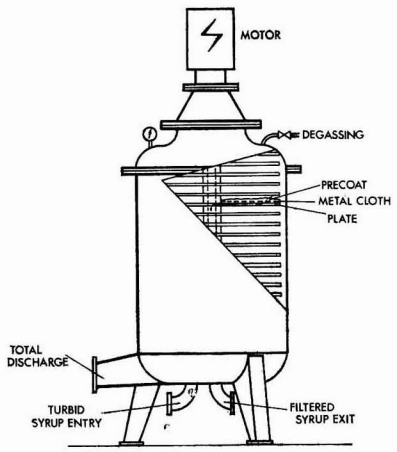

Fig. 1

Most of the filters are connected to the compressed air system, either for partial discharge of syrup at the end of the cycle, or to speed up discharge after washing, or yet again to create the necessary swirling action in the water during washing. This practice, which is justifiable and which is essential in certain equipment, nevertheless is very dangerous for inexperienced personnel.

We have had one accident in which rather nasty scalds were sustained during the emptying of a filter under air pressure: when the filter was empty the air rushed into a rising pipe which collected droplets spat from the de-gassing valve, and threw a sheet of syrup at 90°C into the room.

It seems the time has come to give more precise details of the performance of the syrup and remelt filters at Gembloux during the 1962 campaign.

Two 25 sq.m. Funda filters are used, one in operation at a time. For remelt, we have used a 17 sq.m. filter intermittently.

The Funda filter is a vertical, cylindrical filter in which the filtering surface is formed by the upper surface of a series of discs supported one above the other on an axis. Throughout the whole cycle, the system is stationary, while for cleaning, the axis and the discs rotate and the cake is expelled by centrifugal force (Fig. 1).

After some trials, we were able to filter all the syrup in a single filter, carrying out 7–23 hr cycles with a throughput of 800 litres/sq.m./hr. As Fig. 2 shows, for a normal cycle, the average syrup Brix is slightly higher than 70 and the temperature is generally between 90 and 95°C.

As a pre-coat we used 18 kg of "Celite 545", and for feeding, first 5, later 3·75, and finally, during the greater part of the campaign, 2·5 kg of "Dicalite 478" per hour (that is, about 120 g/cu.m. of syrup).

An accidental breakdown of the reheater, caused by the injection pump, allowed us also to make a check on the importance of the necessity for reheating. However, our 1961 tests had given us average throughputs of 1060 to 1400 litres/sq.m./hr, for a temperature of 85°C and an identical syrup Brix. Thus, comparing the two years, we find only three differences, as follows:

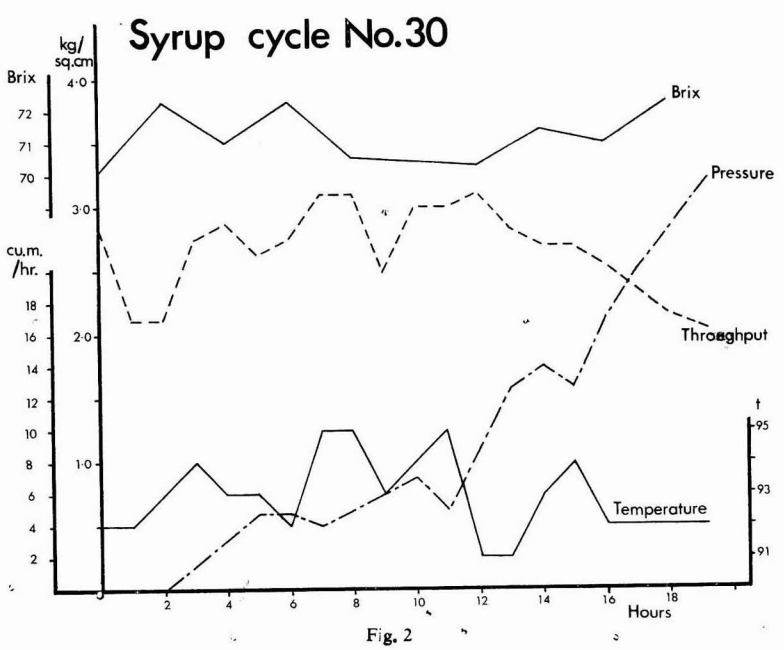

Fig. 2

In 1961, we used for feeding mostly "Hyflo Super-cel" and only a little "Dicalite 478."

The pre-coat was made with filtered syrup in 1961 and with water in 1962.

The beet—the eternal excuse.

Being satisfied despite everything, we learned that a foreign sugar factory, using a 20 sq.m. Funda filter, obtained 23-hour cycles for filtration of 900 litres/sq.m./hr of standard liquor at 76°C with 6 kg of "Dicalite 478" per hour, i.e. 290 g/cu.m. of standard liquor.

If we are not ready to draw conclusions of the causes of similar differences in the results, it nevertheless seems certain that the preliminary deliming of the juice considerably eases the later syrup filtration and perhaps reduces its necessity!

The filtration of remelts has been rather more laborious than that of syrup. The cycles lasted for 6 to 16 hours. They would have been much shorter if we had maintained the flow constant as with the syrup. The diagrams in Fig. 3 illustrate this fall in

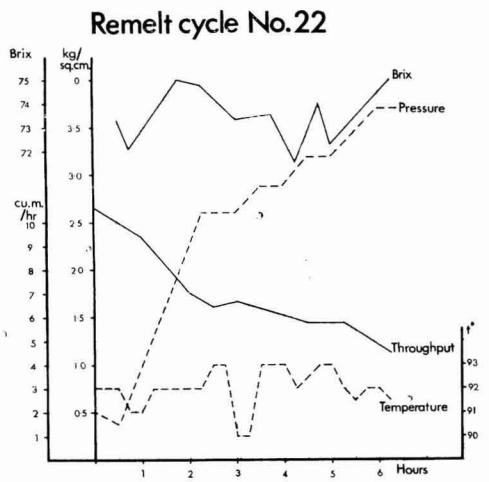

Fig. 3.

throughput during the cycle. We have obtained on average 300–400 litres/sq.m./hr for remelt at 70°Bx and at 88–92°C.

As a pre-coat we used 12 kg of "Celite 545" and for feeding, first of all 5 and then 3·5 kg of "Dicalite 478," i.e. 580 g/cu.m. of remelt.

At the end of the campaign we ran two successive cycles of 18 hours' duration at an average throughput of 500 litres/sq.m./hr with "Dicalite 4158" but we have not had time to study this technique carefully or to evaluate its merits.

Before speaking of the efficiency of filtration, the merits of the filter must be largely separated from those of the filter-aids. The former are of a practical order; frequency of incidents, ease of operation, of cleaning, of maintenance, responsibility for dilutions, consumptions, losses, etc.

But it is mainly the filter-aids that are responsible for the standard of filtration. This said, what results have we obtain with the means used?

A certain number of analyses, principally concerned with the optical density and bacteriology, have been made in the laboratories of the Raffineries Tirlemontoise and we thank Messrs. Henry and Simonart sincerely for their help and the work of their team.

Other analyses, also concerned with optical density and also ash, colour and turbidity of the sugar in aqueous solution, have been carried out in our laboratory at Hougaerde.

The results of the analyses have been very irregular on the whole. Luckily, we know that this irregularity is as much a feature of the analyses as of the filtration quality; the sampling cock is unfortunately in the rising branch of a siphon. The opening of this cock produces first an intake of air in the piping, the siphon is broken, and only then can the cock allow the sample to be collected. The changes in the sample resulting from the air intake and the internal eddies have cause a good number of false analyses.

In order to judge the importance of this incident, we have submitted to analysis samples of filtered syrup after having first withdrawn increasing volumes of syrup from the cock.

We have thus obtained optical densities at 7900 Angströms as follows:—

Unfiltered syrup	0·063
Filtered syrup after preliminary purge of	
5 litres	0·045
7·5 litres	0·034
10 litres	0·031

Another test gave us:

Unfiltered syrup	0·155
Filtered syrup after a purge of	
10 litres	0·024
15 litres	0·022
20 litres	0·024

This has led us to conclude that about 10 litres of syrup must be purged before a valid sample can be taken for the optical density.

We are also certain that all the normal filtration cycles, which are the most numerous, have involved a reduction of optical density at 7200 A of the order of 70–75%. The optical density, read with a spectrophotometer at 720 mμ, measures principally the turbidity of the liquor. Measurements made at other wavelengths indicate at the same time colour and turbidity; at the moment it seems to us that filtration has no or hardly any effect on the colour.

Microbiological counts have also given as irregular results as the optical density measurements. Unfortunately, we do not know if the purging of

SUGAR-HOUSE PRACTICE

Feasibility study for continuous sugar cane diffusers. F. C. SCHAFFER and T. H. HUCKEBA. *Sugar J.* (La.), 1962, **25,** (6), 8–18.—The economics of cane diffusion are compared with those of the conventional milling process for factories with capacities of 500, 2000 and 5000 tons of cane per day. On the basis of these figures, it is estimated that a diffuser would pay for itself in under 2 years. A vertical diffuser, in which the cane would be fed at the bottom together with diffusion juice is described with the aid of a simple diagram. Some factors to be considered in cane diffusion are mentioned; these include the need for equipment to separate the cane arriving in large bundles or for the cane to reach the factory already cut into short lengths (12–36 in). Bagasse dewatering using presses is discussed. To avoid the need for a large number of presses, the last two mills of an existing tandem could be used, or the diffuser could be operated in parallel with a tandem so that the bagasse from the diffuser could be de-watered by the last mill and the water used as maceration for the tandem.

THICK LIQUOR FILTRATION IN THE SUGAR INDUSTRY—*continued*

10 litres of syrup constitutes an adequate precaution. In general, however, the examinations carried out on remelts show good elimination of micro-organisms—of the order of 70%.

We note, by the way, that in a foreign sugar factory using a filter similar to ours, microbiological elimination reached 96%.

We can deal similarly with analyses of the quality of the sugars from the point of view of aqueous turbidity and ash. These analyses were reported for samples which were the average over several days of manufacture and were thus not in step with the various stages and filtration experiments. Nevertheless, there seems to be a connexion between the turbidity of the sugar solution and the throughput of the remelt filtration, which was imperfect and only partial throughout the campaign. The micro-organisms introduced in the first boiling by the remelt, in the absence of filtration, were about 100 times as numerous as those introduced by the syrup. On the other hand, the direct action of remelt filtration on the aqueous turbidity of the sugar seems to us to be more sensitive than that of the syrup filtration. This to the point that one wonders if one is not concerned with a false problem in trying to filter syrup while not filtering the remelts!

From the above we arrive at the following conclusions:

The technical problems of thick liquor filtration seem to be resolved or can pass for such. Certainly though, the problem is more difficult in one factory than another and extrapolations are to be distrusted,

The advantages which can be derived are not clearly established; they are probably not even fully known. We ignore also the development of filtration quality in the course of a cycle and subsequently the means of maintaining this constant.

We would be interested to know the influence which filtration can have on the crystallization rate.

Finally, it would be of greatest importance to define the direct connexion which may exist between filtration of syrup, remelt, rich wash, together or as a mixture, and the sugar quality, not only from the point of view of turbidity and microbial factors but also regarding the ash content.

We hope, with appropriate means of investigation, to be able to apply ourselves during the next campaign to the study of a better knowledge of and better use of filters and filter-aids.

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Deterioration of stored molasses. E. R. DE OLIVEIRA. *Brasil Açuc.*, 1962, **60,** (1/2), 12–17.—Changes which take place during molasses storage are listed and attributed to two causes: the presence of micro-organisms, and autogenic chemical reactions. The former can take place even with molasses of high density (70–75°Bx) where absorption of water at the surface dilutes the material and creates conditions where yeasts and fungi can develop; their effect is not considered to be the major cause of deterioration, however. A number of references are made to the literature on chemical reactions causing decomposition and it is pointed out that these are little understood, although reaction between amino acids and lime or reducing sugars seem to be a cause, and a temperature of 54–55°C to be critical.

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Tests on the behaviour of juice from different cane varieties. P. TRINIDAD C. *Proc. 4th Int. Conf. Sugar Ind. Consult. Technol.* (Veracruz), 1962, 23–39.—Juices from 20 cane varieties were stored for 10 days at room temperature (30–31°C), daily measurements being taken of pH, temperature, % invert and % total sugars, and invert ratio. The measurements are tabulated and discussed and it is concluded that they were as expected, variations in pH and invert and total sugars depending, however, on the variety. From a sugar manufacturing point of view, juice should not be stored for more than 24 hours before processing, and the preferable varieties are CP-D, CP-C, P.P.Q.K., Mex. 53-71, Mex. 53-101, H-B, Co. 213, Co. 419, Co. 475, Co. 650, Co. 449, Co. 617 and Co. 655.

* * *

Relation between crusher juice and factory recovery in Ingenio San Cristóbal. B. A. ROJAS. *Proc. 4th Int. Conf. Sugar Ind. Consult. Technol.* (Veracruz), 1962, 245–247.—Based on 26 sets of figures from the 1958/59 season, the relationships between recovery R and the pol P and Brix B of crusher juice, alone and combined, were formulated by regression analysis. The simplest, $R = 0{\cdot}625\ (P - 1)$, was found to be more convenient and as accurate as the formula $R = 0{\cdot}7195\ P - 0{\cdot}0980\ B - 0{\cdot}2939$, and more accurate than the formula relating R with Brix alone, viz. $R = 0{\cdot}6092\ B - 2{\cdot}2738$.

Statistical control in the factory. B. A. ROJAS. *Proc. 4th Int. Conf. Sugar Ind. Consult. Technol.* (Veracruz), 1962, 248–261.—Losses of sugar in bagasse may be estimated from the residual juice pol, an increase of 1% in the latter producing a 0·63% rise in bagasse pol. Residual juice pol P_R depends on crusher juice pol P_D, the relationship being $P_R = -3{\cdot}75 + 0{\cdot}50\,P_D$. A graph of this relationship may be drawn and operating limits for P_R drawn 1·25 units above and below; the mill superintendent should make his mill adjustments to maintain P_R within the limits of these two lines. Sampling of the residual juice is discussed; samples should be taken along the whole length of the bagasse roller to ensure that they are representative, and every four hours. A continuous sample would be preferable.

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Micro-organism control in cane sugar mills. J. W. APPLING. *Sugar News* (Philippines), 1962, **38,** 654–657.—Solutions of an organic sulphur bactericide "Busan 881" (containing 12·7% disodium cyanodithioimidocarbonate, 4·8% ethylene diamine, 17·5% potassium N-methyldithiocarbamate and 65·0% of inert ingredients)[1] have been found to undergo almost complete decomposition at 80°C, and at 100°C were completely decomposed. Dilute solutions of this bactericide slowly decompose on standing at room temperature; thus, while being an effective bactericide, "Busan 881" does not add impurities to the raw sugar or contribute to final molasses when used in proportions of 10–20 p.p.m. Mill data are recorded for a Brazilian factory using "Busan 881" showing the drop in purity and increase in the glucose ratio from crusher to mixed juice. The savings resulting from the use of this bactericide in Peru and Mexico are discussed.

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Processing raw sugar in the sugar factories of the Lithuanian and Latvian economic regions. F. K. DZHOLMANOVA. *Pishch. Prom. Kazakhstana, Nauch.-Tekhn. Sbornik*, 1961, (5), 61–65; through *S.I.A.*, 1962, **24,** Abs. 899.—Details are given of the refining scheme at three factories (Leipai, Pavenchai and Panevezh) in March and April, 1961. The raw sugar was melted to 36–42° Brix without affination, and the melt was purified by single carbonatation and sulphitation and evaporated in the last three vessels of the evaporator (the first being filled with pure water only). A white sugar of colour 0·8–0·98°St. and molasses of 52–58 purity were obtained.

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Experiences in processing imported raw cane sugar at Leipai sugar factory (Latvian S.S.R.). M. I. PASHKIN. *Pishch. Prom. Kazakhstana Nauch.-Tekhn. Sbornik*, 1961, (6), 58–62; through *S.I.A.*, 1962, **24,** Abs. 900.—The process at Leipai factory is described in greater detail with tables of factory performance and liquor colour (in °St.) before and after purification and evaporation respectively. It is claimed that the process is simple and economically efficient, largely owing to the use of the first evaporator vessel as a steam generator, which avoids overheating of the liquor.

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Improving the technological scheme of processing raw sugar and beet in the sugar factories of the (Kazakhstan) republic. E. E. VARSHAVSKAYA. *Pishch. Prom. Kazakhstana Nauch.-Tekhn. Sbornik*, 1961, (6), 13–17; through *S.I.A.*, 1962, **24,** Abs. 901.—Difficulties and poor performance in the processing of raw cane sugar in local beet factories are discussed, and improved schemes for processing raw sugar alone or together with the beet (to an extent of 2·5–3·5% on beet) are briefly described. The difficulties are mainly caused by the traditional two-massecuite system, the absence of affination, and the effects of lime and heat on the reducing sugars contained in the raw sugar.

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Smallholders' sugar cane and the smallholders' cane sugar industry (in Java). R. SOEKARDJO-SASTRODIHARDJO. *Balai Penjelidikan Perusahaan[2] Gula. Warta Bulanan.* (Rpt. Java Sugar Ind. Exp. Sta.), 1962, (7), 200–219, (9), 321–334.—Information is given on the small-scale growing and processing of cane as a cottage industry in Java. Details are given of the processes and equipment used with mention of modifications. The four sugars produced are: (1) "gula mangkok" (cup sugar) which resembles gur and is cast in coconut shells (hence its alternative name, "gula batok"); (2) "gula tumbu" (basket sugar), which is similar to (1) but is solidified in a basket; (3) "gula tandjung", which is a sandy-coloured soft sugar resembling muscovado; and (4) "gula waru", a centrifugal sugar which takes its name from the town of Waru and is produced by a small-scale version of the normal industrial process.

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Entrainment and entrainment separation in a pilot scale cane sugar evaporator. F. H. H. VALENTIN. *S. African Ind. Chemist*, 1962, **16,** 125–129; through *S.I.A.*, 1962, **24,** Abs. 943.—The entrainment was studied in a small-scale evaporator containing an 85-purity sucrose-cane molasses mixture maintained at a constant Brix in the range 16–76°Brix. The height of the vapour space was 2 or 4 ft. Droplet size distribution was recorded with a Cascade Impactor. Entrainment rates and mean drop diameters are tabulated for various Brix values, evaporation rates and vapour velocities at a vacuum of 0, 15 or 25 in Hg. The degree of separation in the vapour pipe and in a small-scale cyclone separator is also reported. It is concluded that entrainment is a function mainly of vapour velocity, and that the height of the vapour space is relatively unimportant, since larger drops (74–89% of the total entrainment) are separated in the vapour pipe; concentric pipes are suggested for large-scale operation without a pressure drop. Small-scale cyclone separators are efficient owing to the small diameter. Entrainment separation (%) depends only slightly on the process variables.

[1] *See also I.S.J.*, 1959, **61,** 86; 1960, **62,** 222.

Deliming of a sugar solution by means of a cation-exchanger in a sodium and ammonium cycle. S. ZAGRODZKI, E. WALERIAŃCZYK and J. ZALICKI. *Roczniki Technol. i Chem. Żywn.*, 1961, **7**, 5–18; through *S.I.A.*, 1962, **24**, Abs. 686.—Laboratory experiments were carried out in which ~16°Brix solutions of yellow sugars of varying calcium content were passed through two columns of "Wofatit F" (in series) at 20°, 40° or 60°C. Above 70°C the exchange capacity of the resin decreased. Removal of lime was complete and a fall in the colour was observed; in addition, the ammonium cycle achieved a 78% reduction in the total ash content. The temperature had little effect, and there was no fall in pH or increased invert sugar content in any of the treatments of up to 25 min duration.

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Theory of the sugar factory diffusion process. XI. Theoretical heat requirements in the diffusion process. M. TEGZE. *Cukoripari Kutatóintézet Közleményei*, 1961, **6**, 1–11; through *S.I.A.*, 1962, **24**, Abs. 795.—Further to the work of KRAUSE[1], it has been found that the temperature distribution is dependent, not on the rate of heat exchange between cossettes and juice, but on the degree of mixing during juice flow. Basic equations are derived mathematically by which diffusion is divided into simple heat-exchange systems, by which temperature distribution can be calculated. The mixing factor appears in the equations as a dimensionless quantity, together with the flow rate, the length of the system, and the quotient of the heat capacities moving simultaneously with the cossettes and juice (the so-called "heat draw-off").

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Sugar decomposition and acid formation in the various processes of beet sugar manufacture. I. Determination of the non-precipitating anions. II. Decomposition of sucrose during diffusion juice production. K. VUKOV. *Cukoripari Kutatóintézet Közleményei*, 1961, **6**, 12–17, 18–28 & cover p. 3; through *S.I.A.*, 1962, **24**, Abs. 796.—The method of analysis of lactic acid according to MÖSSLINGER, adapted by KNYAGINICHEV and DERKOVSKAYA-ZELENTSOVA, has been again modified to suit sugar manufacturing conditions. Beet extracts or other dilute sugar juices are mixed with an H-form cation-exchanger and then filtered, to remove cations and amino-acids and to precipitate colloids coagulating in an acid medium. The solution is treated with excess $Ba(OH)_2$ and the addition of three volumes of alcohol (giving a 70% alcohol solution) in order to precipitate barium salts of dicarboxylic acids (oxalic, citric, malic) and poly-oxy acids (phosphoric, sulphuric), which are filtered off. If it is desired not to precipitate malic acid, the alcohol concentration is made only 35%. Barium lactate remains in solution. The original method removes Ba by adding Na_2SO_4 and filtering, with subsequent drying and ashing of the solution and measurement of the residual alkali metal. It has been found better to remove Ba with a H-form cation-exchanger and then titrate the acid with KOH to measure the total non-precipitable anions. The lactic acid can be determined by VUKOV's method[2] or by taking the acid solution to dryness, with determination of the volatile acids.

Investigations of the results of microbiological degradation of sugars were made by analyses of 4-hour digests of beet material at 56°C, and determinations of invert sugar (reducing power measured by the Ofner method), lactic acid and volatile acids. The results were correlated with counts of micro-organisms present. Analyses were also made of factory diffusion juices (Robert diffusion and J-diffusion) and of beet extracts prepared at different temperatures and in the presence of disinfectants (NaOCl, HCHO or $CHCl_3$). The results are fully given in tables and graphs. The invertase activity runs parallel with bacterial count when the latter is high (10^5), and is not affected by the disinfectants; it is stopped only by extraction at 75°C. The increase in invert sugar content is correlated with invertase activity in the beet by a factor of 0·62, with the relation: activity = 1·5 invertase + 7·6%. The pH is not a measure of the content of lactic and volatile acids. The total anion content (determined according to WALLENSTEIN) gives good correlation with the equivalents of lactic and volatile acids. Formation of these acids can be prevented by the disinfectants, but not just by heating to 75°C. The use of adequate disinfectants in factory diffusion is therefore essential.

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A new system of final product massecuite crystallization. A. I. VORONKO. *Pishch. Prom. Kazakhstana Nauch.-Tekhn. Sbornik*, 1961, (5), 22–24; through *S.I.A.*, 1962, **24**, Abs. 798.—The application of the method of intermediate centrifuging[3] at Ust'-Labinsk factory is briefly described with a diagram of the alterations made to the existing installation and a summary of the equations for practical control (amount of massecuite to be removed, and molasses Brix at which the intermediate centrifuging is performed).

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Combating microflora in the sugar factory. A. GRUSZECKA. *Gaz. Cukr.*, 1962, **64**, 327–332.—A general survey is given of disinfectants suitable for the beet sugar industry, their effects being illustrated with

[1] *Cf. I.S.J.*, 1962, **64**, 369.
[2] *Cukoripar*, 1955, **8**, 71–73, 93–96, 118–120.
[3] *I.S.J.*, 1961, **63**, 56.

the aid of graphs. Disinfection procedures are described using flow diagrams of the schemes mentioned. A list of recommendations is appended.

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Closed circuit for flume waters. K. SKALSKI. *Gaz. Cukr.*, 1962, **64**, 332–335.—The recycling of flume water in a closed circuit is discussed from the point of view of water economy and BOD. The two main reasons for recycling are: lack of fresh water available for the factories in any one region, and the inadvisability of overcharging rivers and lakes with waste water. The difficulties associated with recycling are discussed, particularly the reduction of the microbial content.

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Invert activity during beet processing. K. VUKOV. *Cukoripar*, 1962, **15**, 325–327.—The invertase activity in a beet brei water extract maintained for 4 hr at 56°C in an ultrathermostat was determined and expressed in the form of a regression equation as a function of moisture loss: $y = 8{\cdot}3\,x - 28$, where y = invertase activity (mg invert sugar formed)/100 g beet/hr and x = moisture loss %. The correlation coefficient was 0·88. It was found that the number of micro-organisms in the sample did not affect the invertase activity below 10^6/ml. Results of tests at 56 and 65°C using sodium hypochlorite, formaldehyde and chloroform showed that none of these affected the invertase activity, which was found to be greatest at 65°C, falling sharply at 70°C and ceasing altogether at 75°C. That invertase activity is almost proportional to invert formation in normal diffusion (at 56°C) is demonstrated graphically. With inadequate preheating (from 50 to 65°C) the sugar losses rise as a result of considerable inversion, whereas with automatic regulation of the heating, as in a J diffuser, (heating of cossettes at 80°C for 6–7 minutes and subsequent processing at 71–72°C) inversion is negligible.

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Testing the automatic controls of a continuous tower diffuser. B. A. EREMENKO, A. I. TSENZURA and B. G. SUSOROV. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1962, **9**, 18–28.—Details and a flow sheet are given of the automatic controls of the Buckau-Wolf diffuser at Salivonkovsk sugar factory. A central console is provided with a flow diagram having a signal system indicating the operation of the various electric motors. More detailed information is given on certain pieces of equipment, including the continuous band weigher, juice level control for the scalding chamber and condenser water level control for the boiler, Arca water level control for the tower, juice and water temperature control, and controls for juice draw-off, condenser and press-water feed to the scalder. The results obtained in tests are reported and modifications and additions are recommended.

Testing the controls of a continuous rotary diffuser. B. A. EREMENKO, B. G. SUSOROV and A. I. TSENZURA. *Trudy. Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1962, **9**, 28–38.—Details with a flow sheet are given of the automatic controls of the twin-scroll RT diffuser at Turbovsk sugar factory. The controls mentioned in greater detail are those of the continuous band weigher and cossette feed control; the Kent raw juice density meter, pneumatic controllers for raw juice feed to pre-liming and steam feed to press-water and recycled juice heaters and to the diffuser drum; the press-water and condenser water feed control; the Kent juice level control for the circulation tank and juice and water temperature controls; and the remote control for steam feed to the diffuser drum. Some recorder charts are reproduced together with flow diagrams.

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Testing the automatic controls of a twin-scroll sloping continuous diffuser. B. A. EREMENKO, B. G. SUSOROV and A. I. TSENZURA. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1962, **9**, 39–48.—The DdS diffuser at Ust'-Labinsk sugar factory is described with details of the automatic control equipment, including the temperature control for the juice-cossette mixture in the diffuser, and the controls for condenser water feed and for juice level. (All the above controllers are Foxboro instruments.) Other temperature and level controls are mentioned in less detail. Operation charts are reproduced and recommendations concerning modifications to the various control systems are listed.

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Testing the APR-5P pH meter. B. A. EREMENKO and B. G. SUSOROV. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1962, **9**, 48–55.—Details are given of this Soviet-made continuous pH meter together with circuit diagrams of the potentiometer and amplifier components. The instrument incorporates glass and calomel electrodes and the range covered is pH 6–13. On the basis of factory tests, the pH meter is recommended for measurement of 1st and 2nd carbonatation juices, variations at 85–95°C still being within the limits of permissible error.

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Investigation of electrodes for pH control in factory conditions. B. A. EREMENKO, B. G. SUSOROV and K. A. BARABANOVA. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1962, **9**, 55–61.—Glass and calomel electrodes were tested for their suitability in the measurement of 1st and 2nd carbonatation juices. The results are given in detail and certain recommendations are made regarding scale removal and cell shape and type of diaphragm.

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Testing electrode units for pH control. B. A. EREMENKO and B. G. SUSOROV. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1962, **9**, 61–69.—Various electrode units of Soviet manufacture and one of Austrian origin (Seibold) were compared in factory tests on pH control of 1st and 2nd carbonatation juice. The results are discussed in detail.

Characteristics of the technological value of the sugar beet. J. RASMUSSON and O. WIKLUND. *Proc. XIth Session C.I.T.S.*, 1960, 13–27.—The effects of certain characteristics of beet on processing are discussed under two headings: the morphological characteristics, including shape, skin, root, root fangs, bolters, and anatomy; and chemical characteristics, which deals chiefly with experiments carried out in 1942–45, mainly to determine the effect of the characteristics on thick juice produced by optimum diffusion, carbonatation and evaporation. The apparatus, processes and analytical methods have been described previously[1]. The average cossette and juice analyses are tabulated for each year in the period, and are discussed statistically with tables of coefficients of correlation between the thick juice analyses and those of the cossettes. It is pointed out that beet pol cannot be considered a reliable guide to thick juice properties, whereas the (K+Na) content of the beet will give an approximate indication of the (K+Na) content in the thick juice as well as, to some extent, thick juice purity, colour and possibly N content. The beet invert content gives some indication of thick juice purity, lime salts, colour and possibly N content. Beet pol and purity have only a slight influence on thick juice pol and purity. The effect of beet nitrogen on thick juice is discussed. While this has a considerable and constant effect on juice purity, and the correlation between beet N and (K+Na) pH and alkalinity of the juice is fairly good, low correlation values have been found in certain years. The ratio of (K+Na):noxious N in beet is shown to have a fairly stable effect on thick juice pH and alkalinity and a considerable effect on juice (K+Na)/noxious N. More reliable predictions of thick juice properties are given by multiple correlations, and coefficients are tabulated.

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Experimental data on the technological value of sugar beet in Czechoslovakia. M. DRACHOVSKÁ. *Proc. XIth Session C.I.T.S.*, 1960, 55–66.—Formulae are derived for calculation of white sugar rendement, losses in stored beet and molasses yield[2], and tabulated data are presented showing the statistical treatment of results on beet pol calculation from Brix values, showing comparison between campaign results and results obtained at six test stations, on varietal differences and showing pol and white sugar yields at various sugar contents in the beet. Thirty-five references are given to the literature.

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Evaluation of beet according to the conductimetric ash and noxious nitrogen content. W. KRÜGER. *Proc. XIth Session C.I.T.S.*, 1960, 67–77.—See *I.S.J.*, 1961, **63**, 351.

Raw juice extraction in the laboratory for determination of the technical value of the sugar beet. C. J. ASSELBERGS, P. W. VAN DER POEL, M. L. A. VERHAART and N. H. M. DE VISSER. *Proc. XIth Session C.I.T.S.*, 1960, 78–93.—See *I.S.J.*, 1961, **63**, 154.

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Preliminary study on the technical value of beet according to analyses of sugar beets from 1959 field trials. J. HENRY, R. VANDEWYER, R. PIECK, G. RENS and A. VANDEZANDE. *Proc. XIth Session C.I.T.S.*, 1960, 94–168.—See *I.S.J.*, 1961, **63**, 282.

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Effect of beet non-sugars especially on molasses formation. I. F. SCHNEIDER, A. EMMERICH, E. REINEFELD, E. WALTER and W. KELM. *Proc. XIth Session C.I.T.S.*, 1960, 171–180. **II.** F. SCHNEIDER, E. REINEFELD and F. AMDING. *ibid.*, 181–189. **III.** F. SCHNEIDER, E. REINEFELD and A. EMMERICH. *ibid.*, 190–202.—See *I.S.J.*, 1961, **63**, 317, 351.

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Non-sugars in factory juice with special reference to effective alkalinity. R. J. CAROLAN. *Proc. XIth Session C.I.T.S.*, 1960, 203–223.—See *I.S.J.*, 1960, **62**, 230.

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Methods for the assessment of beet quality. A. CARRUTHERS and J. F. T. OLDFIELD. *Proc. XIth Session C.I.T.S.*, 1960, 224–248.—See *I.S.J.*, 1961, **63**, 72–74, 103–105, 137–139.

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Report on test results on the determination of sugar beet technological value in Yugoslavia. A. VAVRA. *Proc. XIth Session C.I.T.S.*, 1960, 249–250.—In laboratory tests, the amount of milk-of-lime to be added to cold raw juice was found to be given by the formula CaO = 0·11 Bx (g/100 g juice). After liming, the juice was heated to 90°C, gassed with CO_2 at about 85°C to pH 10·8–11·0, the juice was filtered and further CO_2 added at about 95°C to phenolphthalein endpoint. The juice was boiled for about 5 min to precipitate the bicarbonate and the filtered juice then analysed for Brix, sugar content, colour, lime salts content and alkalinity. Results showed that processing of the crowns adds little to the beet sugar yield since the upper portion of the crown yields a thin juice having a purity only slightly above that of molasses and with a lime salts content 7 times as great as in normal thin juice. The lower portion of the crown yields a thin juice containing 4 times the lime salts content of normal juice and a colour 5½ times as great.

[1] WIKLUND: "The Industrial Value of the Sugar Beet", *Socker Handl.*, 1949, **5**, 41–63.
[2] *I.S.J.*, 1961, **63**, 282.

Methods of estimating the technical value of sugar beet. J. DUBOURG, P. DEVILLERS and P. NAFFA. *Proc. XIth Session C.I.T.S.*, 1960, 253–275.—See *I.S.J.*, 1961, **63**, 216.

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Sugar and glutamic acid in beets. J. DUBOURG, R. SAUNIER and P. DEVILLERS. *Proc. XIth Session C.I.T.S.*, 1960, 276–282.—The effect of nitrogen applied as fertilizer on the glutamic acid content of beet, on sugar production and on the Na/K ratio was studied. The results are expressed in the form of graphs which indicate that N in fertilizers reduces beet pol and increases the nitrogen content of the root (and therefore the noxious N % sugar). The part played by the beet leaves increases with increasing N application. Nitrogen has no apparent effect on the mineral content of beet.

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Problems of sugar beet analysis. V. PREY. *Proc. XIth Session C.I.T.S.*, 1960, 283–290.—See *I.S.J.*, 1961, **63**, 90.

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Non-nitrogenous organic acids of sugar cane. I. A chromatographic analysis of non-nitrogenous organic acids present in raw juice, clarified juice and molasses. S. BOSE and A. S. DATTA. *Sharkara*, 1962, **5**, 46–53. The acids concerned were isolated as their sodium salts by use of ion exchange resins and subjected to partition chromatography on a silicic acid column[1]. The acids, eluted with mixtures of chloroform and *n*-butanol in 10-ml fractions, were identified by comparison of peak effluent volumes with those found when standardizing the column with mixtures of known acids. In raw juice all the acids reported by ROBERTS and MARTIN[2] were identified and also two further acids which were identified as maleic and tartaric acids. All were retained in clarified juice and molasses, both of these containing, in addition, lactic and malonic acids. The mesaconic, fumaric, succinic and aconitic acid contents decreased during juice processing while lactic, malonic and glycollic acid increased. Behaviour of the other acids was irregular.

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Kinetics of sucrose crystallization in a flowing liquid stream. S. MOCHIZUKI. *Proc. Res. Soc. Japan Sugar Refineries' Tech.*, 1962, **11**, 1–11.—In a study of the effect of flow conditions on the velocity of sucrose crystallization, the solution rates of single sucrose crystals were measured under conditions of natural convection and flow at 20–50°C at Reynold's number of 0–20 and liquor concentrations of 50°Bx and 75°Bx. The Sherwood number was compared with that of sucrose crystallization under the same conditions. The results show that the effects of diffusion are not considerable under ordinary conditions and the overall kinetic constant of crystallization under flow conditions may be generally expressed by a formula which is presented. The activation energy of the pure crystallization process is 7·9 kcal/mole at 20–60°C.

An expression for size and size distribution of sugar crystals. S. MOCHIZUKI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1962, **11**, 12–14.—A nomogram is presented for the rapid calculation of M. A. (Mean Aperture) and C.V. (Coefficient of Variation) of sugar crystals from cumulative proportions of a sample through standard sieves.

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A simple method for the determination of invert ratio of a viscous solution. S. MOCHIZUKI. *Proc. Res. Soc. Japan Sugar Refineries' Tech.*, 1962, **11**, 15–19.—A formula has been developed for calculating the invert ratio J and takes the form: $J = 75{\cdot}2 - 22{\cdot}5\ R/\text{Bx}.\ d + 0{\cdot}27\ (t - 20)$, where R = polarimeter reading, d = a constant and t = temperature of the solution. A nomogram based on this is presented. The method used for invert ratio determinations is claimed to be more accurate and simpler than the conventional titration procedure.

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On the quantitative determination of raffinose by the chromatographic elution method. K. KATO, S. MATSUI and S. SAWAE. *Proc. Res. Soc. Japan Sugar Refineries Tech.*, 1962, **11**, 20–27.—A method is described using paper chromatographic separation with *n*-propanol: ethyl acetate:water (7:1:2 v/v/v) as developing agent followed by cutting out of the raffinose spot, eluting and colorimetric determination with 0·2% anthrone in conc. H_2SO_4. It has been found that soluble carbohydrate extracted from the filter paper during elution reacts considerably with the anthrone, causing an error; to eliminate this the paper is pre-washed in water for 10–24 hr after spotting of the 0·05 ml samples and drying, but before development. The eluate must be reacted with anthrone reagent within 3 hr to avoid inconsistent results. The error is ±5% for solutions containing more than 4% raffinose on sucrose. Inositol was found not to interfere with the determination.

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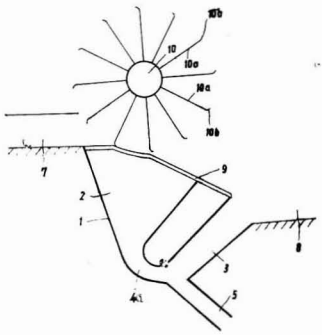
Determination of sucrose, invert sugar and raffinose in sugar solutions. S. OIKAWA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1962, **11**, 28–37.—Tests conducted on beet juices and molasses solutions have shown that determination of the invert sugar by Ofner's method and of the raffinose and sucrose by double polarization is the best method of controlling factory processes. Determination of sucrose and invert sugar by Ofner's method without pol correction and of the raffinose by paper chromatography[3] is advocated for determining the pol correction to be applied for a corresponding invert component, although it takes longer than the double polarization method, but is more accurate with small raffinose contents.

[1] MARVEL & RANDS: *J. Amer. Chem. Soc.*, 1950, **72**, 2642.
[2] *Anal. Chem.*, 1954, **26**, 815.
[3] ALBON & GROSS: *I.S.J.*, 1953, **55**, 52.

PATENTS

UNITED KINGDOM

Separating impurities from water-carried beet. ELFA-APPARATE-VERTRIEBS G.M.B.H., of Muelheim/Ruhr, Germany. **917,330.** 7th April 1960; 6th February 1963.—Beet passing along duct 7 in a flow of water meets the trap 1 which consists of two compartments 2, 3, the latter discharging at a lower level 8 and interconnected by passage 4. A discharge outlet 5 leaves the bottom of the trap. The beet is moved by means of wheel 10 having dividing walls 10a



fitted with hooks 10b for catching tops, leaves, etc., and passes over grating 9 through which fall rocks, sand and other heavy impurities as well as the flume water. The beets re-enter the overflow water at level 8. The grating and wheel may be replaced by sets of intermeshing discs mounted on shafts below the level of duct 7 or by an endless chain conveyor system.

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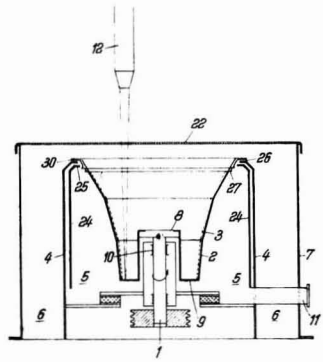
Continuous centrifugal. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT A.G., of Brunswick, Germany. **917,393.** 13th March 1959; 6th February 1963.—The continuous centrifugal is provided with a central shaft 1 carrying a basket 2 having a number of steps of varying incidence to the axis of rotation but such that the greatest centrifugal force will apply where the frictional resistance is also highest owing to the elimination of the molasses which would act as a lubricant. Massecuite is supplied through nozzle 12 and is separated into crystals, which rise to the top of the screen 3 and overflow into chamber 6, and molasses which passes through and collects in chamber 5 from which it is withdrawn through duct 11. At the top of the basket 2 is a hoop 27 carrying a runnel such that molasses is flung off at this point, impinging on inner wall 24. The slight amount which rises to the top 25 of this wall drains into chamber 5 through the passage between walls 24 and 24a, thus not contaminating the separated sugar. The nozzle 12 may be provided with a number of jets of different sizes, mounted on a housing so that the one required to adjust the flow rate to a desired value may be slid into position. A flexible slotted ring may be mounted on the housing of the machine so as to make only a narrow gap for overflow of sugar. A small flat, horizontal circular platform, mounted on a vertical shaft, may be fixed in the bottom plate 8 of the basket, with a smaller central hole into which water is delivered through a second nozzle; this produced a uniform water spray on the basket surface.



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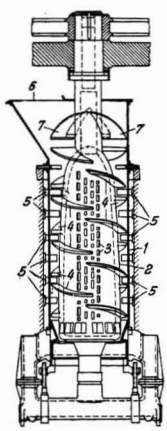
Beet pulp presses. WEIGELWERK A.G., of Essen, Germany. **917,777.** 1st September 1961; 6th February 1963.—The press consists of a rotary spindle 2 of paraboloid shape, the apex being in the region of the opening 6. The body has sieve apertures 3 and helical screw vanes 4 with interruptions corresponding to baffles 5. The vane 7 in opening 6 is of such



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).

a helical pitch as to distribute and press pulp entering. The vanes are faced with perforated covers spaced away from the solid central part of the vane so as to provide ducts for expressed water into the inside of the spindle body. The baffles 5 may also be of sieve construction to provide a further outlet for expressed water.

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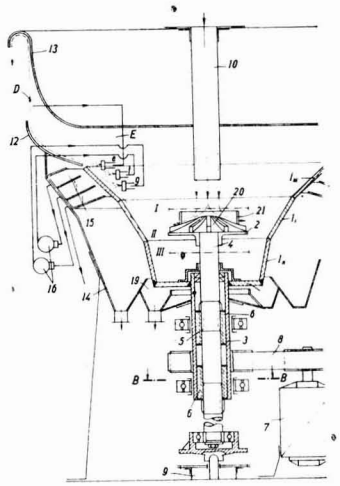
Continuous centrifuges. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT A.G., of Brunswick, Germany. **918,386.** 22nd May 1959; 13th February 1963.—Massecuite is fed to the centrifugal through pipe 10 and impinges on the rotating distributor disc 2. This is provided with ridges and grooves 20 and a cylindrical jacket 21, and is mounted on shaft 4. This, under hydraulic action from the motor, can move up or down relative to the basket 1 by virtue of the splined sections 5 engaging with internally grooved shells 6 inside shaft 3. This shaft carries the basket 1 which is bell shaped, either continuously or in sections as



shown, so that movement of the distributor plate 2, e.g. to positions I, II or III, ensures that the massecuite is directed to the portion of the basket having a slope appropriate to the nature of the massecuite. Molasses passes through the screen on the basket and is collected in chamber 14 while the sugar overflows at the top of the basket where it strikes collector rings 12, 13 tangentially, losing much of its energy in this way and reducing crystal damage. Massecuite entering the basket below the level of the plate 2 passes through large perforations to the outlet chamber 19 from which it returns to the supply mixer. The sugar may be washed in a number of stages (3 as shown), a pure saturated syrup being sprayed at *e*, and the wash collected through the top of the runnels 15 from which it is sent by pump 16 to spray *f*, and again circulated to spray *g*.

UNITED STATES

Thermosetting material. J. S. WOODHEAD and J. E. WORTHINGTON, of Tonbridge, Kent. **3,046,146.** 8th June 1959; 24th July 1962.—A composition is composed of a carbohydrate (mono-, di-, hydrolysed polysaccharides or their substituted compounds, substituted polyhydroxyalcohols of at least 3 C atoms, e.g. cane molasses), a tanning extract (e.g. sulphited quebracho extract) to the extent of not more than 25% on carbohydrate, and a compound containing a trivalent N atom (hexamethylene tetramine, anhydro-formaldehyde aniline, α- or β-naphthylamine, thiocarbanilamide, *p*-aminophenol, *p*-phenylene diamine, pyridine, urea, thiourea, *iso*amylamine, hydroxylamine, ammonia, aniline, and/or melamine) to the extent of not more than 15% on carbohydrate. In addition, the composition may contain up to 20% of a tackiness reducing agent (talc, Ca or Zn stearate, clays, or ZnO), up to 10% of a strengthening agent (a phenol-formaldehyde condensate, a urea-formaldehyde condensate, silicone resin or melamine aldehyde condensate), up to 10% of an agent to increase resilience and resistance to thermal shock (a natural or synthetic thermoplastic material), up to 15% of an acidic hardening agent (sulphuric, phosphoric, chromic, hydrochloric, hydrobromic, hydriodic, lactic, acetic, formic, citric, oxalic, gallic, phthalic or salicylic acid or anhydride), and up to 15% of a cross-linking agent. The composition is coated on a granular refractory material (e.g. quartz sand) (at least 10 parts per part of carbohydrate).

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Water insoluble cyanoethyl sucrose ethers (as plasticizers). G. P. TOUEY and H. E. DAVIS, of Kingsport, Tenn., U.S.A., *assrs.* EASTMAN KODAK CO. **3,068,220.** 13th April 1959; 11th December 1962.—The ethers, containing 5–7·8 cyanoethyl groups per sucrose mole (heptacyanoethyl sucrose) are prepared, e.g. by warming sucrose in 10% KOH solution (350 g/mole) to 40°C and adding 8·4 moles/mole of acrylonitrile during 1 hr with occasional ice-water cooling to maintain at 40 ± 3°C. After addition the mixture is cooled to 20°C, and 1:2 dichloroethane (1000 ml/mole added. The water layer is withdrawn and washed with more dichloroethane (2 × 75 ml/mole). These latter are combined and washed with water containing a little acetic acid. The solvent layer is dried over Na_2SO_4, filtered, and the solvent removed by vacuum distillation to give a viscous water-white liquid, suitable for use as a plasticizer for cellulose ester film.

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Beet harvester lifting wheel adjustment. J. W. MCCOLLUM, of Boise, Idaho, U.S.A., *assr.* DEERE & CO. **3,070,175.** 4th August 1960; 25th December 1962.

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Cane planter. E. M. MOVILLA and G. T. BOCOBO, of Manila, Philippines. **3,073,265.** 14th January 1960; 15th January 1963.

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.

Type BN-b sugar wrapping machine. SAPAL Société Anonyme des Plieuses Automatiques Lausanne, Avenue Dapples 54, Lausanne, Switzerland.

This machine is an adjustable high-speed automatic wrapping machine with automatic feeder for lumps of sugar. It is claimed to be the most economical for the wrapping of sugar lumps because of its high-rate of production, regularity and easy accessibility, despite having an entirely closed casing for perfect protection.

Several important advances have been made with the automatic feeder for this machine which now provides a maximum economy of labour.

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"Magic eye" bag stitcher. Thames Packaging Equipment Co., 28 City Rd., London E.C.1.

Electronically operated, completely automatic closure of any type of container, ranging from nine-ply thickness of bag to tissue paper, is now available from the Thames Packaging Equipment Company.

This new stitcher unit, requiring virtually no operator, incorporates an electronic cell which has eliminated the need for constant adjustment of the stitching head.

A continuous flow of sacks, moving along a high-speed single or three-phase motorized conveyor system (available in 6 to 9 ft wooden slatted lengths) at a rate of 30 ft per minute, pass individually into a V-shaped channel attachment. In the channel the neck of the sack moves through the ray of an electronic cell, an action that instantaneously operates the stitching head. As the bag leaves the stitching head, an automatic knife cuts the thread, perfect closure of bags being maintained at a rate of 10 to 15 a minute.

No operating skill is required—as the machine does not require an operator. The stitching head, working to very close tolerances, closes every type of sack—jute, canvas or multi-wall paper—without assistance, ensuring perfect sealing effectiveness.

Other features of the T.P.E. electronic bag stitcher are that (1) the head is fitted with an automatic brake to prevent any over-runs or cotton wastage, (2) an automatic counter keeps a tally of output and (3) a "king-size" spool of twine enables approximately 22,000 one hundredweight sacks to be closed before the spool needs changing.

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Saunders diaphragm valve type R. Saunders Valve Co. Ltd., Cwmbran, Monmouthshire.

The Saunders type R diaphragm valve is a new valve designed to withstand working pressures higher than those normally recommended for the standard type A. The construction is of cast steel, flanged to A.S.A. B16-5/1957—Class 300 or equivalent European flange tables. Overall lengths are to DIN 3300.

The bonnet assembly is sealed and has a rising spindle with position indicator and limit stop and ball thrust. Padlocking facilities can be provided. At the moment the type R valve is fitted either with diaphragm grade "C" or "237" for the control of aqueous services and oils or acids and alkalis respectively. Bodies can be "Penton"-lined. Maximum working pressure is 400 p.s.i. and maximum working temperature 100°C.

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PUBLICATIONS RECEIVED

VIBRATING FEEDERS AND CONVEYORS. Triton Engineering Co. (Sales) Ltd., Kingsnorth Industrial Estate, Wotton Rd., Ashford, Kent.

A new leaflet illustrates the variety of types, shapes and sizes of electromagnetically operated bulk material feeding equipment of Triton manufacture. Troughed and tubular feeders and conveyors are included, totally-enclosed equipment being available as well as a vibrating feeder which incorporates a double-deck vibrating screen.

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THE MODERN PRE-COAT "METAFILTER". The Metafiltration Co. Ltd., Belgrave Rd., Hounslow, Middx.

Brochure M1 features a general and detailed description of the working of the patented Metafiltration system and indicates its variety of uses in a number of industries for filtering a range of materials including sugar syrups. The filter medium is in the form of rigid "ring packs" made up assembling a series of rings along a fluted rod. The rings are flat on one side and scalloped on the other so that when assembled scalloped side to flat side they provide passages for filtrate. The "ring pack" is pre-coated with filter-aid and the suspension introduced into the "Metafilter" tank; impurities are collected on the surface of the pre-coat while the filtrate passes into the rod flutes and so to the collector head. A wide range of filter-aids has been developed by Metafiltration, while free laboratory testing facilities and the use of a pilot-scale filter are also available.

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CONTINUOUS MAIN DEFECATOR. CEKOP, P.O. Box 112, Warsaw, Poland.

The apparatus comprises two vertical tanks into the first of which a mixture of raw beet juice and lime, the inlet pipe discharging at the bottom of the tank. The outlet pipe from the first tank feeds into an inlet pipe in the second tank; this again discharges near the bottom, while the second tank outlet is at the top. Central shafts in the tanks carry rotors and are mounted in bearings at the top and bottom. They are driven through flexible clutches by electric motors, and ensure thorough mixing of lime and juice before discharge. They permit continuous operation without supervision, eliminate frothing and are available in a range of sizes. Good insulation reduces heat losses.

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Western States centrifugals for new Holly sugar plant.—The contract for centrifugalling equipment at the new $18 million beet sugar factory to be erected near Hereford, Texas, has been awarded to The Western States Machine Company of Hamilton, Ohio. The contract specifies five electric drive machines for white sugar and twelve fluid drive machines for low raw sugar. The centrifugals will be of the automatic batch type in which all functions from loading to ploughing are automatic, the cycles being repeated automatically without the aid of an operator. The centrifugals will handle massecuites produced from 4000 tons of beet a day, a slicing rate which can be increased to 6000 tons per day. The new plant is expected to be in operation by September 1964 with an annual production of 60,000 tons of sugar, an increase to 100,000 tons being planned within a few years.

WORLD NET IMPORT REQUIREMENTS 1963

The following estimate was made by the International Sugar Council at its Fourteenth Session on 3rd April 1963.

(Metric tons, raw value)

A. Free Market

Country or Area	
EUROPE	
Albania	5,000
Austria	30,000
Cyprus	16,300
Finland	148,000
Germany (West)	150,000
Gibraltar	3,000
Greece	75,000
Iceland	10,300
Ireland	6,000
Italy	150,000
Malta	14,000
Netherlands (incl. territories)	200,000
Norway	150,000
Portugal (incl. territories)	15,000
Spain (incl. territories)	55,000
Sweden	75,000
Switzerland	230,000
U.S.S.R.	2,000,000
United Kingdom	2,075,000
Yugoslavia	70,000
Total	5,477,600
NORTH AMERICA	
Canada	700,000
Total	700,000
CENTRAL AMERICA	
Bahamas and Bermuda	5,000
Honduras	2,000
Panama Canal Zone	5,000
Virgin Islands (U.K.)	400
Total	12,400
SOUTH AMERICA	
Bolivia	10,000
Chile	200,000
Uruguay	50,000
Total	260,000
ASIA	
Afghanistan	40,000
Arabian Peninsula:	
Aden, Colony & Protectorate	26,000
Saudi Arabia & neighbouring Red Sea & Persian Gulf Territories	90,000
British Borneo:	
Brunei	4,000
North Borneo	10,000
Sarawak	13,000
Burma	25,000
Cambodia	11,900
Ceylon	204,000
China (Mainland)	1,100,000
Hong Kong	73,000
Iran	350,000
Iraq	257,000
Israel	50,000
Japan	1,300,000
Jordan	49,000
Korea (North)	50,000
Korea (South)	75,000
Laos	2,700
Lebanon	35,000
Malaya, Federation of	232,000
Mongolia	19,600
Nepal	4,500
Pakistan	125,000
Singapore	73,000
Syria	75,000
Vietnam (North)	20,000
Vietnam (South)	55,000
Total	4,369,700
AFRICA	
Gambia	4000
Ghana	77,000
Kenya	30,000
Liberia	2,000
Libya	25,000
Morocco	400,000
Nigeria	75,000
Sierra Leone	15,000
Somalia	15,000
Sudan	110,000
Tanganyika	20,000
Tunisia	80,000
Uganda	500
U.A.R. (Egypt)	130,000
Zanzibar & Pemba	6,500
Total	990,000
OCEANIA	
New Zealand	125,000
U.K. Admin. Oceania	2,500
U.S. Admin. Oceania	4,000
Western Samoa	2,800
Total	134,300
Total Free Market	11,944,000

B. U.S. market

U.S.A. net import requirements from foreign countries	3,810,000

C. Grand Total	15,754,000
Grand Total Rounded	15,750,000

Brevities

"Die Zuckererzeugung."—With the issue of June 1963, this East German sugar journal is to cease publication. Articles concerning sugar will then be published in "Die Lebensmittel-Industrie", another journal published by VEB Fachbuchverlag, Leipzig.

* * *

Philippines Central taken over by the Government[1].—Under a Presidential Proclamation the Philippines Government has seized the Talisay-Silay Milling Company in Negros Occidental. It is alleged that the Company was unable to arrive at a milling agreement with the majority of its planters and had refused to mill the planters' cane. The owners claim that the Central had not refused to mill but was stopped by a workers' strike. In addition an offer had been made to mill the remaining cane in two other Centrals. The owners also state that the Talisay-Silay Central had already exceeded the sugar quota given it by the County's sugar authority.

[1] *Public Ledger*, 4th May, 1963.

BREVITIES

U.K. beet area.—According to the March 1963 Agricultural returns for England and Wales, published by the Ministry of Agriculture, Fisheries and Food, the area estimated to be under sugar beet in June 1963 is 406,000 acres as opposed to 408,000 acres in June 1962.

* * *

Japanese factory for Algeria[1].—The Algerian Minister for Industry has announced that Japan is to supply equipment for the erection of a sugar factory in Algeria. Training is also to be provided for Algerian personnel for the factory.

* * *

Moroccan sugar expansion[2].—In addition to the first sugar refinery which has been built by Polish firms in the Tharb area, and which will start production in May 1963, a second refinery is planned by the Moroccan government in the Tadla area.

* * *

Antigua Sugar Factory Ltd., 1962 report.—Crop started on the 1st March and finished on the 2nd August, and 194,583 tons of cane were crushed with a total output of 19,119 tons of commercial sugar. The whole of the Company's export sugar, amounting to 17,504 tons, was sold to the U.K. Sugar Board at the negotiated price of £45 15s 3d per ton, c.i.f. London, including £2 15s per ton payable as Special Funds. As this quantity was again less than the negotiated price quota the Company had no free sugar to dispose of on the open market. The payment for Contractors' cane totalled 45s 0·567d per ton, while outside suppliers were paid 44s 6d per ton. Crushing of the 1963 crop started on the 3rd December and it is hoped that sugar production will be approximately 30,000 tons.

Stock Exchange Quotations

	CLOSING MIDDLE
London Stocks (*at 17th May* 1963)	
Anglo-Ceylon (5s)	16/7½
Antigua Sugar Factory (£1)	8/–
Booker Bros. (10s)	20/10½
British Sugar Corp. Ltd. (£1)	24/3
Caroni Ord. (2s)	4/9
Caroni 6% Cum. Pref. (£1)	14/6
Distillers Co. Ltd. (10s units)	32/4½
Gledhow Chaka's Kraal (R1)	17/–
Hulett & Sons (R1)	43/–
Jamaica Sugar Estates Ltd. (5s units)	4/6
Leach's Argentine (10s units)	15/4½
Manbré & Garton Ltd. (10s)	51/6
Reynolds Bros. (R1)	19/3
St. Kitts (London) Ltd. (£1)	10/9
Sena Sugar Estates Ltd. (10s)	9/–
Tate & Lyle Ltd. (£1)	51/7½
Trinidad Sugar (5s stock units)	3/6
United Molasses (10s stock units)	35/–
West Indies Sugar Co. Ltd. (£1)	18/9

	CLOSING MIDDLE
New York Stocks (*at 16th May* 1963)	$
American Crystal ($10)	55
*Amer. Sugar Ref. Co. ($12.50)	25⅞
Central Aguirre ($5)	29¼
North American Ind. ($10)	18½
Great Western Sugar Co.	45½
South P.R. Sugar Co.	47⅜
United Fruit Co.	27

* 1 for 1 share issue

Burma sugar factories tender[3].—The Government of Burma has invited tenders for two sugar factories, each with a crushing capacity of 1500 long tons of cane per day. Deadline for bids was the 31st January 1963.

* * *

Beet sugar production in Japan[4].—Total production of beet sugar in the 1962/63 crop in Hokkaido and Aomori, Northern Japan, was 153,621 metric tons from 1,120,773 tons of sugar beets harvested from 47,632 hectares.

* * *

British Honduras cane price stabilized[5].—After nearly a year of negotiations and discussions the price of sugar cane delivered in British Honduras during 1962 has been set at B.H.$11·12 per ton subject to minor adjustments. This was the decision of the panel of five arbitrators appointed by the Sugar Board. The grinding of the 1963 sugar crop began on the 21st January. It is considered unlikely that sufficient cane will be available to fill the total Commonwealth quota of 25,000 tons.

* * *

Sugar industry for Nyasaland?—It is reported[6] that a Commission which recently held an inquiry into the sugar industry suggested that import control of sugar entering Nyasaland might help to attract private investment or other finance to drain and irrigate 100,000 acres of Elephant Marsh with a view to establishing a sugar industry there. Until 1959 Nyasaland drew its supplies of sugar from Mozambique but growing demand from Portugal brought supply from this source to an end. Since then the country's sugar has come mainly from South Africa and Rhodesia. The Commission said that sugar cane grows easily in Nyasaland.

* * *

Bagasse paper in India[7].—Mandhya National Paper Mills Ltd., the first integrated pulp and paper mill in India designed to operate almost wholly on bagasse as its raw material has started commercial production in Bangalore, Mysore State, with an output of 35 metric tons per day. The entire plant was designed, constructed and placed in operation by the Parsons & Whittemore Organization to produce high quality writing and printing papers. Parsons & Whittemore is responsible for the continuing operation of the mill jointly with an Indian management group, while it trains Indian technicians and managers to assume eventual supervision. The total capital requirements of the project were about $10,000,000.

* * *

Record Mexican crop in prospect[8].—According to the National Union of Sugar Producers, the Mexican sugar crop for 1962/63 will reach a record total of 1,650,000 metric tons. Unofficial estimates from the mills are even higher—up to 1,673,548 tons. Peak production is attributed to the "incentive policy" of premium prices to cane growers, and mills have also been cajoled into starting up earlier than usual. Thus instead of the usual end-November start, San Cristóbal mill in Veracruz and El Mante in Tamaulipas began operations at the end of October. Production will permit satisfaction of domestic needs and compliance with export commitments, while a reserve stock is to be built up against unforeseen future contingencies. With progressively increasing yields and acreages in Veracruz, Michoacan and Jalisco production at the lower estimate is 200,000 tons over the 1961/62 outturn, in spite of slight drops in the cane area of Morelos and Colima and elimination of cane growing in Guerro where the only mill, San Martín, has closed. Steady expansion is forecast for the industry, with production probably reaching 2,000,000 metric tons within the next two seasons, i.e. in the 1964/65 crop.

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[1] *Zeitsch. Zuckerind.*, 1963, **88**, 100.
[2] F. O. Licht, *International Sugar Rpt.*, 1963, **95**, (Supp. 3), 42.
[3] *Willett & Gray*, 1962, **86**, 536.
[4] *Willett & Gray*, 1963, **87**, 119.
[5] *Overseas Review* (Barclays, D.C.O.) February 1963, p. 82.
[6] *Overseas Review* (Barclays D.C.O.), February 1963, p. 34.
[7] *Sugar J.* (La.), 1963, **25**, (8), 33.
[8] *Sugar y Azúcar*, 1963, **58**, (2), 27–28.