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NOTES AND COMMENTS

Our Agricultural Editor

In this issue appears the last of the articles signed with the familiar initials H.M.-L. which have appeared in *The International Sugar Journal* during the past thirty years. DR. HUGH MARTIN-LEAKE, our Agricultural Editor during these years, has decided that the time has come to retire. His articles have been a valuable part of the Journal, often challenging and controversial, and have resulted in wide correspondence with sugar agriculturalists all over the world.

With us, our readers owe a debt of gratitude to Dr. MARTIN-LEAKE which we readily acknowledge; and we are sure that they will join us in wishing him many years of deserved ease.

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Supply and demand in 1963 and the future.

Ever since the world crisis in October 1962 drew the attention of the sugar trade to the impending shortage there has been a much closer preoccupation with the supply and demand situation. Assessments of the 1963 statistical situation made by various authorities at the beginning of this year showed an apparent world shortage in the region of one million tons; C. Czarnikow Ltd.[1] have recently examined how the position has developed so far.

"A statistical shortage presupposes that certain sections of the world's population must make do with smaller quantities than they would otherwise like to consume and in some degree this situation has actually developed. High prices, reflecting the anxiety of buyers not to be left behind in the scramble for supplies, leading at one time to panic buying which ended only when the world price of sugar exceeded £100 per ton c.i.f. U.K., necessarily led to consumption being curtailed in several countries where per capita incomes are low. Indeed, it has even been reported that in some parts of the world sugar has actually disappeared from the diet altogether.

"That offtake of sugar should be reduced in this way, especially in view of its value as a form of rapid and still relatively cheap energy, is most regrettable. Nevertheless, it has not been the reduction in consumption but rather the expansion in supplies which has been mainly responsible for ensuring that no major buyers have found themselves unable to cover their requirements. It had been well known that a fair tonnage of sugar might become available from the second hand, and this had generally been taken into consideration in assessing the supply and demand situation. The actual tonnage which has come forward, however, has been far in excess of earlier expectations and there is now some agreement that although the level of stocks has fallen considerably there is no longer need to fear a physical shortage during the balance of the year.

"It does not follow, however, that the surplus conditions which existed for so long are on the point of returning. It is far too early for any very accurate assessment of the statistical position for 1964 to be made, but from information presently available it seems probable that overall supplies and demand will amount to approximately the same figure, and a crop failure in any of the major producing regions would bring about an immediate shortage. A fundamental difference will exist next year, however, from the position as it was at the beginning of 1963, for whereas this year stocks from both first and second hands have been able to emerge and overcome the deficit, they will by then have dwindled by such an extent that it is hardly likely that they will be able to play any significant rôle.

"In these circumstances it is understandable that the market should be particularly interested in any news of crop developments, and in view of recent rumours of difficulties which have been encountered by certain of the Latin American producers it can be expected that special attention will be paid to that area of the world."

[1] *Sugar Review*, 1963, (620), 131.

European Beet area[1]

The second estimate of beet area in Europe was published by F. O. Licht K.G. recently[2], and is reprinted elsewhere in this issue, together with the corresponding figures of the first estimate in April[2]. As will be seen, a slightly higher area is forecast for Western Europe (1,788,000 ha *vs.* 1,767,000 ha), while a considerable drop in that for Eastern Europe is indicated (4,533,000 ha from 4,762,000 ha). Most of the latter drop of 231,000 is found in the U.S.S.R., where the area is thought now to be 150,000 ha lower than in April. This drop had been anticipated since a number of harmful climatic and other factors had been reported.

In April an increase of 3·8% was forecast in the overall European area; the latest figures correspond to an increase of only 0·5%, i.e. practically the same as in 1962.

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Indian steps to increase production[3].

The rising trend of consumption in India has recently given rise to doubts about that country's future position in the export market. It has been pointed out that consumption has recently been expanding rapidly and is now in the region of 2·6 million tons, or rather more than the latest production estimate for 1962/63. The importance of the export market to India has been mentioned on many occasions and steps have now been announced which, it is hoped, will provide growers with an incentive to increase the availability of cane for the sugar factories.

It was only in November last, at the beginning of the current campaign, that a new scheme was introduced whereby growers would in future receive payment based upon the sugar content of the cane, and at that time the minimum price was fixed at 1·62 rupees per maund, equivalent to 66s 2d per ton, based upon a sugar content of 9·8%. What amounts to an upward adjustment in the price range has now been announced with the basic return of 66s 2d per ton applying in future to cane having a sugar content of 9·4%. The Food and Agriculture Minister is reported to have stated that, if this measure does not in itself provide sufficient inducement to divert cane from the manufacture of gur to the production of sugar, further steps will be taken.

Planting for the next campaign has been completed in most states and weather conditions are favourable at present. According to a recent official announcement production in 1963/64 is expected to be in the region of 3·3 million metric tons.

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Record Queensland sugar crop prospect.

Queensland's sugar cane crop this year is expected to be the second largest in the State's history. In June the 31 mills commenced the crushing of an estimated 12,083,000 tons of cane which it is expected will produce 1,760,000 tons of sugar. It has also been announced that the Colonial Sugar Refining Co. Ltd., on behalf of the Queensland Sugar Board, has completed negotiations with Japanese importers for the sale to Japan of between 350,000 and 450,000 tons of sugar a year for the next three seasons. The actual quantity to be shipped will be fixed each year within these limits. This is in addition to the 330,000 tons sold previously to Japan for delivery from this season's crop. The Agreement provides for an extension of the contract beyond 1966/67. The proposed annual tonnage represents about one-third of the total yearly volume of Japan's sugar imports. The new Agreement is the result of intensive market planning and development over a long period of years. It will provide the Australian sugar industry with an assured volume of exports in an important and expanding market. With increased sales to world markets it is expected the sugar industry will contribute to Australia's export earnings in the year ended 30th June 1963 a sum of not less than £50 million.

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Record U.S. sugar crop forecast[4].

The U.S. Dept. of Agriculture in its crop report estimated sugar beet production prospects in the country, as of 1st July, to be 19% up on the 1962 record crop, resulting from larger acreage and higher yields. This would be the third successive record production. Production of sugar cane for sugar and seed, at the same date but excluding Hawaii, was forecast at 13,311,000 tons, compared with the 1962 production of 10,097,000 tons.

The output of sugar beets was calculated at 21,672,000 tons compared with the 1962 production of 18,240,000 tons. Yield per acre on 1st July was 17·5 tons compared with 16·5 tons last year. The indicated production this year would be 32% higher than the 1957/61 average of 16,359,000 tons.

Sugar beet growers planted 1,286,000 acres of beets for sugar—9% higher than last year and 31% higher than average. The estimated 1,235,000 acres to be harvested was 12% higher than the acreage harvested last year. The indicated abandonment of 4·0% was well below the 6·4% last year.

The Department's report said that the yield of 17·5 tons per acre was about average but 1·3 tons below the record of 1959. Yields in Colorado and California were almost a ton below average while yields in other States were near or above average.

Production of sugar cane in the United States, including Hawaii, was estimated at 23,157,000 tons compared with 20,092,000 tons in 1962, of which 13,311,000 tons were credited to Louisiana and Florida (against 10,097,000 tons in 1962) and 9,846,000 tons to Hawaii (against 9,995,000 tons). The indicated yield per acre for Florida and Louisiana was 27·9 tons compared with 25·2 tons last year.

[1] *International Sugar Rpt.*, 1963, **95**, (5), 59–60.
[2] *I.S.J.*, 1963, **65**, 161.
[3] C. Czarnikow Ltd., *Sugar Review*, 1963, (613), 103.
[4] *Public Ledger*, 13th July 1963.

PIGS AND SUGAR CANE . . .

A combination of proved profit on a sugar farm in Natal, South Africa

By R. F. OSBORN, H.D.A.

TWENTY-THREE years ago a South African sugar cane planter, Mr. W. T. ROBBINS, of the farm "Upton" in Natal's canebelt on the north coast, stepped energetically into what he called the pig and cane business—or his own application of his new concept of an old idea in sound farming. His experience over so long a time shows conclusively that the combination of pigs with cane means higher returns in the latter, which more than offset lower returns in the former where vulnerable to market fluctuations. From his pig sties, Mr. ROBBINS has built up his cane yields on his light soils from an average of 27 tons an acre to 45 tons an acre.

Preservation of soil structure and fertility by scientific know-how, for as long as we can remember, has been preached persistently in every country throughout the world where agriculture offers a basic contribution to at least the local economy. Every farmer worthy of the name today takes care to return to his soils more than his crops remove from them: but how many still take all they can get, and put less back?

Mr. ROBBINS had been farming sugar cane for just over 30 years when he came to the conclusion that his light soils should be capable of better returns. All he had read and observed of soil fertility, and the conditions necessary to produce and maintain it, began to crystallize in his approach to the problem.

Included in "Upton" are 275 acres of light soils falling in the category of "Recent Sands" on the government soil map, and which enjoy an annual rainfall of 42 inches. Precipitation occurs in the summer months, with soft spring rains changing towards the autumn to short and sometimes violent storms. The remaining 300 acres on "Upton" consist of heavier soils capable of carrying N:Co 310.

In depth, the lighter soils are all that can be desired, but twenty years ago their light, sandy nature, low in humus and consequent indifferent water-retention qualities, with concomitant high rate of evaporation, and a distinct tendency to pack under pressures of heavy rainfall, made Mr. ROBBIN's cane farming little more than guess-work outside of his natural, experienced, and efficient care in ploughing, planting, fertilizing, cultivating, fallowing, green manuring, and following a meticulous programme of crop rotation.

Mr. ROBBINS now took to heart the meaning of the text books when they spoke of soil fertility, and the fact that fertility depends only partly upon the amount of basic plant food available to the crop. It also leans heavily on the power of the soil to make use of such foods, and upon other properties inducing fertility, particularly the power of changing the condition of plant food for ready assimilation. He saw clearly that he would have to strengthen the humus content of these light soils, but was faced immediately with the problem of an economic supply of organic matter, to say nothing of the regularity of this supply in the large quantitities required to do the job properly.

There was no room on "Upton" to run sufficient cattle to be kraaled for their compost, the distance from urban centres was too great for low-cost delivery of municipal compost or sewage sludge and where, again, the regularity of supply would be in question. So Mr. ROBBINS decided to invest in pigs and adequate sties for them, and apply compostable proceeds from their soiled bedding to his lighter soils. He started this new development in 1939. Within nine years his sties housed a thousand pigs in continuous production of what regularly became the first-class humus in his soils. Up to the present time Mr. ROBBINS estimates that 12,000 tons of pig manure have been applied to the "Upton" cane fields needing it.

Throughout this long experience in building up his light soils, Mr. ROBBINS has proved much through trial and error, and is satisfied today that his method as now practised gives the maximum return with the least waste.

In the beginning, Mr. ROBBINS composted carefully, following accepted practice in breaking down his heaps to the ultimate in curing; gradually, however, through observation of his cane crops, he shortened

the curing time, until he arrived at the conclusion that a break-down of 50% seemed to give the best results. Further study, nudged along by inescapable instances in running a farm of the necessity of modifying a plan to meet sudden changes of conditions in weather, markets and even labour, revealed that application of the pig-litter as it was taken from the sties direct to the lands, and promptly broadcast and ploughed in, secured the best results of all.

This immediate use of raw material without curing it in a compost heap is not easy to accomplish on a cane farm as it is applied to the land only at the time of replanting and where each stand occupies the same ground for anything from six to eight years. So it is inevitable that the compost heap comes in for its share of attention. This heap (or heaps) consists of the litter and the wash-water used and cleared daily from the sties, the bedding consisting of cane trash from the fields. As "Upton" is given entirely to cane, there is no other compostable material available.

In whatever condition it may be, the valuable material from the pig sties is broadcast only when replanting at the rate of 14 tons to the acre. The number of pigs has been reduced from 1000 to 500. Mr. ROBBINS finds that this number supplies annually sufficient material to revivify from 50 to 60 acres. He insists that it is the residual effect of the pig manure and litter from his sties applied to the land every six to eight years which is responsible for the steady increase in his cane yields disclosed so graphically in the accompanying table. One 10-acre plot has cut at the rate of 84 tons to the acre . . . a far cry from 27 tons. NPK fertilizers are applied, of course, in mixtures and quantities found over the years to be the most effective under normal procedures.

Year	*Acres reaped*	*Total tons reaped*	*Average yield per acre (tons)*	
1940	250	7980	31·9	
1941	229	5193	22·5	
1942	247	6980	28·3	
1943	226	7228	31·8	Fertilizer rationed and 3 drought years
1944	262	6290	24·5	
1945	221	4830	24·7	
1946	224	4806	22·0	
1947	240	2897	29·02	
1948	220	6805	30·9	
1949	236	6277	26·6	
1950	225	6087	26·7	
1951	239	5479	22·9	
1952	242	6788	28·05	
1953	266	8977	33·7	
1954	237	8517	36·0	
1955	268	10222	38·1	
1956	260	8908	34·2	
1957	247	10071	40·8	
1958	278	11274	40·04	
1959	257	10674	42·0	
1960	199	9143	45·2	
1961	162	10751	65·0	

AGRICULTURAL ABSTRACTS

Some observations on sugar cane chlorosis. M. N. ALAGIANAGALINGAM and M. KANDASWAMY. *Madras Agric. J.*, 1962, **49**, 30–31.—Manganese deficiency caused the development of white and yellow stripes on the leaves and stunting of the plant. Applications of sulphur to the soil to lower the pH (originally 7·5–7·8) and foliar sprays of manganese sulphate, at 0·2% plus lime, alleviated the condition.

* * *

Effect of ratoon stunting disease on the cane variety N:Co 310. Y. J. HSIA and C. S. WANG. *J. Agric. Assoc. China*, 1961, (34), 46–53.—The effects of the disease were most severe under unfavourable climatic conditions. Total cane yield was reduced by 18%, total sugar by 17%, stalk length by 7·8% and stalk diameter by 2·6%. The number of dead stalks was increased by 25·9%.

* * *

Rodent damage to sugar cane in British Guiana. G. I. TWIGG. *World Crops*, 1962, **14**, 150–154.—Infestation history, damage and sugar losses caused by the rat-like rodent *Helochilus sciureus berbicensis* are dealt with, also early and current control methods.

* * *

The West Indian sugar industry. P. RUNGE. *J. Royal Soc. Arts*, 1961, **109**, 91–104.—The economic background is covered, also agricultural and factory operations, and marketing.

Sugar cane in southern Spain. P. RIVALS. *J. Agric. Trop. Bot. Appl.*, 1961, **8**, 293–302.—Cultivation and production are described, the two main varieties being POJ 2727 and POJ 2725. The possibility is discussed of obtaining or producing a variety with a vegetative cycle better adapted to Spanish conditions.

* * *

Inhibition of sugar cane mosaic virus by milk. L. ANZALONE. *Plant Dis. Rptr.*, 1962, **46**, 213–215; through *Hort. Abs.*, 1962, **32**, 967.—Infection by sugar cane mosaic was greatly inhibited when juice from mosaic-infected sugar cane plants was either mixed at various dilutions with milk and inoculated into susceptible plants of sugar cane and sorghum, or when milk was used as a protective spray on these plants 24 hours before inoculation. Whole milk sprays, when applied to young sugar cane plants in the greenhouse in midsummer, were phytotoxic.

* * *

Weed control in sugar cane. R. D. PALMER and D. M. BROADHEAD. *Miss. Fm. Res.*, 1962, **25**, 6–7. "Monuron" at 2 or 3 lb/acre combined with cultivation gave excellent weed control in plant cane for about 6 weeks with no reduction in stand. Cane yield and Brix were increased, and also syrup yield (by 41–81 gal/acre). "Simazine" and "Diuron" also gave good weed control for 6 weeks.

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

SUGAR CANE AGRICULTURE IN THE PHILIPPINES

9th Annual Convention, Philippines Sugar Technologists 1961

THE value of basic slag as a fertilizer was discussed in a paper presented by the International Centre for Information of the Producers of Thomas phosphate. Its especial value is attributed to the fact that the phosphorus (18–25% phosphoric acid) is only released slowly and, therefore, not leached away—particularly valuable in the case of a long-term crop like sugar cane. Additionally, its 45 to 50% lime content reduces the acidity of highly leached soils and it contains 2–5% magnesia and 4–5% manganese besides traces of copper, cobalt, chromium, vanadium and molybdenum. T. R. ESCOBER described a complex series of pot experiments, the main object of which was to determine the effect of fineness in grinding—passing through 10, 50, 100 and 200 mesh. Additional liming and superphosphate dressings were also included. The complex results, which include leaf and root analyses and embracing 8 cane characters, are too complex to detail here, and the effect of fineness of grinding was not clearly indicated.

A series of papers covered other fertilizer aspects. F. E. MERCADO *et al.* described a complex factorial experiment covering 16 combinations each of N, (0–200 with P_2O_5 80 and K_2O 160), of P_2O_5 (0–200 with N 120 and K_2O 160) and of K_2O (0–200 with N 120 and P_2O_5 80), all figures kg/ha. In both the N and P series the best yields of cane and sugar were obtained with the 160–80–160 formula; in the K series the 120–80–200 formula gave the highest yield of both and proved to be the most profitable combination.

Two fertilizer experiments conducted in the Victorias Milling area and of local interest are recorded. The first covered an N, P experiment and suggests that the formula 100–0–160 is the most economic dressing. The second dealt with N only. Increments of yield were obtained up to 140 kg/ha.

V. M. LIMUACO found significant increases in sugar, but not cane yields, by dressings of borax up to 30 kg/ha. Above that figure yields diminished. Statistical determinations, based on 4 years' records covering the Victorias Milling district and using partial correlation, are used by T. R. ESCOBER to determine the relationships between rainfall and yield of cane and sugar.

F. T. TABAYOYONG briefly reviewed the various uses to which radioisotopes may be put in sugar cane research, with the headings: nutrition and uptake of fertilizers, varietal breeding, control of insect pests, cloud seeding, and water distribution.

Variety Trials

The results of a series of variety trials covering plant canes, in which Phil 54-60, a cross between CP 50-11 and H 44-3098, stands out prominently, were noted with much tabular detail by I. P. FERRARIS. It gave a higher yield and better juice quality than the 32 varieties with which it was compared. Its resistance to leaf scorch also appears high. Other variety trials reported include those at the La Granja Experiment Station by J. T. TAPAY and in the Bogo-Medellin district by V. LIMUACO. Unfortunately Phil 54-60 was included in neither of these.

Based on the results of a variety × age experiment with 4 varieties and covering a plant crop only, F. B. AMBOJIA recommends the cutting of Phil 49-22, Phil 48-15, and POJ 3016 at 11–13 months, and POJ 2967 at 11–14 months. The varietal descending order of both yield of cane and sugar was POJ 3016, Phil 49–22, POJ 2967 and Phil 48-15.

Pests and Diseases

B. R. ESTIOKO reviewed the methods of insect pest control during the 5 years 1956–60, classifying them under the several countries.

The Cuban fly, *Lixophaga diatraeae*, is the subject of two papers. B. R. ESTIOKO described the system of culture adopted and its performance. From these experiments it is considered that permanent establishment is likely. A more detailed account of the methods of propagation is given by V. L. SAPLALA and I. B. CANO. These investigations were instigated by the relative failure of chemical control. Interest centred on the finding of a suitable larval host and this appears to have been found in the rice stem borer *Chilo suppresalis*.

The rather complex situation with regard to control of the borers *Chilotraea infuscatella*, *Eucosma schistaceana* and *Sesamia inferens* by mass-bred *Trichogramma* species was discussed by J. N. GIBE.

The germination of the oospores of downy mildew on artificial media and also certain inoculation experiments with these same spores were described by J. R. RIVERA. POJ 3016 and Alunan, commercial varieties, and 4 Phil hybrids were planted in a field infested with root rot, probably due to a combination of *Pythium arrhenomanes* and several species of nematodes. On the basis of plant and ratoon crop, POJ 3016 and Phil 52-8 were not affected. The results are described by J. R. RIVERA and M. E. LOPEZ.

H. M.-L.

The commercial release and prospect of locally bred varieties of sugar cane in Taiwan. C. S. LOH. *J. Agric. Assoc. China*, 1961, (33), 18–33.—Six new varieties are described.

THE SUGAR CANE IN AUSTRALIA

62nd Annual Report, Bureau of Sugar Experiment Stations

Division of Soils and Agronomy: Various interactions were exposed in N–P—variety trials conducted at Bundaberg. A point noted in these was the superiority of the 8-10 internode over the 3rd leaf for the determination of an N index. Leaf N was also determined in variety—N trials at Macay. There was little difference in the N levels up to 6 cwt sugar/acre and no significant increases in yield. Evidence is given of the retarding effect that high N fertilization has on germination.

In a comparison at Mackay between varieties in their response to nematodes, as indicated by comparative yields on non-fumigated and fumigated plots, Q 50, N:Co 310 and Pindar proved resistant, Q 68 being most affected. In a further trial at Bundaberg, where the nematode population showed a somewhat different specific complex, Q 70 was unaffected followed by Q 50, with Q 63 least resistant.

Methods for the control of weeds by herbicides whether by soil, foliar or aerial application, and whether on cultivated land, tram-lines or irrigation channels, as also the various formulae recommended, are briefly summarized.

The Sugar Experiment Stations: A composite statement on the work carried on at the experiment stations is brief; their major activities, breeding and so on, are dealt with in the specialized sections which follow. Perhaps the most interesting record is that of the trash trial at Bundaberg, started in 1933. In this, trash tops have been regularly ploughed in in one plot, for the first 27 years being raked into alternate rows, and, in the last two, left as a continuous blanket. A comparison drawn with a plot in which all residues were burned has so far shown no yield increase from the use of trash.

Plant Breeding: Breeding has developed into so nearly a standard procedure that any annual report necessarily contains little for special comment. Pollen from flowers of Mandalay, a variety of *S. spontaneum*, flown from Fiji, was used to make a number of crosses. The seedlings have yet to be tested.

Further satisfactory results were obtained in the use in the field of CMU and maleic hydrazide, mixed or separate, for the control of flowering. The prospects of tracing the inheritance of resistance to leaf scald appear encouraging.

Following their use by the Genetics Section, Forestry Commission of Scotland, "Terylene" covers for lanterns have been used with success.

During the last few years, the percentage of Queensland varieties grown has remained stationary at about 85·2, a result attributed to the favourable reception given to N:Co 310.

Entomology: No extensive damage has been done to the crop during the season under report either by pests or diseases, though sporadic local outbreaks of the former have occurred. Control of these, mainly by insecticides, is severally discussed. More detailed studies are given of the greyback grub (*Dermolepida albohirtum*),the Frenchi beetle (*Lepidiota frenchi*), the funnel ant (*Aphaenogaster pythia*) and an insecticidal control of grubs. Notes are added on animal and bird pests.

Diseases: The major diseases and the work conducted thereon are discussed under their respective headings. Chlorotic streak, probably of virus origin, is closely examined, particularly as to its method of transmission. The remedy for Leaf Scald (*Xanthomonas albilineans*) appears to lie in finding a resistant variety under the unfavourable conditions in which the disease is found. It is noted that Fiji disease is likely to follow gumming and downy mildew in being completely eliminated.

H. M.-L.

AGRICULTURAL ABSTRACTS

Sugarcane variety trials on Everglades peat in Florida 1957–60. B. A. BELCHER and E. R. RICE. *Sugar J. (La.)*, 1962, **25**, (7), 58–62.—It is pointed out resistance to cold is an important factor with sugar cane varieties grown on Everglades peat. Performance figures are given of the 4 outstanding varieties among 18 tested at Okeelanta (U.S. Dept. Agric. Trials). The best variety was CP 50–28, followed by CP 52–68, both giving significantly higher yields than the standard variety. Both are erect types and adaptable to mechanical harvesting. Although both are susceptible to mosaic and ratoon stunting disease, they may be grown profitably on Everglades peat if the grower starts with clean material, rogues mosaic-infected stools and plants new crops with heat treated seed cane as a precaution against ratoon stunting disease.

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Sugar cane varieties. III. Series of trials carried out over period 1955-58. A. L. SEGALLA. *Bragantia*, 1961, **20**, 323–356.—The highest yielding variety was CB 45/3. Owing to susceptibility to smut it is prohibited in Sao Paulo state. The varieties recommended for fertile soils of the "Terra roxa" types were CB 41/58, Co 419 and CP 44/101, a moderately suitable variety being CB 41/61. Best varieties for the deep clay loam were CP 44/101, CB 41/14, CB 41/58 and CB 36/14. The early CP 44/101 and late CB 41/58 were also suited for poor soils.

The development in Florida of a specialized cane transport prime mover—the "Cat" DW6. *Anon. Sugar J.* (La.), 1962, **25,** (7), 49–50.—An account is given of the successful conversion of the Caterpillar D6 tractor by substituting large rubber tyred wheels for tracks and roller frames, with chain drive from rear hubs to front wheels. This resulted in a faster working haulage vehicle where improved road surfaces allowed of greater speed. It is now being extensively used by some of the larger concerns in Florida.

* * *

Milling studies with stalk segments. L. P. HEBERT. *Sugar J.* (La.), 1962, **25,** (7), 66–74.—The full title of this paper is "Milling Studies with Stalk Segments of Three Sugarcane Varieties on Different Dates during 1960 and 1961 at Houma, Louisiana." The writer points out that high fibre content is needed for erect growth, freedom from lodging, and suitability for mechanical harvesting as now practised in Louisiana. On the other hand low fibre content makes for good milling properties and high juice content. Varieties tested were CP 44-100, CP 52-68, and N:Co 310. Lower segments had both more fibre and more juice than upper segments. Fibre content increased markedly in upper segments as the season advanced.

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The "Agri Robot". *Australian Sugar J.*, 1963, **54,** (10), 737.—A description, with photograph, is given of a sensational automatic plough now in commercial production and designed by Mr. SIELING, a South Holland farmer. Before commencing work a "starter" furrow and two end furrows are made. A feeler arm touching a peg stops the machine when the field is ploughed.

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Use of chemicals in sugar cane culture in India—chemicals as weedicides. P. S. MATHUR. *Indian Sugar,* 1962, **12,** (7), 475–477.—This constitutes a useful historical survey of the use of chemical weedkillers in sugar cane cultivation in India, notably 2,4-D, M.C.P.A.:P.C.P. and "Dalapon". The larger and more progressive growers are taking an interest in chemical herbicides but the peasant cultivator, with his family or cheap labour and on the grounds of costs, is less interested.

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Sugar industry in Punjab. D. D. PURI. *Indian Sugar,* 1962, **12,** (7), 489–494.—The adverse affects of bad weather conditions and of diseases and pests, notably borers, on yield in recent years is outlined. The need for producing improved varieties suited to local conditions is stressed as is the establishment of seed cane farms in the various factory areas.

Sugar in the intercellular spaces of white mustard roots. R. G. H. CORMACK and P. LEMAY. *J. Exp. Botany,* 1963, **14,** 232–236.—A method is described in which it is possible to test directly for the presence of translocated radioactive sugar in white mustard roots (in the apical meristem). Transverse sections of frozen root tips, following treatment of living seedlings with radioactive glucose, are examined by radioautography. Radioactivity is concentrated in the conspicuous intercellular spaces and to a lesser degree in the intervening cell walls. These results are in harmony with the theory of PRIESTLY that the intercellular spaces and cell walls are the channels of transport of soluble nutrients from the ends of differenciating vascular strands to the dividing cells in the root meristem.

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Betaine: a plant-growth substance from sugar beet (*Beta vulgaris*). A. W. WHEELER. *J. Exp. Botany,* 1963, **14,** 265–271.—Speed of germination in sugar beet seeds is increased by removing them from the pericarp or by washing the seed balls. Aqueous extracts of sugar beet seed balls inhibited germination of naked sugar beet seeds, cress, and various vegetable seeds. Smaller amounts of aqueous extract stimulated experimental growth.

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Report on Diatraeophaga, etc. M. A. GHANI. *Berita dari Perusahaan Gula di Indonesia,* 1962, (1), 1–23.—The author, entomologist-in-charge at the Commonwealth Institute of Biological Control, Rawalpindi, Pakistan, gives an account of his successful expedition to procure *Diatraeophaga striatalis,* a larval Tachinid parasite of sugar cane borers that occurs only in Java. It was distributed to Mauritius, Pakistan and Trinidad.

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Studies on bacterial pathogens of sugar cane. A. C. HAYWARD. *Occ. Paper Mauritius Sugar Ind. Research Inst.*, 1962, (13), 1–27.—Part I is concerned with the organisms (*Xanthomonas*) responsible for gumming disease in Réunion and elsewhere and Part II on the bacteria causing red stripe and mottled stripe disease of sugar cane. Mottled stripe is more widely distributed than red stripe and has been mistaken for the latter.

* * *

Agriculture in the islands of the Western Pacific. Part II. R. J. A. W. LEVER. *World Crops,* 1963, **15,** (5), 209–213.—This includes a brief account of the sugar industry of Fiji where about 129,000 acres are cultivated yielding some 200,000 tons of sugar. Present varieties of cane (hybrid Ragnar and Pindar canes) average 3·2 tons of raw sugar per acre as against 2·77 tons for the varieties formerly grown. Reference is made to cultural methods, green manure crops, pests and diseases.

Early weed succession on arable land in Trinidad. W. D. RICHARDSON. *Tropical Agriculture*, 1963, **40**, (2), 89–101.—With the increasing use of selective herbicides a better knowledge of weeds and their biology has become desirable. Many of the species dealt with or referred to in this paper are common weeds in cane fields in the Caribbean region, as well as in other cane growing countries; they include *Cyperus rotundus* ("nut grass"), *Eleusine indica*, *Cynodon dactylon*, species of *Panicum* and other grasses. In Trinidad, cane field grasses are often the common or dominant weeds. In this work a phytosociological method was used for studying the weed populations as a whole and two quantitative methods are recommended for the study of individual weed species.

* * *

A plan for the improvement of sugar cane varieties in Egypt. G. ARCENEAUX and E. S. KASSEM. *Sugar J.* (La.), 1963, **25**, (9), 10–18, 33–36.—The urgent need to breed sugar cane varieties to suit the rather exceptional climate of Egypt is stressed, with its very high daytime summer temperature and wide diurnal fluctuations throughout the year. The present 3 principal varieties Co 413, NCo 310 and Co 281 are all susceptible to mosaic disease and Co 413 to streak disease. These diseases may increase their inroads. The four factories operating in Egypt have a total daily capacity of 32,000 tons. Production is expected to rise sharply when the Aswan dam is completed.

* * *

Sugar industry in Thailand. ANON. *Sugar J.* (La.), 1963, **25**, (9), 20–22.—An account of the economics of the industry in recent years is given, sugar production having increased from 54,000 tons in 1956 to 151,000 tons in 1962. Cholburi province is the most important producer of centrifugal sugar, accounting for 42%. Characteristics of this and other cane areas in the Kingdom are given. Many small native mills produce syrup and muscovado or crude sugar. A number of Japanese and Taiwan sugar technologists are now employed in Thailand at the larger centres.

* * *

Control of weeds and grass including Johnson grass. E. R. STAMPER and D. T. LOUPE. *Sugar Bull.*, 1963, **41**, (10), 125–132.—As mechanization of Louisiana sugar cane production increases, weed and grass control becomes more and more important. Details are given of the best methods for controlling Johnson grass, the worst weed of many areas, and of the herbicides recommended e.g. TCA, 2,4-D, "Fenac", etc.

* * *

Reduction of nutria damage in sugar cane and other croplands of Louisiana. E. E. PARKS, K. M. GARNER and G. R. ABRAHAM. *Sugar Bull.*, 1963, **41**, (10), 133.—With the establishment of a Nutria Control Research Laboratory at Houma, Louisiana, it is hoped that more efficient methods to halt nutria damage in cane fields will be found. The present recognised methods of control are outlined.

Selection of cane varieties for mechanical harvesting. H. DE ALMEIDA LEME and A. P. COBRA. *Brasil Açucareiro*, 1962, **60**, (1 & 2), 23–26.—The need for special attention to be paid in cane breeding to characteristics desirable in mechanical harvesting is stressed such as erect growing culms, uniform height, absence of excessive leafage etc.

* * *

Why and how to save sugar cane crops from lodging. R. L. BHOJE and B. K. MATHUR. *Indian Sugar*, 1962, **12**, (8), 525–527.—Lodging is common in Uttar Pradesh in the rainy season. Methods of reducing this by earthing up and binding of canes (by hand) are outlined.

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The sugar cane in Puerto Rico. R. A. BONILLA. *Bol. Azuc. Mex.*, 1962, (162), 7–17.—The writer, a sugar cane specialist in Puerto Rico, deals to some extent with drainage in wet areas and irrigation in the drier areas but most of the paper is concerned with the use of modern chemical weedkillers in cane fields.

* * *

Pests and diseases of sugar cane. ANON. *Bol. Azuc. Mex.*, 1962, (162), 18–27.—This is a report from the Pests and Diseases Section of the Sugar Institute of work carried out during the period March 1961–May 1962. Different regions are dealt with separately. Rats are troublesome in some areas, "Warfarin" proving effective.

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Successful sowing of sugar beet seed. L. VAN STEYVOORT and M. MARTENS. *Publ. Inst. Belge Amél. Betterave*, 1962, (2), 33 pp.—The advantages of monogerm seed in reducing thinning costs are outlined with the conditions needed for obtaining a good stand of seedlings.

* * *

Improved production of sugar cane cuttings. T. P. PAO and S. L. HUNG. *Rpt. Taiwan Sugar Exp. Sta.*, 1962, (29), 1–32.—As the planting season is in August and September and harvesting from November to March, tops from harvested cane cannot normally be used for planting and an area of seed cane needs to be set aside. A modified nursery method to avoid this is described using tops or cuttings from harvested cane planted very close together and used for field planting 6 or 7 months later.

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Preliminary studies on Green Muscadine fungus. W. Y. CHENG and C. B. CHEN. *Rpt. Taiwan Sugar Exp. Sta.*, 1962, (29), 67–73.—This fungus, *Metarrhizium anisopliae*, which attacks black beetle, *Alissonotum*, and various cane borers, was introduced to Taiwan from Hawaii over 40 years ago and is still active. A detailed description of the fungus is given.

FURTHER STUDIES IN THE DRYING OF WHITE SUGAR

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

Paper presented to the 16th Technical Conference, British Sugar Corporation Ltd., 1963.

PART I

Introduction

IN a previous paper[1] the authors suggested that there were certain difficulties involved in determining the moisture content of granulated sugar (in particular recently manufactured sugar) by the commonly used gravimetric method. Results quoted in this paper from a large number of experiments showed that the standard gravimetric determination carried out on sugar immediately after it was produced, did, in fact, indicate an appreciably lower moisture content than that which actually existed. There was a continual "release" of moisture from sugar after it was apparently dried, and this moisture the authors referred to as "Bound Moisture", because it was only "freed" from the sugar as a slow form of crystallization proceeded on the surface of the crystal. Indeed, it required a very long time for the sugar to reach equilibrium conditions, although for practical considerations, most of this so-called Bound Moisture was released 72 hours after manufacture. However, the quantity involved, and the form in which it was present, could have serious effects later both on bulk transport and storage of the sugar.

To avoid difficulties resulting from this Bound Moisture, it seemed imperative to remove the moisture as soon as it was released. This is the so-called conditioning of sugar immediately after production, which can involve elaborate sugar storage and air conditioning plant. On the other hand, if it was possible to reduce the amount of this Bound Moisture in some way, this would obviously have some marked advantages, and may even obviate the necessity for conditioning plant. The authors were able to illustrate in last year's paper that an improvement in crystal shape—in particular the elimination of, or a marked reduction in, conglomerates—could in fact effectively reduce the amount of Bound Moisture. Further it was also shown that it was possible to achieve this reduction in conglomerates by applying forced circulation to the massecuite in the pan by the use of a driven propeller.

The purpose of this report is therefore to continue the studies of last year and in particular, firstly, to confirm the findings in respect of the Bound Moisture existing in freshly manufactured sugar, and secondly, to substantiate the claim that forced circulation of massecuite can produce a sugar with improved crystal shape and, in doing so, reduce the Bound Moisture. Some further tests were also carried out on the differently shaped vacuum pans available at King's Lynn factory, and with propellers operating at varying speeds, to ascertain the effect of these variables on the final sugar crystals. Finally, as the amount of Bound Moisture has such an important bearing on different aspects of sugar handling, and as its quantitative determination in a humidity oven requires a good deal of time—often only producing results when they are too late—it was decided to experiment with a different apparatus to find out if reasonably reliable results could be achieved in a much shorter period of time.

In view of the promising results in crystal formation achieved during the 1961/62 campaign in a vacuum pan fitted with a propeller to give forced circulation of the massecuite, it was decided to have this circulation available on all four white sugar pans at King's Lynn factory during the 1962/63 campaign. Consequently, propellers were fitted, and in such a way that in three pans at least the speed could be varied within certain limits. This latter was considered to be necessary, as we wanted to determine the effect of circulation quantity, and in any case, as some of the pans were of markedly different design, it would be coincidental if the same speed gave optimum results in all types of pan. A brief description of the design and various propeller speeds follows, but it will now be apparent to the reader that except when mechanical trouble arose, or an experiment was being made, all white sugar produced at King's Lynn during 1962/63 campaign was done so with forced circulation in the pan. Consequently the results of tests quoted in this paper for moisture content, the photographs and various other data, all refer to sugar produced with mechanical circulation except where otherwise stated.

In Fig. 1 are illustrated the four white sugar pans, dimensions being given in Table I. We feel it is important to draw attention to the following points. Pans Nos. 1 and 2 are parallel sided, while 3 and 4 are the so-called low head. The central downtake of pans 1 and 2 has a diameter of 5 ft 3 in, reducing to 4 ft 9 inches compared with 4 ft 3 inches in pan 3 and 3 ft 11 inches in pan 4.

Pan No. 2 was, in fact, the one in which the original experiments were carried out. No change was made to the propeller or its drive, and the speed could not be altered from 93 r.p.m. Pans 1, 3 and 4 were fitted during last summer with identical propellers, except that the tips of the blades were machined down to fit the shroud fastened to the base of the downtake tube in each pan. The diameter of the downtake

[1] *I.S.J.*, 1962, **64**, 359–362; 1963, **65**, 12–16, 43–45, 80–83.

therefore controlled the overall diameter of the propeller, and in this way had an important influence on the quantity of massecuite circulated. Later in the report, in Table VIII, more design details are quoted as these were used in making calculations for the recirculation rate and velocities.

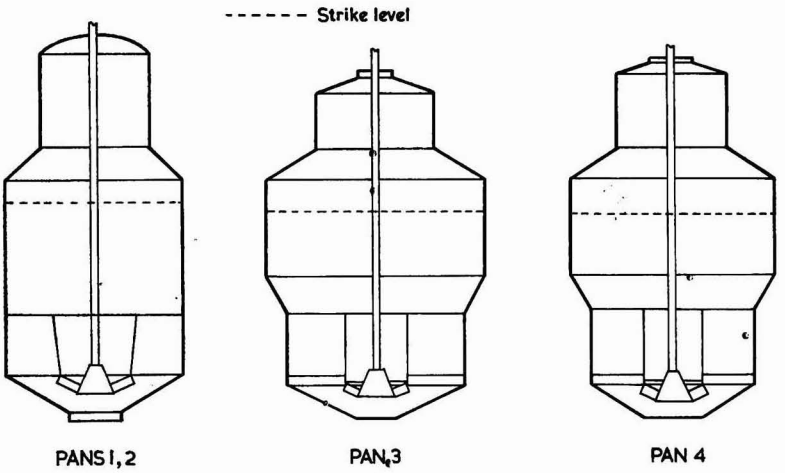


Fig. 1

Table I

	Pans 1, 2	Pan 3	Pan 4
Height of pan body	13 ft 0 in	13 ft 8½ in	13 ft 10 in
Strike level	11 ft 6½ in	11 ft 9 in	11 ft 5 in
Diameter of body	12 ft 0 in	14 ft 9 in	13 ft 9 in
Calandria diameter	12 ft 0 in	12 ft 0 in	11 ft 0 in
Tube diameter	3½ in	3½ in	3½ in
Heating surface	205 sq.m.	275 sq.m.	220 sq. m.
Capacity	1100 cu.ft.	1530 cu.ft.	1250 cu.ft.

With pans 1, 3 and 4, the motor was connected to the gearbox through V-belts and this gave the means of speed variation. No allowance was made, therefore, for variation during an actual boiling operation. The gearboxes were of different ratio from that on No. 2 pan, and with a 1:1 pulley ratio gave a propeller speed of 75 r.p.m. Pulleys were originally provided to give three speeds on each of the three pans, viz. 64 r.p.m., 75 r.p.m. and 80 r.p.m. Subsequently, because of certain dissatisfaction with results from pans 3 and 4, pan 3 was speeded up to a propeller speed of 100 r.p.m.

Moisture Tests on White Sugar

These tests were carried out using the same technique as in a previous report[1] by the authors, i.e. the sugar was subjected to a gravimetric test, drying for 3 hours at 105°C and allowing to cool before re-weighing.

A similar sample was put in a humidity oven at 40% R.H. and a temperature of 30°C and the loss in weight after 24 hours, 48 hours and 72 hours was recorded by re-weighing. Finally, the sample was dried for 3 hours at 105°C to measure the total moisture loss after 72 hours. This test was made on freshly manufactured sugar from each of the four vacuum pans, and also on a sample of sugar withdrawn from the sugar silos, and the results are recorded in Table II. Also recorded are the screening analyses.

The results of the drying tests are illustrated in Fig. 2.

It is apparent that these results follow closely those obtained in previous tests during the 1961/62 campaign. The standard analysis gave a moisture of less than 0·02% in each sugar tested, but the total moisture released in 72 hours, as measured by the sum of the amount released in the humidity oven and by the final 3 hours drying, was in all cases greater than the original test.

The samples from the pans, however, showed a percentage increase typical of that obtained in the pan fitted with mechanical circulation the previous year. The percentage increase in the case of the silo sugar was, of course, least of all, due to the "conditioning" that had taken place because of its age.

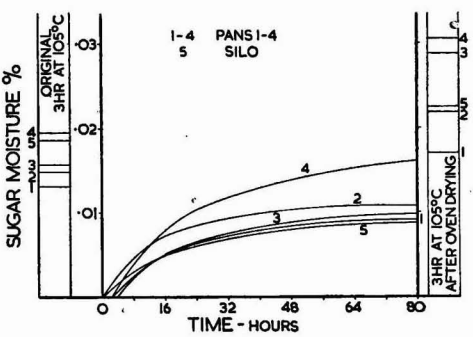


Fig. 2

The results of these tests are, in our opinion, reasonably good. They do show, however—and this was confirmed by a number of similar tests—that there was a difference between pans both in the "initial" and "final" moistures. In particular, pans No. 1 and 2 gave consistently better results than pans

Table II

Pan	% Moisture: Initial 3 hr at 105°C	After hours: 24	48	72	Final 3 hr at 105°C	% increase	Screen analysis: on 18	on 25	on 36	through 36	C.V.	M.A.	Speed of circulator r.p.m.
1	0·0131	0·0063	0·0077	0·0092	0·0168	28·2	6·6	42·8	36·5	19·1	26	0·0243	75
2	0·0148	0·0088	0·0101	0·0106	0·0219	47·9	12·4	42·9	31·8	12·9	28	0·0253	93
3	0·0157	0·0070	0·0074	0·0108	0·0287	65·5	16·6	53·0	22·9	7·5	25	0·0275	75
4	0·0195	0·0103	0·0136	0·0153	0·0306	56·9	18·8	46·1	28·4	6·6	24	0·0271	75
Silo	0·0186	0·0060	0·0070	0·0090	0·0226	21·5	15·7	39·7	32·7	11·9	31	0·0253	—

Fig. 3

Pan No. 1. Date 18.10.62.
Circulator speed 75 r.p.m. Conglomerates 10%.

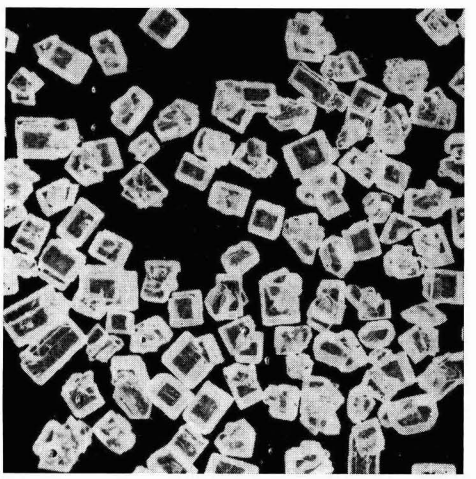


Fig. 5

Pan No. 3. Date 18.10.62.
Circulator speed 75 r.p.m. Conglomerates 27%

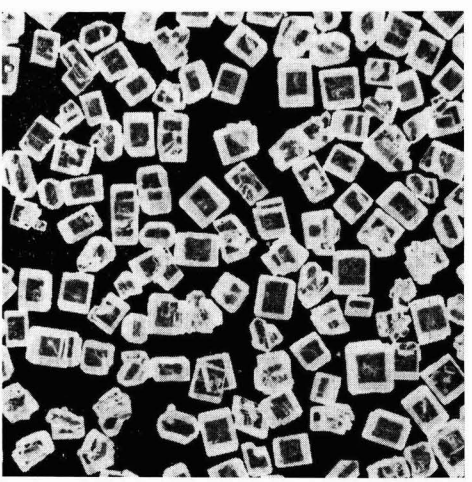


Fig. 4

Pan No. 2. Date 18.10.62.
Circulator speed 93 r.p.m. Conglomerates 11%

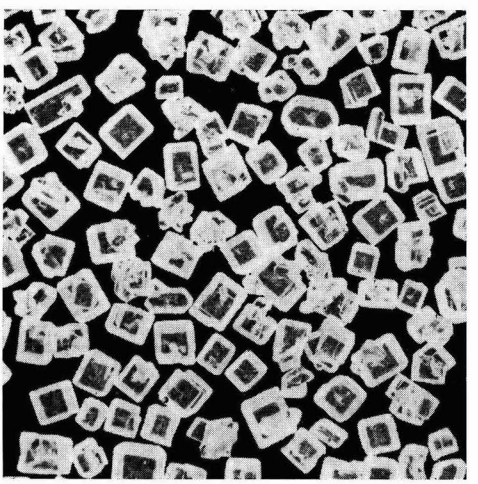


Fig. 6

Pan No. 4. Date 18.10.62.
Circulator speed 75 r.p.m. Conglomerates 20%

Nos. 3 and 4. This can best be illustrated by referring to Table III. Here we compare, for a reasonably large number of samples, the % original moisture, % ash, M.A. and C.V. of the sugar from the four pans.

Table III

Pan No.	*No. of Samples*	*Original % Moisture*	*% Ash*	*M.A.*	*C.V.*
1	58	0·0151	0·009	0·0255	27
2	65	0·0151	0·009	0·0255	28
3	66	0·0228	0·011	0·0268	27
4	65	0·0224	0·011	0·0265	26

A visual inspection of the various sugars also showed a variation in crystal formation, and, as expected from the moisture determinations, Nos. 3 and 4 contained quite obviously more conglomerated crystals than Nos. 1 and 2. The point is illustrated by Figs. 3–6. The difference in the sugars is quite apparent from these photographs, and to attempt an evaluation we have tried to count the conglomerates.

The results are as follows:—

Pan 1	10% conglomerates
Pan 2	11% ,,
Pan 3	27% ,,
Pan 4	20% ,,

The difference is significant, and is undoubtedly the reason for the differences in the moisture tests. The authors are, of course, aware of the difficulties involved in this test of counting conglomerates. There are, in all samples, some border line cases which are a matter of opinion. For this reason the same person performed the count in all tests quoted in this paper, so that although the results may not be absolute, they have at least some relative significance. It should be mentioned that these results in Table II and Fig. 2 were from sugar produced in the pans boiled at the same time, so that the feed liquor and operating conditions were as nearly the same as possible.

(To be continued)

TREATMENT OF LOW GRADE MASSECUITES

By J. EISNER
Sugar Technology Consultant

THE writer has recently had the opportunity of introducing at the Kiriat-Gat beet sugar factory in Israel a method for the treatment of the low-grade massecuites in the crystallizers, which he has developed on the basis of observations and experiments carried out over many years in both beet and cane sugar factories. The aim of the method is to achieve a satisfactory exhaustion of the final molasses without the need to carry out any analysis, tests and calculations for establishing the correct amount of dilution and lubrication[1] necessary for each strike undergoing treatment in the crystallizers.

The application of this method pre-supposes the availability of good water-cooled crystallizers with individual electric drive. Each driving motor is fitted with an ammeter and it is desirable to instal these on a panel situated on the pan floor together with thermometers which indicate the temperature of the massecuite in each crystallizer. Further, it is necessary to instal a mixing tank for the preparation of "lubricating liquor" and distribution piping from this tank to the crystallizers; the mixing tank is fitted with a calibrated level indicator, so that measured quantities of lubricating liquor may be admitted to each crystallizer as required.

The lubricating liquor is prepared by mixing equal volumes of molasses and hot water, which means that it will have a density of about 45°Bx. (The proportion of equal volumes has proved satisfactory for beet massecuite but it is likely that for cane massecuite diluted molasses of between 65 and 75°Bx would give better results.)

The following points describe the steps to be taken for the initial and permanent application of the method:

(1) The massecuite is struck from the vacuum pan into the crystallizer in the usual manner, the steaming-out water being allowed to run into the massecuite.

(2) If the time available for cooling is very limited, the cooling water may be started immediately, otherwise the beginning of cooling with water should be delayed by one to two hours.

(3) Readings of temperature and motor current are taken at intervals of an hour (to begin with, until experience is gained, it is advisable to take readings more frequently).

(4) The ammeter readings for a crystallizer just filled with hot massecuite will always be found to be very nearly the same, even with strikes of considerably different Brix.

(5) As the cooling proceeds, the ammeter readings will rise, very slowly at first and gradually faster; when they begin to show a tendency to rise quickly, lubricating liquor is added in small portions (50–100 litres); this will check the rise for a while; when there is a new distinct rise in the current used by the motor another portion is added, thus maintaining the same ammeter reading (the magnitude of which may easily be established once for all after some experimenting), right to the end of the mixing and cooling period, i.e. to the start of the curing of the massecuite in the centrifugals.

(6) Addition of any more lubricating liquor later than one hour before the start of curing must be avoided, even if the ammeter reading rises somewhat above that which has been determined as the proper level as mentioned under (5).

[1] *See* J. EISNER, Basic Calculations for the Cane Sugar Factory, p. 9.

TREATMENT OF LOW GRADE MASSECUITES

Current No. of Strike	Date June, 1963	—Duration (hours)— Boiling	Mixing	Curing	Massecuite Temp. at start of curing °C	Massecuite °Bx	Massecuite Purity Q_1	Molasses Purity Q_2	Purity Drop Q_1-Q_2	Lubricating Liquor Litres	Ammeter reading Amp	
149	15–17	10	17¼	6½	50	95·0	77·9	59·0	18·9	1000	7½	
150	16–17	10	19½	5¼	47	94·4	76·3	58·9	17·4	800	7¼	
151	16–17	10¾	18½	5¼	49	95·0	76·6	60·0	16·6	800	7¼	
152	16–18	11¾	18	11¼	52	95·6	78·0	59·9	18·1	800	7	Long curing time because of mechanical defects of centrifugals.
153	16–18	10¼	24	5¾	46	95·2	76·0	57·8	18·2	1000	7	The previous disturbance resulted in a long mixing time, good cooling and exceptionally low molasses purity.
154	17–18	9	25¾	7	47	94·6	76·9	57·7	19·2	1500	7¼	
155	17–18	11½	24¼	4¼	47	95·2	78·1	59·7	18·4	1200	7½	Relatively high molasses purity partly explicable by higher massecuite purity.
156	17–19	17	17½	7¾	54	95·4	78·2	58·8	19·4	450	7¼	Poor cooling, and therefore little lubrication; nevertheless a good purity drop occurred.
157	17–19	16¼	19¼	4¾	49	94·1	78·2	58·6	19·5	600	7¼	
158	18–19	12¼	17	5½	50	95·2	78·0	60·0	18·0	800	7¼	
159	18–19	11½	17½	5½	49	95·2	77·1	59·2	17·9	1000	7½	
160	18–20	10½	16½	6	54	94·8	77·6	60·0	17·6	900	7¼	
161	18–20	11½	17¼	5	52	94·4	77·7	60·1	17·6	850	7	
162	19–20	10	16¾	6½	50	95·4	77·9	58·7	19·2	900	7¼	
163	19–20	10	18	6½	48	94·6	78·0	58·3	19·7	700	7½	
164	19–21	10¼	18½	6	50	95·3	77·7	59·3	18·4	1200	7½	
165	19–21	10¼	19½	4½	49	95·7	77·5	61·3	16·2	1700	7¼	Exceptionally high lubrication was used because of high Brix and good cooling; the purity drop was unsatisfactory, however, because some of the lubricating liquor was added too late.
166	20–21	11½	18	4¾	49	95·0	78·3	61·2	17·1	1000	7¾	
167	20–21	12¾	16¾	5	48	94·4	78·4	57·7	20·7	800	7½	Exceptionally great purity drop and good molasses purity.
168	20–22	11	16¼	7¼	54	95·1	77·2	60·2	17·0	400	7½	Poor cooling; little lubricating liquor was used despite high Brix, and a relatively small purity drop occurred.
171	21–22	12¼	20	5	44	94·2	78·5	58·7	19·8	700	6½	Low current in spite of good cooling, indicates that some of the lubricating liquor was added too late; without this mistake the purity drop would have been greater.
176	22–24	12	14¾	6¼	58	94·1	75·2	59·0	16·2	Nil	6¾	Mixing time was short and cooling poor; therefore current was low and no lubricating liquor was needed; with better cooling the purity drop would have been greater.
194	27–28	10	14¾	3¾	50	93·4	79·1	59·0	20·1	Nil	7	Mixing time was short and cooling fair; Brix was low and therefore no lubricating liquor was required for great purity drop from high massecuite purity.

(7) The rate of cooling is so adjusted that the desired final temperature of the massecuite (say 45°C) is reached gradually just before the start of curing.

(8) Once curing has begun, neither the ammeter nor the temperature readings are of any further interest and no further lubrication must take place, except in rare cases of badly boiled and therefore badly curing massecuite (the cooling water must, of course, be stopped when curing begins).

It will be noted that in carrying out this procedure there is no need to have any prior knowledge of the characteristics (Brix and purity) of the massecuite.

The table on page 265, which is an actual record of operation at Kiriat Gat, will illustrate the method and show that even under considerably varying conditions satisfactory results were obtained. The first twenty strikes are consecutive ones, boiled between 15th and 20th June, 1963, while the others were processed on later dates and are chosen because of certain irregularities which are of special interest.

In addition to the observations entered in the table, the following remarks will serve to clarify some points of interest:

(*a*) The strikes were boiled in two vacuum pans (heating surface 220 sq.m.) and were of about 42 tons each;

(*b*) Only four crystallizers (50 sq.m. cooling surface) were available and the normal mixing and cooling time was therefore only about 18 hours;

(*c*) The cooling water had a temperature of 25–29°C and cooling was also affected by the considerable differences in air temperature between day and night;

(*d*) The 20 consecutive strikes were chosen because they include Nos. 153–155 which, from accidental causes, had exceptionally long cooling times; despite unforeseeable deviations from the normal conditions, our method adapted itself automatically and produced very good results;

(*e*) The average molasses purity of the 20 strikes is 59·3 (max. 61·3, min. 57·7); with longer cooling times or cooler water or both, the purity figures would have been lower still;

(*f*) A purity drop of 20 and over (see No. 167) can be obtained (cases of up to 22 have been recorded), especially with massecuite of high purity; this means that it is possible to obtain from massecuite of 80 purity molasses of well below 60 purity;

(*g*) In our case the ammeter readings with fresh strikes varied only between 6 and 6¼; it was found by experiment that the amperage had to be stabilized by lubrication at between 7 and 7¼ and, as the table shows, this was generally achieved; occasional somewhat higher readings produced no detrimental effect.

(*h*) The ammeters used permitted readings by ¼ amp between 6 and 8 amp and this accuracy proved sufficient;

(*i*) It is often believed that it is necessary to add some dilution water at the beginning of the mixing, but our method has disproved this, as in most cases the first portion of lubricating liquor was added 6–8 hours after the beginning of mixing.

An explanation, or theory, which would offer a full understanding of why this simple practical method is successful, has not yet been evolved, but to a certain extent logical reasons can be given; for instance, some simple calculations show that additions of both water and molasses must be made to normally boiled massecuite and that these additions should, on the average, be made in equal quantities (by volume), if well exhausted molasses and easily manageable massecuite (for pumping and curing) are to be obtained.

ESTIMATION OF SUGARS IN BEET MOLASSES

By A. CARRUTHERS, J. V. DUTTON, J. F. T. OLDFIELD, C. W. ELLIOTT, R. K. HEANEY and H. J. TEAGUE

Paper presented to the 16th Tech. Conf., British Sugar Corp. Ltd., 1963.

PART II

In a comparative exchange of molasses samples, however, it was shown that if the molasses was applied as a 50% solution equivalent to 2 mg of molasses per spot, the raffinose content as estimated visually was only about two-thirds of that obtained using the ICUMSA-recommended application of 10% molasses with a maximum of 20μg of raffinose per spot. This discrepancy occurred to about the same extent whether the raffinose was estimated directly or after conversion to melibiose and so, although the standard method gave reproducible results, it was necessary to investigate the possibility that some component falsely elevated the apparent raffinose value as determined at the lower concentration.

Separation of carbohydrates on ion exchange resins

To attempt to verify the chromatographic raffinose value, it was clearly desirable to use a procedure depending on some entirely different principles from those normally employed. JONES *et al.*[13] had found that a mixture containing 200 mg each of raffinose, sucrose and glucose could be separated into chromatographically pure components on columns (100 × 2 cm) of "Dowex 50W" (2% divinylbenzene, 200-400 mesh, Li^+ form) by 24-hour development with water. The fine particle size of the resin was essential for the separation and no other resin was found to work as well as that specified.

The use of an ion exchanger permanently in the salt (lithium) form together with water elution is attractive because the separation must be more akin to a molecular sieve effect than to ion exchange, so that it seemed probable that a quantitative separation might be feasible with molasses despite the more adverse relative concentrations of sucrose and raffinose

[13] *Chem. and Ind.*, 1959, 1196.

A column application of only 200 mg of molasses to the column would be equivalent to 1 to 5 mg of raffinose and provided adequately sharp bands could be obtained, this amount of raffinose would be measurable by the anthrone technique for which carbohydrate concentrations in the range 0·01 to 0·05 mg/ml are required.

In initial experiments, it was found that separation was less efficient with the sodium form than with the lithium form of polystyrene nuclear-sulphonic acids and that better separations could be obtained with "Dowex 50W" (2% D.V.B., 200–400 mesh) or "Zeo-Karb 225" (2% D.V.B. <200 mesh) than with "Amberlite CG120" (8% D.V.B., <300 mesh). The first two resins had apparently similar separation efficiencies and were used throughout the investigation in the lithium form. As the "Zeo-Karb" resin contained the greater quantity of fine beads it was necessary to force the eluant through the bed using a D.C.L. micro-pump but the "Dowex" column ran freely with only the hydrostatic pressure due to the length of the column.

Because of the high sucrose-raffinose ratio in molasses, the column length was increased to 150 cm and the diameter was reduced to 1 cm. The flow rate throughout was 6–7 ml per hour and 1-ml fractions of eluate were collected automatically at 9-minute intervals. A separation of chromatographically pure raffinose, sucrose and fructose was readily obtained from artificial mixtures. To avoid the possibility of microbiological attack during the 10 hours required for elution of raffinose, 0·1% lithium benzoate was used as eluant, and the lithium form of the resin in the column was equilibriated with 0·1% lithium benzoate before use.

For molasses analysis, 1 ml of 20% molasses was applied to the surface of the resin and forced on to the resin with nitrogen pressure. The walls of the column were then washed down with 3 × 0·25 ml portions of 0·1% lithium benzoate. The column was then eluted with lithium benzoate and approximately 60 fractions were obtained before carbohydrates appeared in the eluate. This position was determined by spraying 5 µl aliquots of each fraction on paper with α-naphthol:phosphoric acid reagent. A more rapid procedure than paper chromatography was required to establish the position of the individual carbohydrates, and this was accomplished by thin-layer chromatography[14] on "Kieselgel G" (E. Merck A.G., Darmstadt) in ethyl acetate:*n*-propanol:water (2:2:1). After irrigation for 90 minutes, the carbohydrates and standards were revealed by spraying with α-naphthol:sulphuric acid reagent.

Phase I. A clear separation between tri-, di-, and monosaccharides was obtained; about 8 or 9 fractions containing raffinose were first eluted, followed after an interval of 1 or 2 blank fractions by 8 or 9 fractions containing sucrose and after a second interval of 1 or 2 fractions the hexoses were recovered in the following 9–10 fractions. Although the separation between sucrose and raffinose was adequate, the raffinose fraction also contained the kestoses from molasses. Presumably the technique was inadequate for separation of different trisaccharides and hence, although an estimate of raffinose plus kestose could be obtained with anthrone, the raffinose alone could not be measured.

Phase II. To avoid kestose interference, the molasses was hydrolysed with invertase to convert kestose and sucrose to monosaccharides, and raffinose to melibiose before application to the column. Again clear separation between di-and mono-saccharides was obtained. At this stage of the investigation, the amount of galactinol in British molasses was not known, but the thin-layer chromatographs revealed that the melibiose fraction also contained appreciable amounts of galactinol and so again the raffinose content could not be calculated precisely.

Phase III. It appeared that a single fractionation resin could not yield pure raffinose from molasses. A combination of phase I and phase II techniques would however be expected to avoid interference from both galactinol and kestose. A resin column 150 cm long and of 2 cm diameter was prepared to permit application of twice the quantity (2 ml of 20%) of molasses. The raffinose plus kestose fraction and the sucrose plus galactinol fraction were separated as in phase I, and the two fractions were each concentrated and then hydrolysed with invertase and re-applied to the smaller columns. From the hydrolysed sucrose plus galactinol fraction, galactinol was separated from the monosaccharide hydrolysis products but the determination of the galactinol with anthrone was subject to error if the hydrolysis of the sucrose was incomplete; for example, if only 99·5% hydrolysis efficiency was obtained the residual sucrose would be sufficient to double the apparent galactinol value. The hydrolysed raffinose plus kestose fraction was not subject to an error of this order and the melibiose was readily separated from the monosaccharide hydrolysis products. In all probability a realistic value for raffinose was obtained by determination of the separated melibiose. The monosaccharide fraction would be expected to contain 3 molecules of hexose of each original kestose molecule plus one molecule of hexose of each original raffinose molecule. The total hexose in this fraction was determined, one fructose molecule per molecule of recovered melibiose was subtracted to allow for the hydrolysis of the raffinose and the original kestose was calculated from the residual hexose value. In fact this procedure gave kestose values which were higher than those calculated by deducting the calculated raffinose from the sum of raffinose plus kestose before hydrolysis. This difference might have been due to the glycerol which is present in the invertase solution.

Although the procedure could probably have been developed to give satisfactory raffinose values, this phase using two ion exchange columns, one of which was of increased size, required 3 days for completion. Moreover the solutions for application to the second

[14] ATTERSON *et al.: Paper presented at 16th Tech. Conf., British Sugar Corp. Ltd.*, 1963; *I.S.J., in press.*

column had to be concentrated to 1 ml or less for satisfactory separation, and the quantitative inversion and reapplication of such small volumes presented some difficulty. An alternative technique was therefore sought for separation of the raffinose and kestose fraction from the smaller column, phase I procedure.

Phase IV. Mono-, di- and tri-saccharides can be separated on carbon-"Celite" columns by successive elution with water, 5% ethanol and 15% ethanol[15,16]. Normally the rate of elution of such columns is fairly slow because at least 150 ml of the carbon: "Celite" mixture is required per gram of carbohydrate mixture. The raffinose plus kestose fraction from the phase I separation contained less than 6 mg of carbohydrate, however, so that even 5 ml carbon columns provide a generous carbon-carbohydrate ratio and it was found that these small columns could be eluted completely in less than 90 minutes.

Raffinose and kestose are not separated on these small columns and so the trisaccharides from the phase I separation were hydrolysed with invertase and applied to the carbon column. The monosaccharide hydrolysis products were eluted with water and the melibiose was eluted with 10% ethanol. This concentration is higher than that normally recommended for disaccharides but, in the absence of trisaccharide following hydrolysis, the higher concentration could safely be used to provide more rapid elution and a more compact melibiose band. Qualitative separation was demonstrated by thin-layer chromatography.

Raffinose and kestose were calculated as in phase III. Realistic values were again obtained for raffinose but the monosaccharide recovery again tended to be high.

It was found that constituents of commercial invertase interfere with the anthrone determination of the monosaccharide, and this interference was ultimately avoided and satisfactory hexose recoveries were obtained by using hydrochloric acid inversion of raffinose and kestose.

Phase V. In the method as finally adopted, 1 ml of 20% molasses was fractionated on the smaller ion exchange column as in phase I. The raffinose plus kestose fraction was diluted to 25 ml and the sucrose plus galactinol fraction was adjusted to 50 ml and the total carbohydrate in each fraction was estimated with anthrone. 20 ml of the raffinose plus kestose fraction was then evaporated under reduced pressure to about 2 ml, and 0·2 ml of N hydrochloric acid was added. This solution was hydrolysed by heating at 70°C for 30 minutes with regular mixing. The solution was then cooled, neutralized and quantitatively diluted to 5 ml.

From this solution duplicate 2 ml aliquots were applied to 0·9 mm diameter columns containing 5 ml of 1:1 mixture of B.D.H. activated charcoal and "Celite 545".

When the solution had run on to the carbon, the walls of the column were washed twice with 2 ml of water and the column eluted with water applied at a pressure of 1 p.s.i. Monosaccharides were completely eluted with 25 ml of water, after which the eluant was changed to 10% ethanol and a further 25 ml fraction, containing all the melibiose, was collected.

The monosaccharides and the melibiose were determined with anthrone in 2-ml aliquots of the eluates. These aliquots normally contained between 20 and 100 µg of hexose or melibiose. For anthrone estimation of the monosaccharides, a heating time of 12 minutes was adopted because the colour yields from fructose and glucose coincide at this period. A heating time of 6 minutes was adopted for melibiose determination. The concentrations of raffinose and kestose in molasses were then calculated as outlined in phase III.

Although the ion exchange column did not require regeneration after each application of molasses, the separation efficiency as shown by thin-layer chromatography generally decreased after 5 or 6 applications. The efficiency could be restored by removing the resin from the columns, treating with 4N hydrochloric acid followed by reconversion to the lithium form, but it may prove simpler to discard the resin after 5 cycles. The carbon columns were not re-used after separation of hexoses from melibiose.

It was possible to measure the polarization of the raffinose plus kestose fraction from the ion exchange column using the ETL-NPL polarimeter and the higher concentration in the sucrose plus galactinol fraction permitted polarization with considerable precision. However, while a column recovery within 1 or 2 parts in 100 of the theoretical value would be more than adequate for estimation of the minor carbohydrates, a column recovery of this nature would be inadequate for direct measurement of sucrose by this method.

From application of artificial solutions, raffinose was recovered in the range 99–100% from the ion exchange column. When different amounts of raffinose were inverted and measured as melibiose off the carbon columns, recoveries were consistently high by about 8%. The melibiose reference standard, however, had a specific rotation, after mutaration, equivalent only to 94% anhydrous melibiose and so it was considered more reliable to calculate the raffinose content relative to standard raffinose, inverted under the standard conditions and separated on the carbon columns. Under these conditions raffinose was recovered in the range 97–100% for the complete phase V procedure, and this procedure is considered to provide a reliable control method for evaluating practical methods of determining raffinose. The fructose liberated from raffinose was recovered in the range 94–102%. Fructose applied directly to the carbon column was recovered in the range 100–105%.

As kestose yields three hexose units, whereas raffinose yields only one hexose unit, it is considered that the monosaccharide fraction provides a reasonable estimate of kestose even though the calculated

[15] WHISTLER & DURSO: *J. Amer. Chem. Soc.*, 1950, **72**, 677.
[16] *Methods in Carbohydrate Chemistry*, 1962, **1**, 42. (Academic Press Inc., New York.)

raffinose normally is several times greater than the kestose level. If the raffinose content was extremely high, however, the precision of an estimate of an extremely small kestose concentration would be low.

Results: Analytical values for 4 samples of molasses are recorded in Table 3.

Table 3

Minor carbohydrates in molasses

Sample I Kidderminster composite, 24.12.62—14.1.63
Sample II Wissington composite, 24.12.62—14.1.63
Sample III Felsted composite, 24.12.62—14.1.63
Sample IV Felsted composite, 1.10.62—29.10.62

Sample	*Concentrations in g/100 g molasses* I	II	III	IV
Chromatographic raffinose—				
direct	1·8	1·8	1·4	0·8
after hydrolysis	1·7	1·7	1·4	0·9
Raffinose—Phase V	1·65	1·68	1·52	0·88
Kestose—Phase V	0·34	0·25	0·42	0·16
Total of Phase V values	1·99	1·93	1·94	1·04
Raffinose plus Kestose, Phase I	2·04	1·91	1·97	0·96
Raffinose plus Galactinol—Phase II	2·27	2·16	1·68	—
Galactinol—Phase II minus Phase V	0·62	0·48	0·16	—
Reducing sugars—Phase I hexose fraction	1·86	0·36	1·54	—
Reducing sugars—direct in molasses	2·10	0·45	1·75	—

In no sample did the chromatographic raffinose value differ from the Phase V raffinose by more than 1 part in 10, which is the estimated precision of the visual method. It is concluded that the visual chromatographic estimation of raffinose by the standard ICUMSA method[10] provides a sufficiently precise value for the estimation of raffinose in molasses.

The kestose values are probably appreciably more reliable than the values which can be estimated chromatographically but the galactinol values should be viewed with reserve because of the potential contamination of the phase II sample if minute amounts of original sucrose escape hydrolysis.

From the concentrations obtained by the column procedure the contributions of raffinose, kestose and galactinol to the molasses polarization have been calculated as recorded in Table 4.

Table 4

Contribution of raffinose, kestose and galactinol to molasses polarization

Sample	I	II	III	IV
Raffinose	+ 3·06	+ 3·11	+ 2·60	+ 1·67
Kestose	+ 0·13	+ 0·10	+ 0·16	+ 0·06
Galactinol	+ 1·26	+ 0·98	+ 0·33	—

Discussion

Raffinose considerably elevates the molasses polarization in all samples and since the raffinose content of molasses can be determined readily by paper chromatography, it is not difficult to correct the molasses polarization for the raffinose contribution.

Although the large change in rotation on hydrolysis of kestose can produce a significant error in methods of double polarization, the contribution of this trisaccharide to the direct polarization of the molasses is relatively small because of the low specific rotation. Kestose can be estimated simultaneously with raffinose by paper chromatography but adjustment of the molasses polarization for this contribution would scarcely be worthwhile unless deteriorated beet were being processed.

In two of the samples, the calculated contribution of galactinol to the molasses polarization is quite appreciable and in samples I and II the positive rotation due to galactinol and kestose is numerically greater than the negative polarization which would normally be attributed to the reducing sugars.

It is tempting to consider that the direct polarization of the molasses, corrected for raffinose polarization, would provide a better estimate of sucrose in molasses than correction for both raffinose and reducing sugars. Such a conclusion, however, could only be justified after examination of many individual molasses samples, rather than composite samples, and might not apply if beet of low galactinol content were being processed at a factory which produced large amounts of reducing sugars by hydrolysis at low pH in the final stages of crystallization.

Comparative estimations of raffinose by chromatography, by acid hydrolysis using the Herzfeld-Schrefeld procedure with the Wortmann formulae and by single hydrolysis with invertase were made on molasses samples from two factories throughout the campaign. The analytical results are recorded in Table 5. For invertase hydrolysis the calculations were based on the divisors used in the Paine & Balch method, but the polarizations were corrected for reducing sugars as in the Wortmann formulae.

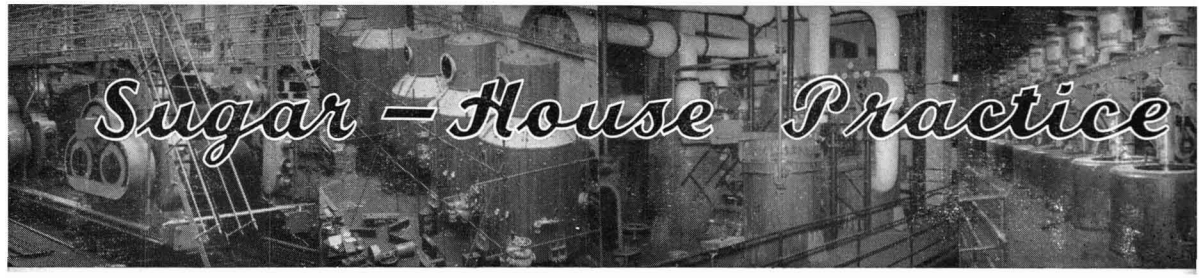
Table 5

Comparison of raffinose determined by chromatography, acid hydrolysis and single-enzyme hydrolysis

Molasses	*Raffinose in molasses g/100 g* *Invert %*	*Chromatography*	*Acid inversion*	*Enzyme inversion*
Bardney				
1.10.62	1·42	0·8	1·04	—0·33
8.10.62	1·35	0·9	1·34	—0·13
15.10.62	1·00	0·9	1·23	—0·05
22.10.62	1·05	1·1	1·17	—0·40
17·12·62	1·18	1·5	1·65	0·05
31.12.62	1·63	1·4	1·85	0·60
14.1.63	1·81	1·5	2·17	0·73
21.1.63	1·84	1·6	1·82	0·80
Bury				
12.10.62	0·41	0·7	1·34	—0·64
19.10.62	0·35	0·8	1·47	—0·63
16·11·62	0·43	1·1	2·04	—0·38
30.11.62	0·38	1·5	2·30	0·16
14.12.62	0·39	1·7	2·48	0·12
1.1.63	0·39	1·7	2·18	0·44

Although both the hydrolysis methods gave good recoveries when applied to synthetic mixtures of sucrose, raffinose and invert sugar, excessive raffinose values were obtained by acid hydrolysis for all the molasses samples whereas low or negative values were obtained by enzyme hydrolysis.

High raffinose and low sucrose values are obtained by double polarization if excess dextro-rotary materials are present in molasses or if an unjustified correction is made for levorotary components. It would not be valid to deduce that the high raffinose values on acid hydrolysis arose from this source, because of the uncertainty as to the effect of acid on the optical rotations and also because of the possible errors induced by comparing a direct lead clarified polarization with a charcoal clarified hydrolysis polarization. Both these uncertainties are avoided



Mechanism of entrainment and entrainment catchers. B. B. PAUL. *Proc. 30th Ann. Conv. Sugar Tech. Assoc. India*, 1962, 227–233.—The relationships between droplet size and velocity and its carryover are discussed as is the mechanism of separation of such droplets from the vapour stream, a number of catchers being illustrated.

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Okeelanta Sugar Company. M. A. RUBIO, W. J. BAPTISTE and V. E. BAIKOW. *Sugar J.* (La.), 1962, **25**, (7), 16–20.—An account is given of the history and present status of Okeelanta Sugar Refinery Inc. which owns and operates the Okeelanta and Fellsmere refineries. Combined area for the factories is 42,000 acres and approximately 1,000,000 tons of cane is crushed by the two plants. Equipment installed in recent years is noted.

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Four new Farrel tandems in Florida. ANON. *Sugar J.* (La.), 1962, **25**, (7), 22–30.—Detailed accounts are given of the tandems installed at Bryant, Glades, Moore Haven and Talisman factories by The Farrel Corporation.

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Improvements in cane mud filtration. C. MARTINEZ and L. ACONSKY. *Sugar J.* (La.), 1962, **25**, (7), 32, 36, 38.—An account is given of the successful introduction of the Dorr-Oliver "RapiFloc" system at Clewiston, Florida, in 1961/62 after pilot trials in 1960/61. The very fine mud particles are coagulated with "Separan AP-30" (1·05 lb/100 tons cane) and the rotary drum filters provided with special non-woven porous cloths. The filtrate goes direct to the evaporator and the cake pol was reduced from 4·19% in 1960/61 to 3·08% in 1961/62 in spite of an increase in mud load.

ESTIMATION OF SUGARS IN BEET MOLASSES—*continued*

in the enzymatic hydrolysis but again it would be invalid to deduce that the low raffinose values arose because of excessive levorotary materials in the original molasses since kestose, although dextrorotary, depresses the raffinose as estimated by single hydrolysis. Even when the actual raffinose content is known, the polarization of the non-sucrose constituents cannot therefore be deduced from hydrolysis methods of polarization.

CONCLUSION

It is considered that the combination of separation on ion exchange resins, acid hydrolysis and separation of the hydrolysis products on carbon columns can provide a suitable method for assessing the concentrations of the minor carbohydrates in molasses and for deducing the effect of these carbohydrates in conventional methods of molasses analysis.

Glades Sugar House. A. WEBRE and F. C. SCHAFFER. *Sugar J.* (La.), 1962, **25**, (7), 52–56.—See *I.S.J.*, 1963, **65**, 137–140.

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The chemical removal of scale. Laboratory and factory experiments. E. T. RELF and D. H. FOSTER. *Sugar J.* (La.), 1962, **25**, (7), 75–80.—Laboratory tests were made with HCl, sulphamic acid and "Versene" (EDTA) as scale removers, the acids containing 5% of molasses to inhibit corrosion. The HCl and "Versene" were effective but the former was more economical and was used for factory trials. Used at 1·5–2% concentration, inhibited with molasses, the HCl cleaned evaporator tubes effectively at Farleigh mill although under difficult conditions preliminary treatment with 5% NaOH is required. Corrosion of mild steel amounts to 0·005 inches per season, and of brass 0·003 inches. It is recommended that the acid pump should be protected with an epoxy resin paint, reinforced with glass fibre.

* * *

Decolorizing ion exchangers. XVIII. Brief characteristics of types of decolorizing ion exchangers produced or being developed. J. ŠTAMBERG. *Listy Cukr.*, 1963, **79**, 6–11.—The three major groups under which decolorizing ion exchange resins are classified (polycondensate, polyamine, and polystyrene) are described as to their chemical or physical structure, production methods, exchange and sorption properties, and the principles of their application in the sugar industry. An outline is also given of trends in the development of new resins.

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Application of ion exchangers in mixed beds to purification of refinery products. S. ZAGRODZKI and E. WALERIANCZYK. *Roczniki Technol. i Chem. Zywnosci*, 1961, **7**, 143–155; through *S.I.A.*, 1962, **24**, Abs. 1008. Tests were carried out on 16–18°Brix solutions of 1st, 2nd or 3rd product beet sugars at 7–8°C. "Wofatit MD" anion-exchange resin and Polish-made KP-38 cation-exchange resin were mixed together and used in six columns in series, with provision for intermediate sampling. The resins were regenerated separately after separation of the smaller "Wofatit" resin by sieving. Column tests with individual resins and KCl or acetate buffer solutions showed that the rate of ion exchange as well as the exchange capacity was higher in the case of the cation exchange resin. In the tests with sugar solutions a pH minimum was observed in the earlier columns (in spite of 28% excess anion exchange capacity) which gave rise to some inversion. The pH minimum shifted down towards the last column with increasing saturation of the bed. A roughly constant proportion (~65%) of the non-sugar in each sugar product was removed, including ~40% of the colour. Several regenerations were carried out without deterioration of the resin properties.

Last mill juices, a possible pointer to over-extraction. B. G. KRISHNAMURTI. *Indian Sugar*, 1962, **12**, 523–524.—Use of imbibition water extracts non-sucrose impurities which enter the last mill juice, so resulting in lower purity. Measurement of last mill juice purity will therefore give an indication of the extent of extraction of these impurities.

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Combination of triple-effect evaporators. A. L. WEBRE. *Sugar y Azúcar*, 1963, **58**, (1), 35–36, 44.—Steam usage, evaporation per pound of steam, vapour sent to condensers, etc., are worked out for five triple-effect evaporator plus heaters plus vacuum pans systems. The first is the simplest with a straight triple-effect, heaters and pans all heated with exhaust steam. In the second, juice heating is done with 1st effect vapour, while in the third it is done successively with 2nd effect vapour and exhaust steam. In the fourth system, 3rd effect vapour is used for juice heating while in the fifth, juice is heated successively by 3rd, 2nd and 1st effect vapours. Comparative data are tabulated and the efficiency of the last system emphasized; it is pointed out that it is as good as a quadruple effect system with 1st vapour bleeding for juice heating.

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"Segura" high-speed vacuum pan. A. DE KRYGER. *Sugar y Azúcar*, 1963, **58**, (2), 20–21.—A new Spanish vacuum pan design is described and illustrated. In it, steam is admitted to the calandria from above through a central steam pipe which is fitted with an evacuated jacketing pipe to insulate the massecuite from the steam. Incondensable gases are withdrawn from the "floating" calandria through a series of radial outlets and collected in an external circular pipe.

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Bulk sugar handling in Barbados. ANON. *Ind. Handling*, 1963, (Feb.), 14–15.—Further information is presented on the Bridgetown bulk handling installation[1]. Diagrams show how the raw sugar is unloaded from road transport, weighed and tipped into a 12-ton hopper feeding a 42-in conveyor belt beneath the centre line of the warehouse. The conveyor transfers 150 tons of sugar per hr from the hopper to the warehouse or 500 tons per hr from the warehouse to the loading berth. Sugar for storage is carried to a weigher tower whence it is fed by an inclined conveyor to a second conveyor running the length of the warehouse just beneath the roof apex. A travelling throw-off on the conveyor feeds a sugar thrower which can distribute the load of 80,000 tons over the full length and breadth of the floor to a height of 70 ft. Also presented are diagrams of the inclined conveyors feeding the sugar from the transfer house to the ship-loading towers and of a loading boom conveyor. The boom conveyors allow loading to continue whatever the tide level.

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Processing of kieselguhr in a chlorine atmosphere. I. G. BOGDAN. *Sakhar. Prom.*, 1963, (2), 22–23.—Kirovograd kieselguhr contains 3% iron oxide, but after heating at 950–1000°C for 30 min in a stream of chlorine it has been found suitable for syrup filtration, its filtration qualities being better than those of kieselguhr heated with or without addition of NaCl.

* * *

Instructions on evaporator boiling-out with acid. A. F. GIKALO. *Sakhar. Prom.*, 1963, (2), 23–25.—The risks of explosions caused by reaction of hydrogen, liberated from acid used for evaporator cleaning, with atmospheric oxygen are discussed and reference is made to regulations on this subject. The need to sample the air in an evaporator for the presence of hydrogen before repairs involving arc-welding are made is emphasized.

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Treatment and disposal of sugar factory effluents. T. R. BHASKARAN, R. N. CHAKRABORTY, N. DAS and S. N. SINHA. *Indian Council Med. Res., Special Rpt. Ser.*, 1961, (39), 19 pp.; through *S.I.A.*, 1963, **25**, Abs. 57.—A survey of 103 cane factories in Uttar Pradesh and Bihar, N. India, showed a mean production of 290 gal of waste waters (excluding condenser water) per ton of cane per day, with a mean 5-day B.O.D. of 570 p.p.m. Waste water treatment experiments at Bihta factory in the period 1956–1961 are briefly reported, and a design for a full-scale treatment plant is proposed (capacity 2,500–10,000 gal/hr) and described with diagrams and specifications. The waste water passes via a bar screen and grease trap to sludge digestion tanks and thence to oxidation ponds of the up-and-down flow type. The ponds are divided into an inlet portion containing water hyacinth (shown to give effective clarification) and an outlet portion for stabilization of the water with an active algal culture. The effluent B.O.D. was 20–95 p.p.m. in the trials. Biological treatment of the digested waste waters (after liming) in a trickling filter was relatively inefficient.

* * *

Exhaustibility of final molasses. T. S. RAO. *Indian Sugar*, 1962, **12**, 579–580.—To effect maximum molasses exhaustion, particular attention should be paid to clarification and to low-grade boiling. Maximum non-sugar removal should be aimed at in the former and a maximum yield of crystallizable sugar in the latter in order to increase cooling and curing efficiency. The massecuite should be boiled to about 58 purity and retained for about 30 hr in the crystallizers. A purity drop of 28–30 from massecuite to molasses is possible. Other factors affecting molasses exhaustion are listed.

* * *

Florida sugar industry. ANON. *Sugar y Azúcar*, 1963, **58**, (3), 45–46.—Some information is given on the geography of the Everglades region, and on drainage and water control, soil structure, climate, the Everglades Experiment Station, the growers' associations and on the farm labour costs. Details are given of the cane and sugar production and of sugar cane acreages by companies.

[1] *See also I.S.J.*, 1962, **64**, 121.

BEET FACTORY NOTES

An equation for sugar diffusion in factory conditions. P. V. GOLOVIN. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 3–4.—By substituting in an equation previously developed by the author, an expression is obtained for calculating the amount of sugar extracted from cossettes (G) per day: $G = \frac{FLbz\theta\alpha k(m-1+p)}{28{\cdot}75\,\delta^2 ln\,\frac{s_o}{s}}$ tons, where F = effective cross-section area of diffuser (sq.m.), L = effective length (m), b = diffuser charge (tons/cu.m.), $z/100$ = raw juice sugar content %, k = coefficient of cossette "equivalence" (the ratio of cossette total surface to the side surface), m = draught coefficient, p = sugar losses per unit sugar, s_o = sugar in cossettes %, s = total diffusion losses %, α = coefficient of diffusion in cossettes (sq.m./hr), δ = equivalent cossette thickness (m) and θ = operating period of the diffuser per day (hr) (= 24 for continuous operation). The expression is slightly modified for calculating q, the diffuser throughput (tons of beet per day): $q = \frac{FLb\theta\alpha k(m-1+p)}{0{\cdot}2875\,m\,\delta^2 ln\,\frac{s_o}{s}}$ tons. A worked example for both expressions is presented.

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A new empirical relationship for the determination of the coefficient of friction resistance λ in a pipeline during final molasses flow. Z. S. SHLIPCHENKO. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 41–44.—The system described previously[1] for the study of flow resistances in pipelines was applied to a determination of the relationship between the coefficient of friction resistance (λ) for molasses and Reynolds' number at small values of Re, in a temperature range of 35·5–73°C and at feed pressures of 1–3·5 atm. The relationship is defined by the equation $\lambda = 132/Re^{1{\cdot}12}$. While laminar flow is usually expressed by $\lambda = 64/Re$, at low Re values this gives too low a value of λ. However, with increasing Reynolds' numbers the values given by the two equations gradually converge, and coincide at Re >100. A graph is given of λ as a function of Re.

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The effect of circulation tube cross-sectional area on the circulation rate of sugar solutions in evaporators. I. M. FEDOTKIN. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 60–65.—Tests were carried out to establish the effect of structural elements in evaporators and of juice concentration on the circulation rate. A Kestner and a V-Ts evaporator were used and the apparent juice level, heat flow, Brix and other factors were varied. The greatest change in the circulation velocity occurred as a direct function of the apparent juice level. In the Kestner evaporator at a relative tube cross-sectional area ($= F_{Ts}:F_k$, where F_{Ts} = cross-sectional area of the circulation tubes and F_k = cross-sectional area of the boiling tubes) of 0·8–1·0 and a heat flow of 15,000, 40,000 and 50,000 kcal/sq.m./hr, the average circulation rate increased only very slightly with rise in the apparent level to 50%, but with increase from 50 to 100% in the apparent level, the circulation rate rose by more than 300%. That the effect of the relative cross-sectional area of the circulation tubes on the circulation rate varies according to the apparent juice level is demonstrated by a graph of the circulation rate (W_o) *vs.* $F_{Ts}:F_k$. This shows that at 30–75% apparent level, the mean circulation rate increases only with increase in the relative tube cross-sectional area from 0 to 0·2. With further increase from 0·2 to 1, the mean rate remains almost constant at less than 100% apparent level. W_o *vs.* heat flow and juice level is expressed by a straight line semi-log graph. Equations are developed for calculating the circulation rate for water and sugar solutions.

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Analysis of wear of plunger pump parts at sugar factories. N. A. SOLOGUB. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 77–83.—The wear of plunger pumps used to transfer milk-of-lime, clarifier muds and molasses and—more rarely—wash liquor, raw juice, etc. has been studied at a number of Soviet sugar factories. Results of the analyses are discussed and various recommendations are given regarding the best materials for various components.

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The effect of the liquor level and circulation rate on heat exchange during massecuite boiling. V. P. TROINO and V. D. POPOV. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 89–98.—Studies were made of the boiling of 1st refinery massecuite in a test unit, using initial syrup quantities of 21, 35 and 45% of the total syrup intake and with varying heating tube and downtake diameters. The effect of the level of syrup above the calandria on the heat transfer at various crystal contents was studied. The crystal content (at 0–13% by weight) had no effect on the optimum level, and the boiling tube diameter and pressure due to temperature had almost no influence, at constant crystal content. At 45% initial syrup, the whole of the boiling process proceeds under optimum conditions, whereas at 21% initial syrup only one-third of the process takes place under optimum conditions. At constant crystal content, the circulation rate increases with the syrup level, reaches a maximum, and then falls with further increase in the syrup level. The optimum circulation rate increases with rise in the pressure due to temperature and with decrease in the boiling tube diameter, and decreases, as does the maximum attainable circulation rate, with increase in the crystal content (by weight). At about 45% crystal content, the optimum and maximum circulation rates are identical and do not depend on the pressure due to temperature.

[1] *I.S.J.*, 1961, **63**, 18.

The optimum heat transfer coefficient falls with increase in the crystal content and in the total massecuite concentration, but increases with increase in the pressure due to temperature. Various tests have shown that the diameter of the boiling tube does not affect the heat transfer from wall to the boiling mass. Since the crystal sizes do not play a decisive rôle in boiling, it is completely possible to maintain an optimum massecuite level throughout the whole process and ensure an adequately high throughput, by feeding as small an initial quantity of syrup as is possible. This amount is determined from the massecuite level at the moment of nucleation. The test data are recommended for calculations to be used in the design of vacuum pans, and the procedures to be used in the determination of the various factors are presented.

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The relationship between the quantity of heat drawn from massecuite and the massecuite temperature during cooling in crystallizers. I. S. GULYI and V. D. POPOV. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 112–117.—To determine the amount of heat drawn from massecuite (for crystallizer calculations) necessitates calculating the specific heats of the molasses, crystals and massecuite. The heat capacity of massecuite is determined to a large extent by its crystal content and graphs of temperature *vs.* specific heat are presented based on calculations for pure sucrose theoretically crystallized under phase equilibrium conditions. These graphs demonstrate the change in specific heat during cooling from 80 to 30°C, with increasing crystal content (0–50%) and with a constant crystal content. The difference between the two examples is that between a final specific heat of 0·500 kcal/kg/° and 0·595 kcal/kg/°. For lower purities the difference will be less pronounced. HONIG's data[1] on the heat of crystallization for cane sugar are used to construct a nomogram which together with the weight of the crystallized sugar (kg) is used to determine the heat of crystallization with beet products. The various factors mentioned (temperature, crystal content, specific heat and heat of crystallization) are then used for a further diagram for determining the heat drawn from the massecuite during cooling as dependent on the initial crystal content.

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The relationship between the coefficients of scale formation and the circulation rate during the evaporation of sugar juices. I. N. ZASYAD'KO. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 124–129.—In experiments[2] it has been found that increasing the rate of circulation to values above that at which the boiling proceeds beyond the heating tube does not have any greater effect on scale reduction; at a circulation rate of 15 times the optimum value (that rate at the optimum level of boiling juice), the amount of scale deposited is only reduced by half. Similar behaviour is observed for the thermal coefficient of scale formation. The weight coefficient of scale formation (scale deposited per unit of evaporation) and the thermal coefficient of scale formation may be determined from equations developed for circulation rates of 0·05–6·4 m/sec, and the relationship between scale formation and the circulation rate is demonstrated by a number of graphs.

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Hydrocyclones in the sugar industry. S. BEDNARSKI. *Zeitsch. Zuckerind.*, 1963, **88**, 69–79.—A survey is presented of the application of hydrocyclones to the treatment of 2nd carbonatation muds, waste water and milk-of-lime. The fundamentals of the hydrocyclone are described and results of various tests are tabulated and flow-sheets presented. On the basis of these, various recommendations are made regarding hydrocyclone dimensions and feed pressures,etc. Thirty-one references are given to the literature.

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The determination of optimum equipment size. P. FREUND. *Zeitsch. Zuckerind.*, 1963, **88**, 85–86.—The significance of equipment size in regard to capital and running costs is discussed and the "degression exponent" submitted as an indication of the relative decrease in capital outlay with increase in the characteristic size of the equipment. By means of graphs, the relative costs are compared for: (1) a diffusion battery of n units and one unit of the same capacity as n units, and (2) a battery of n units plus one reserve unit and one unit of the same capacity as n units plus a reserve of the same capacity. These demonstrate that from the economic and operating angle, the optimum is one unit only for a given capacity, or if the capacity must be split, equal-sized units.

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Juice purification at Hougaerde sugar factory (Belgium). L. P. MOTTARD. *Zeitsch. Zuckerind.*, 1963, **88**, 87–88.—See *I.S.J.*, 1962, **64**, 339.

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Method of controlling the extent of damage to beet and the scalding of cossettes. K. ČIŽ. *Listy Cukr.*, 1963, **79**, 31–32.—To determine the extent of damage to beet during transportation or storage, the author recommends treating samples (cossettes or thin slices) with a 0·05–0·3% solution of $KMnO_4$ for 1–5 min. This will give a clear indication of the beet morphology and of the optimum time and temperature of scalding of cossettes for continuous diffusion.

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Optimum heating surface distribution in a multi-effect evaporator station. A. BUCZOLICH and A. ZÁDORI. *Zucker*, 1963, **16**, 117–119.—See *I.S.J.*, 1963, **65**, 149.

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Addendum to "Mechanical vapour compression in sugar factories". G. VERNOIS. *Zuckererzeugung*, 1963, **7**, 39.—Some calculations given in the earlier work[3] are further explained.

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[1] *Sugar J.* (La.), 1951, **14**, (5), 11–14, 30–31; *I.S.J.*, 1952, **54**, 163.
[2] *Cf.* ZASYAD'KO & TOBILEVICH: *I.S.J.*, 1961, **63**, 275.
[3] *I.S.J.*, 1963, **65**, 148.

Beet juice purification and the utilization of carbonatation mud. J. VAŠÁTKO. *Gaz. Cukr.*, 1963, **65**, 37–41. See *I.S.J.*, 1963, **65**, 22.

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Some problems in the coagulation of raw juice colloids. V. TIBENSKÝ. *Gaz. Cukr.*, 1963, **65**, 41–43.—See *I.S.J.*, 1963, **65**, 22.

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Proportional feeder for lime and juice. S. ZAGRODZKI and S. M. ZAGRODZKI. *Gaz. Cukr.*, 1963, **65**, 43–45.—See *I.S.J.*, 1963, **65**, 22.

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The use of inhibitors in the cleaning of heat exchangers. E. MALANOWSKI. *Gaz. Cukr.*, 1963, **65**, 52–54.—Among the inhibiting agents mentioned for corrosion protection of metal when HCl is used for scale removal are: hexamethylenetetramine and formalin–both strong inhibitors—and joiners' glue, pyridine, quinoline and furfural (weak inhibitors). Cleaning juice heaters with HCl in the presence of 0·1% hexamethylenetetramine proved to be rapid and economical.

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A method of fractionation by ion exchangers. P. DEVILLERS and M. LOILIER. *Sucr. Franç.*, 1963, **104**, 59–62.—Fifty or a hundred ml of beet juice, 25 g of syrup, 5 g of molasses or solutions of various amounts of sugar, depending on its quality, are passed successively through 30 ml each of a cation and anion exchanger in two 5 mm dia. columns to yield four non-sucrose fractions: A contains sugars and neutral products, B contains amino-acids and betaine, C organic acids, and D contains metals. Cane juice and beet press and raw juice must first be purified by the conventional lime method or by alcohol flocculation, followed by flocculation in acid. After effluent fraction A has been collected (the collecting dish contains $CaCO_3$ to avoid inversion), the cation exchanger is eluted with 150 ml N ammonia and is rinsed to yield about 250 ml of fraction B; 200 ml of 3N HCl are then passed through in 50 min and combined with washings to give fraction D. The anion exchanger is then eluted with 150 ml N HCl and washed to give fraction C. The fractions are concentrated *in vacuo* at 40–50°C, A and B fractions being concentrated simultaneously, the former to the consistency of a light syrup and the latter to about 5 ml. Fraction C is concentrated to about 5 ml and fraction D to dryness. Details are given of the drying procedures for each fraction, as well as the analytical procedures.

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Statistical data analysis and factory control in the sugar industry, Part IV. W. SCHMIDT. *Zeitsch. Zuckerind.*, 1963, **88**, 132–137.—The taking of samples for the establishment of criteria is discussed, and the accuracies obtainable with random sampling and systematic sampling (e.g. at equal distances on a conveyor belt or at equal time intervals) are considered. "Stepwise" sampling is necessary with heterogeneous materials, e.g. for sugar determination in beet. Generalizing conclusions from tests is valid at first only for the material studied and for others of the same type under identical conditions. In complex tests, in which many variables undergo changes, it is possible to find how the criteria respond to the different conditions, so that the generalized statements will be of use for future planning. Suitable test procedures are explained.

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Centrifugal development at the cross-roads. K. PAUSE. *Zeitsch. Zuckerind.*, 1963, **88**, 138–141.—The development of large capacity basket centrifugals (1000 kg of massecuite or more) is discussed, and particularly the two possible directions that designers can follow: increasing the effective volume by increasing the basket diameter while maintaining or reducing the conventional basket height and the more usual speeds, or maintaining the conventional basket diameter and increasing the basket height and speeds. Two centrifugals are compared: each basket has a capacity of 1000 kg of massecuite, but one has an i.d. of 1600 mm, a height (inside) of 600 mm, and runs at a maximum of 960 r.p.m., while the other has an i.d. of 1200 mm, an inside height of 1100 mm and runs at a maximum of 1450 r.p.m. From the operational data supplied it is shown theoretically that the former centrifugal is less economical than the latter. The various factors involved are discussed. Charging of a higher basket is considered not to be difficult.

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Propeller agitators in sugar factories. J. BROKHAGE. *Zucker*, 1963, **16**, 148–153, 177–181.–The applications of propeller agitators for mixing in sugar factories are discussed, and in particular the factors that must be considered in their construction, such as power requirements, circulation rate required, dimensions of the vessel housing the agitator, the location of the agitator and design of the agitator support, and the possible effects from other installations in the vessel. It is pointed out that while propeller agitators are highly economical, very often in sugar factories they are too large for the particular duty. The article contains numerous diagrams.

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Optimum temperature conditions in diffusion. YU. D. KOT. *Sakhar. Prom.*, 1963, (3), 24–26.—Experience has shown that the use of tail heaters as well as head heaters in a battery diffuser to raise the average diffusion temperature has resulted in improved performance and has also improved the settling and filtration of 1st carbonatation juice. The argument that head heaters have advantages over tail heaters is refuted.

NEW BOOKS AND BULLETINS

Zucker—ein Grundnahrungsmittel und seine Geschichte. (Sugar—a Staple Food and its History.) Dr. THOMAS GEERDES. 144 + viii pp.; 7 × 9¾ in. (Stuttgarter Verlagskontor G.m.b.H. and United Publicity Service Wolf Uecker, Hamburg 1, An der Alster 25, Germany.) 1963.

The aim of this book is to provide the general reader with information on many aspects of one of the world's staple foods. It achieves this object excellently, giving clear and concise explanations of the nature of sugar, how it is manufactured, and how important it is as a food. A brief history of sugar is given (this includes an interesting section on the first beet factory set up by Achard at Kunern in Silesia complete with a photograph of the factory and illustrations of a complete model of the factory), followed by short sections on the economic and agricultural importance of sugar and on the control of the sugar market. The mechanism of sugar photosynthesis and the formation of the various sugars are explained as is the extraction of sugar from beet. The numerous by-products from molasses and sugar are dealt with, including possible future uses of the latter. The chapters that follow are concerned with the food value of sugar, with a discussion of its energy-giving properties and the process of hydrolysis in the body and absorption into the blood stream. The remainder of the book contains information on the preserving properties of sugar and the many household uses with hints on preparing fruit and fruit juices, and on jelly and jam making, etc. A short glossary of sugar terms is included and eight coloured diagrams are appended showing: the cane and beet areas of the world; world sugar consumption per caput; the rôle of sugar beet in agriculture; the yield from one acre in terms of beet, sugar, molasses, pulp and leaves with a comparison with other crops in calorific values; the photosynthesis process; sugar distribution in a beet; a beet factory diagram; and the energy cycle in nature. The book, in the production of which a number of distinguished German scientists have collaborated as well as sugar technologists, is very well printed with black-and-white illustrations and its presentation is excellent.

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Africa and Irrigation. 259 pp.; 8½ × 11 in. (Wright Rain Ltd., Crowe, Ringwood, Hants., and associated companies.) 1963.

This volume constitutes the proceedings of an international symposium held at Salisbury, Southern Rhodesia (21st–29th August, 1961), on irrigation in Africa, the symposium having received the full moral backing of the Federal Government of Rhodesia and Nyasaland[1]. As pointed out in the preface, the correct and economical use of water for irrigation is one of the keys to the future prosperity of Africa, for water is in short supply for crop plants in so many areas. With the population increasing by millions, the need is for more and more food every year, and it is in this connexion that the irrigation expert in Africa will assume more and more importance.

There are some three dozen papers in the proceedings and they cover all aspects of modern irrigation in Africa. Eight or nine papers are concerned specifically with Rhodesia and four are devoted to the irrigation of sugar cane, viz. "The Overhead Irrigation of Sugar Cane in Natal" by T. G. CLEASBY[2]; "Good Design for the Overhead Irrigation of Sugar Cane" by D. S. HUGHAN[3]; "Researches into the Use of Irrigation Water on a Sugar Cane Crop" by C. H. O. PEARSON; and "Sugar Growing on the Hippo Valley Estates in Southern Rhodesia" by J. T. BOAST.

Other irrigated crops dealt with include vegetables, cotton, tobacco, coffee and citrus. Most of the papers, however, are concerned with what might be termed the broad general principles of irrigation in Africa. There are, for instance, interesting accounts of selection of sprinklers and pumps for African conditions, frictional losses, irrigation design, drainage and the training of unskilled labour for efficient irrigation, especially in Africa. This work will be useful to anyone concerned with the practical problems of irrigation. An index is provided.

F.N.H.

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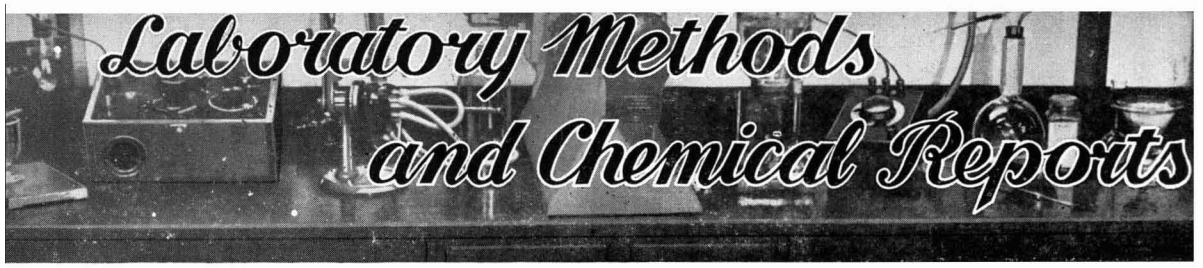
World Catalogue of Sugarcane Genetic Stocks. J. THULJARAM RAO and –. VIJAYALAKSHMI. 77 pp.; 8 × 12 in. (Sugarcane Breeding Institute, Coimbatore, India.) 1963.

This typewritten mimeographed work should be of interest to sugar cane breeders and to cytogeneticists in general, containing as it does the chromosome numbers of so many forms and varieties of sugar cane. The authors point out that Coimbatore and Canal Point, Florida, U.S.A., are the two centres in the world where a world collection of sugar cane germ plasm (in the form of wild and cultivated sugar cane) is maintained. The Indian collection is being moved to a sub-station at Cannanore, Kerala State, an area comparatively free of pests and diseases, including mosaic, with a duplicate set at Coimbatore for detailed cyto-taxonomical and other studies.

The available information concerning this collection (as on June 30, 1962) has now been brought together in the present catalogue, which is largely in tabular form, using abbreviations, with a remarks column for special comments regarding each variety or clone. The number of canes dealt with is as follows: *Saccharum officinarum* 664; *S. robustum* 50; *S. spontaneum* 451; *S. barberi* 65; *S. sinense* 17; *S. edule* 13; foreign commercial hybrid varieties 381; Indian commercial hybrid varieties 1003; miscellaneous 69. The Indian commercial hybrids will be dealt with in Part II, expected to be available in the latter part of 1964.

F.N.H.

[1] *I.S.J.*, 1962, **64**, 163.
[2] *I.S.J.* 1961, **63**, 327, 359.
[3] *I.S.J.* 1962, **64**, 63.



Progress in investigation of colorants in sucrose crystal. C. C. TU. *Amer. Chem. Soc. 142nd Meeting Abstr. of Papers*, Sept. 1962, 1D–2D, and original MS.; through *S.I.A.*, 1963, **24,** Abs. 1048.—The sensitivity of the colour of the impurities in the crystal to changes in pH was studied and a separation of individual colour fractions and amino-acids from the sugar was effected by ion-exchange paper chromatography. Two raw sugar samples were dissolved and the colour of the solutions was measured at pH 4·0–9·0 by absorptiometery at 420 mμ. Differences in the colour of the two sugars appeared only at pH values above 7·0, and are ascribed to thermal degradation products of reducing sugars[1]. A sample of the impurities was obtained by dissolving 500 g of crystal in 85% methanol and removing most of the sucrose by crystallization. The impurities were separated by descending cation-exchange paper chromatography with water followed by ethyl acetate-pyridine: water (50:50:5) mixture. Three spots corresponding to sugars, colorants and amino-acids were clearly separated. The colorants were also retained after washing of the impurities on anion-exchange resin paper, and were separated into three groups (of which the intermediate one was very faint) by descending chromatography with ethyl acetate:acetic acid:water (6:3:2) mixture. The colour was not removable with NaOH solution. Individual amino-acids were also separated on cation-exchange resin paper. At least two basic ninhydrin-reacting compounds were revealed, which had presumably dissociated from the colorant complex, since free basic amino-acids are normally absent.[2]

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Simple instructions for microbiological control of diffusion. S. SCHMIDT-BERG-LORENZ. *Zeitsch. Zuckerind.*, 1963, **88,** 32–37.—Advice is given on suitable laboratory equipment for practical bacteriological control of diffusion. Details are given of the procedures to be used in the determination of live bacteria counts in juices using a modernized Koch plate process with a yeast extract as culture medium, and in the determination of the sucrose splitting activity, measuring the pH at 68°C. These two methods, amongst others, are used in combination at the Berlin Institut für Zuckerindustrie.

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Viscosity of molasses from Kirgizian sugar factories. G. B. AIMUKHAMEDOVA. *Izv. Akad. Nauk Kirgiz. SSR, Ser. Estestv. i Tech. Nauk*, 1960, **2,** (5), 65–69; through *S.I.A.*, 1962, **24,** Abs. 1000.—The viscosities of 20 samples taken from four factories in the 1951 and 1952 campaigns were determined at 40°, 50°, 60° and 70°C (all at 82°Brix by refractometer without dilution) by means of a Höppler viscometer. The tabulated results show values ranging from 2501 to 6341 centipoises at 40°C, of which the majority were less than Silin's standard viscosity of 4400 cp. It is concluded that in the majority of cases a higher Brix than 82° could have been handled at the centrifugal station, and that the actual sugar losses in molasses were greater than those calculated by Silin's procedure. The calculation of the corrected standard purity is explained.

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Methods for determination of the decolorizing power of animal black. G. PIDOUX. *Ind. Alim. Agric.*, 1962, **79,** 1045–1054.—See *I.S.J.*, 1963, **65,** 123.

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The sphere photometer. W. O. BERNHARDT, F. G. EIS and R. A. MCGINNIS. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12,** 106–126.—An instrument is described for measuring colour and turbidity of white sugar solutions as functions of the absorption and scattering of light passing through them. A filtered and collimated light beam is passed through a cell located inside a double-hemisphere lined with a highly diffuse-reflecting white paint. Light passing through meets an exit shutter which may be replaced by a mirror, while scattered light, after a number of reflections partly enters a housing, located behind a baffle, which contains a photo-cell. The latter provides readings related to the light flux falling on its cathode. The sample cell may be placed in the light path outside the sphere so that with the mirror in place the photo-cell current measures the light transmitted. When the sample cell is inside the sphere, the mirror is removed when the photo-cell current measures turbidity. A "standard" clear colourless sugar solution of the same concentration as the sample is used first to adjust the photometer to indicate unit transmittancy, when replacement of the standard with the sample allows the transmission and scattering (colour and turbidity) to be measured directly. Tabulated and discussed test results show that the measurements are reasonably accurate (±2%) and reproducible. An appendix gives details of the electronic circuitry of the instrument.

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Nitrogenous substances in molasses from beet sugar factories in the Ukraine. I. M. LITVAK and E. A. GRIVTSEVA. *Sakhar. Prom.*, 1963, (2), 25–29.—Molasses from factories in 12 *oblasts* of the Ukraine were analysed for total N, betaine N, glutamic acid N and amino-acid N. The results for 1959/60 and 1960/61 are compared, as are the results from different *oblasts*.

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[1] *Cf. I.S.J.*, 1961, **63,** 56.
[2] *Cf. I.S.J.*, 1961, **63,** 119.

Carrying out the floc test and its technological significance. H. SCHIWEK. *Zucker*, 1963, **16**, 80–89.—The problem of floc formation in non-alcoholic carbonatated clear drinks is discussed and the various methods developed for quantitative and qualitative determination of the flocculating capacity of a white sugar are described. The method of WALKER[1], whereby saponins are determined with a reagent containing 10% antimony pentachloride in chloroform, is considered time-consuming and moreover only a part of the total floc is determined—the oleanolic acid portion. The polarographic determination of the surface-active substances in white sugars, as described by VAVRUCH[2], allows up to 10^{-9} moles of reducible and oxidizable substances per litre to be quantitatively determined, giving an accuracy of 1–3%. It has been found that with increase in voltage, the current intensity also increases to a point after which it falls to a minimum and then increases again. This first stage is a "1st order maximum" and the theory of the maxima formation is briefly discussed. The maximum reached in the 1st reduction stage (the 2nd stage is a normal polarographic stage) is dependent on a number of factors including the surface-active substances content. The damping effect of saponins on the maximum has been investigated and the maximum found to be logarithmically proportional to the saponin content, this relationship being expressed by an almost straight line graph. A procedure for purification of the sugar used for a calibration curve is described which will give a smaller damping of the maximum than with VAVRUCH's procedure. The polarographic method of OHASHI[3] is also described. Measures to adopt in order to keep the oleanolic acid content of white sugar below 2 mg/kg of sugar are enumerated.

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Titrimetic determination of glucose. K. R. MANOLOV. *Zhurn. Anal. Khim.*, 1962, **17**, 898–899; through *S.I.A.*, 1963, **25**, Abs. 42.—A new method is described in which unreacted Fehling's solution is titrated with KCN. Fifty ml of Fehling's solution are mixed with 50 ml of water and heated to boiling. Twenty-five ml of a glucose solution (> 1%) are then added and the mixture is boiled for 2 min. The Cu_2O is removed on a glass filter (No. 4) and washed 2–3 times with a few ml of hot water. The filtrate is again heated to boiling and titrated with 0·3N KCN until colourless. The titre is then subtracted from the result of a blank determination. The glucose equivalent of KCN is determined for a standard glucose solution (~0·5%). The maximum error is $\sim \pm 0{\cdot}9\%$.

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Thin-layer chromatography of sucrose esters and mixtures of raffnose and sucrose. M. GEE. *J. Chromatogr.*, 1962, **9**, 278–282; through *S.I.A.*, 1963, **25**, Abs. 45.—Sucrose esters consisting of a mixture of mono- and di-substituted esters were separated by ascending chromatography on glass strips coated with silica gel (containing 5% of starch binder), with toluene:ethyl acetate: 95% ethanol (10:5:5 by volume) mixture as the solvent, and were revealed with dichlorofluorescein in U.V. light. The esters were applied in solution in $CHCl_3$. A long spot was obtained corresponding to the monoesters followed by four or five spots corresponding to different diesters. Sucrose and raffinose were similarly separated in aqueous solution with isopropyl alcohol:toluene: ethyl acetate:water (10:2:5:2·5 by volume) as the solvent, and were revealed with naphthoresorcinol-H_3PO_4 indicator. The spots were quantitatively analysed by scraping off the gel and eluting with dimethyl formamide, followed by colorimetry with a ketose reagent. The recovery of sucrose was 90–105%.

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Rapid method of determination of saturation coefficients of solutions in sugar manufacture. D. M. LEIBOVICH, I. F. ZELIKMAN and N. L. TROYANOVA. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1962, (5), 137–139; through *S.I.A.*, 1963, **25**, Abs. 48.—A modification of the VK-1 vibration chamber (designed by K. P. ZAKHAROV) is described with a diagram and notes on its application. A massecuite containing 60% of crystal is prepared from the solution, and is introduced into the chamber which has a vibrating rubber base and can be inverted manually from time to time to re-distribute the crystals. The chamber is jacketed with liquid from an ultra-thermostat which is also connected to a universal refractometer, so that measurements of refractometric Brix can be made on samples of syrup at the same temperature. Syrups of higher purity should be examined at room temperature, whereas 60–70°C is recommended for molasses; correction tables are required in the latter case. A determination requires 60–80 min.

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Examination of the coefficients of friction of certain food products as dependent on the speed of slip over various materials. V. Z. SHAPRAN and V. D. POPOV. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 13–17.—Details are given of a device which was used to determine the coefficients of friction of tablet sugar from certain Soviet refineries, as well as certain types of caramel, on materials most commonly used for wrapping machine feeders: steel, aluminium, vinyl and fluoro-plastics and rubberized cloth. The device has no components for measuring strengths, but merely measures the friction as a function of the weight of the sample. The materials were first rubbed with fine dispersion dust from active carbon, then thoroughly washed with alcohol, dried, and finally rubbed with refined sugar or caramel respectively. The tests were conducted at 19–21°C (room temperature), and at an R.H. of 43–45% at speeds of from 0·17 to 6·0 m/sec. The specific pressure was 1·8–3·2 g/sq.cm., i.e. up to double the weight of

[1] *I.S.J.*, 1957, **59**, 257.
[2] *Anal. Chem.*, 1950, **22**, 930.
[3] *I.S.J.*, 1955, **57**, 147.

the samples. The results are expressed in graph form and are recommended for use in the manufacture of feeders.

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Mineral substances in molasses from Ukrainian sugar factories. E. A. GRIVTSEVA. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 20–27.—The molasses from Ukrainian factories were analysed for two campaigns and the results tabulated by *oblasts*. Graphs are also presented showing the relationship between the K, Na, lime salts and carbonates and the melassigenic coefficient for the molasses and "standard" molasses by *oblasts* and state farms. It was found that the melassigenic coefficient both of factory and "standard" molasses increases with increase in the proportion of total and alkaline ash in the non-sugars, but decreases with increase in the lime salts. The carbonate ash content occurred in the range 10·21–13·46% on dry solids, while the lime salts covered the range 0·36–2·09%. The carbonate ash and the melassigenic coefficient increase with a fall in the mean air temperature and with increase in rainfall (with certain exceptions). While in 1959/60 a correlation was established between the amount of mineral fertilizers applied and the total carbonate ash in the molasses, no such relationship was found for 1960/61.

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Colorimetric method for determining betaine in final molasses and discard Steffen alkali. M. I. BARABANOV, S. T. VIL'CHINSKII and I. M. LITVAK. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 69–73.—See *I.S.J.*, 1962, **64**, 247.

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Experimental investigation of the specific gravity of discard alkaline solutions from sugar factory Steffen plants. E. L. ZARECHANSKII and A. M. CHERNYI. *Trudy Kiev. Tekhnol. Inst. Pishch. Prom.*, 1962, **25**, 122–123.—An empirical formula has been derived for calculationg the s.g. of discard Steffen alkali containing 10·6–75·5% dry solids at 20–95°C. Graphs are given of the specific gravity *vs.* temperature at constant Brix and *vs.* Brix at constant temperature.

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Acids in beets and juices. IV. Variation in the anion content during manufacture. H. D. WALLENSTEIN and K. BOHN. *Zeitsch. Zuckerind.*, 1963, **88**, 125–131.—Of the 41 acids, apart from amino acids, to be found in beet and beet products and which are tabulated, it is pointed out that only 18 occur regularly and that considerable variation in their concentrations may take place during washing and storage as well as during processing. The causes may be chemical or biochemical. The behaviour and determination of oxalic acid and nitrate in beet and juices are discussed with reference to the work of others. Expressing the results in meq per kg of beet enabled variations to be more easily detected than if the results were calculated on 1 litre of 10°Bx juice or of 100 g dry solids. Non-nitrogenous organic acids, pyrrolidone carboxylic acid and phosphoric acid could be determined simultaneously within ± 5–10% by means of chromatography on an ion exchange resin. Seven of the acids separated by this method could not be identified. The acids found in the press juice recurred in raw juice, the latter containing more lactic and acetic acid. The considerable difference between the maximum and minimum lactic acid contents in the raw juice samples indicates the considerable effect of factory conditions and of the beet material on acid formation. However, raw juice samples from battery diffusers did not have significantly higher lactic acid contents than those from continuous diffusers. Increase in a number of acids from beet to juice was assumed from the tests, although a greater number of samples is considered desirable in order to clarify the increase in oxalic acid and the decrease in phosphoric acid. Considerable changes in the acid contents as a result of carbonatation are shown: while the majority of the polybasic acids are eliminated, monobasic organic acids are formed as products of decomposition. Phosphoric acid is almost completely eliminated, while the citric, oxalic and malic acid contents are considerably reduced. The sulphate and chloride contents remain almost unchanged. Lactic, glycolic, pyrrolidone carboxylic, formic and acetic acids are increased. Raw juice from beet stored for a long time was used in studies of the relationship between invert sugar decomposition and acid formation. The average acid formation was 6·9 meq/g of invert sugar decomposed, of which about 40% was lactic acid, 15% acetic acid, 30% unknown acids, and the rest formic and glycolic acid. With a high invert content and correspondingly high acid formation, the natural alkalinity of the liberated alkali ions is insufficient to neutralize the newly formed acids, so that the lime content of the thin juice rises; however, a mathematical relationship could not be established between the acid formation and the increase in the Ca content. Samples from two sugar factories revealed an increase in total acid and lactic acid from thin to thick juice, the acid content in the thick juice being little less than in the raw juice. The acid formation in carbonatation and evaporation corresponds to a sucrose loss of approximately 0·2% on beet, and it is considered possible to reduce this loss by improving the processes and the equipment. Determination of the individual acids in thin and thick juice as well as after each evaporation effect is believed to be a better guide to acid formation than pH measurement. The acid contents in molasses are also summarized and show that some of the acids, particularly lactic, acetic and pyrrolidone carboxylic acid, are also formed in the sugar house. The results of the studies are summarized in the form of a diagram and some data are provided showing the extreme contents obtained with abnormal beet and juice qualities.

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Sucrose determination on non-pure products. J. A. LÓPEZ HERNANDEZ. *Sugar y Azúcar*, 1963, **58**, (4), 41–42.—See *I.S.J.*, 1963, **65**, 46–48. 72–73, 107–109.

UNITED KINGDOM

Manufacture of glutamic acid by fermentation. NIPPON TENSAI SEITO K.K., of Hokkaido, Japan. **921,962.** 17th September 1959; 27th March 1963.—Glutamic acid is produced by aerobic fermentation with *Brevibacterium sibeti*, of a medium containing at least one sugar (glucose, fructose, sucrose, molasses, etc.), at least one N compound (an ammonium salt, urea, peptone or hydrolysed protein), at least one inorganic compound (potassium biphosphate, magnesium sulphate or ferric chloride) and growth-promoting media (meat extract). The initial pH is 6·8–7·2 and the medium is incubated at 29–32°C with agitation to produce the glutamic acid.

* * *

Mixed fatty acid esters of mono- and disaccharides and their preparation. EASTMAN KODAK COMPANY, of Rochester, N.Y., U.S.A. **922,023.** 15th April 1959; 27th March 1963.—Non-crystallizable fully esterified mono- or disaccharides, having at least 20% of the acyl groups *iso*-butyryl or propionyl and the remainder acetyl or propionyl, are formed by heating the sugar (glucose or sucrose) with a mixture of the acyl anhydrides concerned in the presence of (1–20% of) a catalyst, viz. an alkali metal (Na, K or Li) or alkaline earth metal (Ca) salt of an organic acid (which may be one of those of which the anhydride is present in the reaction mixture). Each mole of glucose is reacted with 5–8 moles of mixed anhydrides (0·5–2 moles of acetic anhydride and 5·25–6 moles of propionic or *iso*-butyric anhydride) while sucrose is reacted with 8–12 moles per mole of mixed anhydrides (1–3 moles of acetic anhydride and 7–9 moles of propionic or *iso*-butyric anhydride). The reaction continues until the product is completely dissolved.

* * *

Sugar purification. R. A. GRANT, P. A. S. CANHAM and DAVCO (PTY.) LTD. **923,109.** 9th May 1961; 10th April 1963.—The sugar solution is purified by passing through a bed or mat of ion-exchange adsorption material which comprises a substrate of inert material (cellulosic, asbestos or synthetic fibre, or kieselguhr) having a surface of a cellulose derivative which contains basic or substituted amino-groups, quaternary ammonium groups or heterocyclic nitrogen atoms. Where the substrate is a cellulose fibre it may be so treated as to produce the required surface, i.e. by converting it into an aminoalkyl cellulose or substituted aminoalkyl cellulose [dimethyl aminoalkyl (dimethyl aminoethyl) cellulose or heterocyclically substituted alkyl cellulose (piperidinoalkyl cellulose)]. The surface layer may be further treated with a quaternizing agent (alkyl halide, sulphate or toluene sulphonate) to form quaternary ammonium groups. The product is able to remove colour from sugar solutions and may be regenerated by a two-stage treatment with dilute alkali and/or sodium chloride.

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Production of sugar. CHEMISCHE WERKE ALBERT and SÜDDEUTSCHE ZUCKER A.G. **924,250.** 7th December 1961; 24th April 1963.—Sugar is extracted from plant material (beet or cane) with an aqueous solution of 20–80 (30–50) g/cu.m. of (the sodium salt of) a condensed phosphate (an acidic or neutral pyrophosphate, a tripolyphosphate, a tetra- or octapolyphosphate, a hexametaphosphate or cyclic metaphosphate). According to an example given this improves the yield of sugar extracted by about 0·05% on beet.

* * *

Production of sugar esters. FARBENFABRIKEN BAYER A.G., of Leverkusen-Bayerwerk, Germany. **925,718.** 5th October 1960; 8th May 1963.—Carboxylic acid esters and/or carbonic acid esters of non-reducing sugars (sucrose) and glycosides, acetals and ketals of sugars (including acetals and ketals of reducing sugars) are prepared by inter-esterification of the sugar or sugar derivatives with (1–7 moles/mole of) a (mono-) carboxylic acid [aryl (phenol or cresyl)] ester (phenyl laurate, myristate, palmitate, stearate, linoleate, or dehydrated castor oil acid esters or their mixtures) and/or carbonic acid ester (carbonic acid phenyl ester) [at 40–190°C (60–170°C)] (the sugar ester produced being further esterified with more carboxylic acid ester and/or carbonic acid ester) in the presence of 0·05–30% on weight of ester of an inter-esterification catalyst (an alkali metal hydroxide, alcoholate, phenolate, acetate, phosphate or carbonate) [and in the presence of dispersion agents (aromatic hydrocarbons) and in an inert solvent (alkylated acid amides, dialkyl sulphoxides, pyridine, pyrrolidone or tertiary amines)].

* * *

Devices for sowing, growing and transplanting seedlings of sugar beet and other root crop vegetables. NIPPON TENSAI SEITO K.K., of Obihiro-shie, Hokkaido, Japan. **927,792.** 10th September 1959; 6th June 1963.—The seeds are planted and grown in water-resistant paper tubes which are sufficiently fragile to be broken by the growing seedling roots and which contain soil suitable for its growth. The tubes are contained in a hotbed which includes a water-proof bag, e.g. of polyethylene or polyvinyl chloride, having a bottom layer of fertilizer solution.

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).

Beet harvesters. K. C. SHOTBOLT and R. A. SHOTBOLT, of Ramsey, Hunts. **927,812.** 7th February 1962; 6th June 1963.

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Brown sugar. THE AMERICAN SUGAR REFINING CO., of New York, N.Y., U.S.A. (A-C) **930,144–6.** 28th October 1959; 3rd July 1963.

(A) Granular brown sugar is dried with agitation to convert its molasses content to a dry, solid and non-sticky material. Before, during or after this stage, 1–10% (1%) of an edible non-hyrogscopic material (powdered starch or powdered sugar) is added and is absorbed on the outside of the particles, agitation then continuing while the mass cools to below 90°F (32°C). The product may subsequently be pulverized.

(B) Granular brown sugar is dried with agitation (in a rotary dryer) until its moisture content is less than 1% and the molasses contained is in the form of a dry, solid and non-sticky layer. The product is then cooled to below 82°F and pulverized.

(C) A mass of granular brown sugar is maintained in a stage of agitation to prevent agglomeration while heating to 140°F (60°C) and drying to below 1% moisture so that the molasses content decomes dry, solid and non-sticky. Agitation is continued while cooling to below 90°F (32°C).

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UNITED STATES

Preparation of hydroxymethylfurfural. R. A. HALES, J. W. LE MAISTRE and G. O. ORTH, *assrs.* ATLAS CHEMICAL INDUSTRIES INC., of Wilmington, Del., U.S.A. **3,071,599.** 25th February 1959; 1st January 1963.—Hydroxymethylfurfural is prepared by the (mineral) acid (mixed HCl and $AlCl_3$) catalysed dehydration at 150–220°C of a hexose [ketose, hydrolysed sucrose (e.g. high test molasses)] to the extent of 25–50% in a reaction medium consisting of 30–95% of an organic liquid such as dioxane, mesityl oxide, glycol monomethyl ether, dichloroethyl ether, methyl *iso*butylketone, dimethyl dioxane, tetrahydromethyl furane or triethylene glycol (50–90% of dioxane, mesityl oxide) and the balance being water.

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Ion exchange process. K. POPPER and V. SLAMECKA. **3,073,725.** 1st December 1960; 15th January 1963.—A liquid (e.g. cane molasses, raw sugar solution, cane juice or raw beet juice) is treated with bentonite and a flocculating agent at an elevated temperature and clear liquid separated from the mixture. It is then passed through a mixed bed of cation and anion exchange resins which have been regenerated with an alkaline earth hydroxide [$Ca(OH)_2$, $Mg(OH)_2$] solution so that the cation exchanger is on the alkaline earth cation (Ca^{++}, Mg^{++}) cycle and the anion exchanger on the OH^- cycle. The cations in the liquid are exchanged for Ca^{++} or Mg^{++} and the anions for OH^-. The $Ca(OH)_2$ or $Mg(OH)_2$ in solution is then precipitated and separated from the liquid.

* * *

Filtration process. G. ASSALINI, of Genoa, Italy, *assr.* ROHM & HAAS CO. **3,078,188.** 2nd June 1959; 19th February 1963.—Impure sugar solution, e.g. molasses, containing flocculent solid impurities, is passed into a tank containing sand. The filtered liquid is mostly sent for recovery while the solid impurities, held by the top surface of the sand, are prevented from forming an impervious cake by skimming the surface with a rake mounted centrally in the top of the filter. When the latter is congested with sediment it is backwashed with water, the washings passing to a sedimentation tank. Clear water from this is sent to the water storage tank or is further used for backwashing. When the wash water from the filter is clear, it is returned to storage. By this use and re-use of wash water, sugar losses are minimized.

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Continuous pulping process for the production of paper products. H. R. AMBUEHL and J. J. LOWMAN. **3,081,218.** 18th March 1960; 12th March 1963.—The fibrous, non-woody ligno-cellulose containing plant material (bagasse) is screened to remove [2–30% (3%) of the] dirt, dust and pith, and pre-hydrolysed at 65–90% (76%) moisture for 5–50 min (30 min) at 140–190°C (165°C). Is is then sprayed in a blow cyclone, de-moisturized to 3–20% (11%) on weight of oven-dry material, compressed to increase its consistency to 15–60% (36%) by weight of oven-dry material, and shredded before passing to a continuous digester. Here it is digested with an alkaline agent containing 2–12 parts (9 parts) NaOH [and S and/or Na_2S to give a sulphidity content of 0·35% (27·7%)], the digester chemical being 5–20% (13·6%) on oven-dry weight of bagasse. The digestion continues for 4–30 min (18 min) at 105–190°C (150–190°C, 160°C).

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Citric acid production by fermentation. M. W. SHEPARD, *assr.* MILES LABORATORIES INC., of Elkhart, Ind., U.S.A. **3,083,144.** 4th April 1960; 26th March 1963.—A carbohydrate, e.g. sugar, is fermented with a citric acid producing fungus (*Aspergillus niger*) in the presence of nutrients including a nitrogen nutrient, NH_3, HN_4OH, $(HN_4)_2CO_3$ or an ammonium compound, sufficient to furnish 50–5000 p.p.m. of N, being added from the 3rd to 7th day of fermentation, i.e. within 1 day of the point of maximum citric acid formation rate, whereby production is stabilized beyond the point at which it normally tends to decrease.

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Beet harvester. L. GRANSDEN, of Edenville, Mich., U.S.A. **3,084,785.** 9th October 1957; 9th April 1963.

Production of cellulose, furfural and fodder from agricultural waste. P. ROVESTI, *assr.* RESEARCH AND MECHANICAL APPLICATIONS S.p.A.-R.A.M.A., of Milan, Italy. **3,085,038.** 13th October 1959; 9th April 1963.—The vegetable material, e.g. bagasse, is subjected to a preliminary hydrolysis in a slightly acidic environment (i.e. in an aqueous medium contining SO_2 or formic acid, at a temperature of $<100°C$). The cellulose is recovered while the pentose-containing liquor is heated with an acid to obtain furfural (the conversion being carried out in the presence of 0·3% by weight of $AlCl_3$ or $ZnCl_2$, and at $>185°C$).

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Preparation of polyethers of mono- and disaccharides. M. WISMER and J. F. FOOTE, *assrs.* PITTSBURGH PLATE GLASS CO. **3,085,085.** 3rd May 1960; 9th April 1963.—Polyether polyols of mol. wt. 700–1800 are prepared by reaction of 10–25 moles of a lower alkylene oxide (ethylene oxide and/or propylene oxide or a propylene oxide/butylene oxide mixture) with 1 mole of a saccharide (sucrose), the latter being dissolved in water (5–50% by weight of solution) and the alkylene oxide added in the presence of an oxyalkylation catalyst (e.g. KOH) (0·15–10% by weight of saccharide), until the reaction mixture is a liquid under the reaction conditions (>200 p.s.i. pressure and 70–270°F). The oxide addition is discontinued and water removed from the reaction mixture until the water content of the latter is less than 10%, when addition of oxide is resumed until the polyether polyol is formed.

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Novel crystalline sugar products. D. V. WADSWORTH, N. ROSENBERG and S. P. MARINO, *assrs.* CORN PRODUCTS CO., of New York, N.Y., U.S.A. **3,085,914.** 30th June 1959; 16th April 1963.—An aqueous sucrose solution of above 50°Bx (50–75°Bx) [containing >10% of another saccharide (1–10% of starch) or up to 25% of invert sugar] is evaporated rapidly at 260–300°F to at least 90°Bx (90–97°Bx) and the resultant supersaturated solution is mixed while the product crystallizes with simultaneous liberation of moisture (to less than 1% water in the product) (during cooling to 180–230°F) and continuing mixing and cooling to below about 100°F. This gives a product which when powdered provides a better fondant cake icing than powdered granulated sugar with or without added starch.

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Carbamide esters of sugars. G. MATTHAEUS and M. QUADVLIEG, *assrs.* FARBENFABRIKEN BAYER A.G., of Leverkusen, Germany. **3,086,010.** 24th July 1958; 16th April 1963.—The surface-active esters are of the formula: Sugar C — CO — NHR, where R is an alkyl group of 8–18 C atoms (stearyl) and the sugar is an unsubstituted disaccharide (sucrose) or tri-saccharide, or a di- or tri-saccharide esterified by a fatty acid of 8–18 C atoms but having at least 1 remaining active OH group. The esters are prepared, e.g., by heating sucrose with stearyl isocyanate in dimethyl formamide for 1–2 hr at 100°C, the number of ester groupings depending on the relative proportions of reactants.

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Production of citric acid. G. SCHULZ, *assr.* JOH. A. BENCKISER G.m.b.H. CHEMISCHE FABRIK, of Ludwigshafen/Rhine, Germany. **3,086,928.** 10th August 1959; 23rd April 1963.—Impure citric acid solution, obtained by fermentation of, e.g., molasses, is concentrated to 40–85% in a vacuum and treated with sufficient hydroxide, carbonate or bicarbonate (NaOH) to form a salt (a mono-alkali metal dihydrogen citrate, Na_2H citrate or trisodium citrate) and this allowed to crystallize on cooling (the concentration may take place after alkali addition). The salt is separated and washed when the mother liquor and washings are combined (heated to 95°C) and treated with $Ca(OH)_2$, $CaCO_3$ and/or $CaCl_2$ to give an alkali metal Ca citrate; this precipitate is collected, suspended in water and the stoichiometric amount of H_2SO_4 added to precipitate $CaSO_4$. The alkali metal dihydrogen citrate is then converted into pure citric acid by electrodialysis with ion exchange resin membranes.

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(Cane) Crop harvester. T. THOMPSON, of Whitehall, Wis., U.S.A. **3,088,263.** 6th April 1961; 7th May 1963.

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Forming and treating calcium carbonate precipitates. R. H. VAN NOTE, *assr.* DORR-OLIVER INC., of Stamford, Conn., U.S.A. **3,089,789.** 23rd March 1959; 14th May 1963. Sugar juice is prelimed at 55–80°C to remove impurities forming insoluble products with CaO, and these impurities removed as a sludge which is sent to continuous filtration, the filtrate being used for lime slaking. The clarified juice is further purified by simultaneous main liming and carbonatation to produce a suspension of $CaCO_3$ and other impurities; these suspended solids are separated and recycled to the carbonatation stage as seed material at such a rate as to have a suspension of active $CaCO_3$ in the range 50–70 g/litre on completion of the $CaO\text{-}CO_2$ reaction. A second portion of the separated solids is recycled to the preliming stage and is removed in the sludge, this portion being equal to the weight of solids suspended in the juice at the end of the $CaO\text{-}CO_2$ reaction.

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Cane harvesting and piling. B. C. THOMSON, of Thibodaux, La., U.S.A. **3,090,183; 3,090,185.** 30th April 1959; 21st May 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.

Complete valve actuation. Jones Tate & Co. Ltd., Great Dover Street, London S.E.1.

The Jones Tate electrical rotary actuator is a modern, automatic actuating device for controlling valves, penstocks, doors and similar equipment and is claimed to be the most efficient device yet for this purpose. The actuator will provide a simple, economic and dependable means of centralized or automatic remote control, providing trouble-free operation of valves situated in inaccessible positions or widely scattered over large areas, or where essential safety devices require a rapid response to control point commands, and on hazardous locations where the manpower used would be exposed to danger.

Jones Tate actuators are thoroughly reliable in operation. The handwheel is automatically disengaged immediately power is initiated and automatically re-engaged when power ceases; no manual transfer operation is required therefore. The handwheel does not rotate during power drive so that plant personnel are safeguarded.

All Jones Tate actuators are of weatherproof or flameproof/weatherproof construction, can be applied to any size of valve, and installed in any position, horizontal, vertical, inclined, or inverted with complete reliability. All gearing is treated with molybdenum disulphide greases eliminating oil baths and thus avoiding possible fire hazards. In providing the means of operating valves, these actuators can deliver automatic repetitive torsional impulses or hammer blows to a jammed valve—a unique feature of the Jones Tate actuator—and are designed to protect all valve working parts from destructive overloads under power operation.

The actuators limit automatically the opening and closing travel, determine to a safe value the maximum torque and thrust that can be developed at any time and apply a constant predetermined closing thrust which is maintained after close-down, thus ensuring continued tight closure of valves. The torque loading can be varied over a wide range by a screw adjusting device to compensate for valve wear or changing conditions. These actuators are of two main designs:

(*a*) Spur driven, incorporating unique and exclusive features, for large bore valves.

(*b*) Worm driven, providing silent and efficient operation for small bore valves.

They cover torque outputs from 15 to 3500 lb/ft and spindle acceptances from $\frac{5}{8}$ in to $4\frac{1}{2}$ in diameter with standard output of 24 r.p.m. Descriptions and technical details appear in Publications 104, 716 and 717.

PUBLICATIONS RECEIVED

SUGAR DUST SEPARATING EQUIPMENT. CEKOP, P.O. Box 112, Warsaw, Poland.

The equipment described in this leaflet includes a sugar dust cyclone separator and a sugar dust wet collector, either of which may be used with sweetwater and recirculating pumps. Illustrations and technical data are provided on the dust catchers, together with flow diagrams. Use of the equipment, which is cheap, durable and requires no attendance, permits the production of a purified air, elimination of explosion, fire hazard, and contamination of the premises, and reduction of sugar loss.

* * *

CANE SUGAR EQUIPMENT. V.M.F. Stork-Werkspoor N.V., Hengelo, Holland.

A new booklet, S 40/6303, illustrates and describes the range of equipment supplied by Stork-Werkspoor for the cane sugar industry. It ranges from cane unloading equipment—four different kinds of crane as well as cane rakes—through cane preparation plant, mills (600—6000 t.c.d. capacity), gears, steam turbine, steam engine or electric drives, juice purification equipment, evaporator and pan stations, crystallizers, screening and bag-filling plant, etc., as well as steam and power generators, pumps, condensers and water-jet ejectors, steel constructions and erection.

* * *

MODEL AB 61 MOISTURE METER. Kappa Electronics Ltd., 159 Hammersmith Rd., London W.6.

The new Model AB61 moisture meter has been designed for materials of a bulky nature, including raw sugar, and can be supplied with one of three standard containers of up to 2700 cc capacity. The unit uses transistors throughout and can be used with internally mounted batteries or from 110–125V or 200–250V 50 or 60 c/s mains supplies. Accuracy is within 0·05–0·4% in the range 20·0% moisture, 0·2–0·5% over 20–30%, 0·3–0·7% over 30–40% and 0·5–1·0% at above 40% moisture.

* * *

ROTAMETER SERIES 750 FLOW ALARM. Rotameter Manufacturing Co. Ltd., 330 Purley Way, Croydon, Surrey.

The new design illustrated and described in Publication No. 2750 fits directly in a pipeline and contains a float carried to a top stop under normal flow conditions. A magnet in the float is coupled magnetically to a mercury switch; if the flow falls below a pre-set level the switch tilts and provides an alarm signal.

* * *

New high capacity Western States centrifugal.—The Western States Machine Co. has recently announced the development of a new, high capacity batch-type centrifugal for sugar. Several batteries of machines having 54 in diameter × 40 in deep baskets are now in the process of manufacture. The new machine contains many of the performance-proved features of the Western States "G-8" automatic centrifugal. It is expected that the large capacity basket on the machine will be a particularly attractive feature for installations requiring high centrifugal productivity. Performance data on the new centrifugal will not be available until early 1964. However, preliminary specifications can be obtained by writing directly to the Company at Hamilton, Ohio, U.S.A.

EUROPEAN BEET AREA ESTIMATE[1]

Hectares	1963/64		1962/63
Western Europe	*2nd Est.*	*1st Est.*	
Western Germany*	318,259	308,000	297,776
Austria	48,200	48,000	47,900
France, ...	330,634	320,000	305,275
Belgium/Luxembourg ..	62,000	65,000	62,000
Netherlands	69,356	70,000	77,439
Denmark	60,000	59,000	39,494
Sweden	56,000†	40,000	46,850
Italy	228,000	240,000	217,900
Spain	150,000	150,000	180,000
Yugoslavia	95,000	95,000	75,000
Greece	9,500	9,500	6,500
Switzerland	6,923	7,570	4,861
Great Britain	166,000	167,000	165,456
Ireland	34,800	34,800	31,418
Finland	17,009	18,000	19,050
Turkey	136,634	136,000	127,939
Total Western Europe	1,788,315	1,767,870	1,704,858
Eastern Europe			
Eastern Germany	255,000	245,000	240,000
Czechoslovakia	241,000	258,000	255,000
Hungary	118,000	130,000	125,040
Poland	380,000	440,000	433,962
Albania	5,500	5,500	5,500
Roumania	162,000	162,000	154,500
Bulgaria	72,000	72,000	70,000
Soviet Union 3,300,000		3,450,000	3,300,000
Total Eastern Europe	4,533,500	4,762,500	4,584,002
Total Europe 6,321,815		6,530,370	6,288,860

* Including the beet area in foreign countries: 12,614 hectares in 1963/64, 1,093 hectares in 1962/63.

† Including 16,000 hectares of beet cultivated in Denmark.

French loan to Mexico[2].—France has granted a loan of 750 million francs to Mexico to aid the progress of basic industrial projects, including the building of three sugar factories.

* * *

New experiment station for Brazil[3].—The Brazilian Sugar and Alcohol Institute, in collaboration with the Pernambuco Mill-Owners' Cooperative Association, has acquired an area of 487 hectares on which to erect an Experimental Station to cultivate and distribute more productive varieties of cane. The initial cost is estimated at 150 million cruzeiros for preparing the ground, building roads and bridges, providing water and electric power and drawing up architectural and engineering projects.

* * *

Sugar factory for Nepal[4].—A Scottish engineering firm has been awarded a £600,000 contract to construct a sugar factory and distillery in Nepal, according to Reuter. The factory is expected to start production next spring and will be capable of crushing between 500 and 750 tons of cane per day.

* * *

Sugar production in Ethiopia[5].—Sugar production from the two mills operating in Ethiopia during 1962/63 amounted to 59,212 metric tons. Last year, with only one factory in operation, 37,416 tons were manufactured.

* * *

Taiwan sugar crop, 1962/63[6].—Sugar production in Taiwan from the 1962/63 crop amounted to 752,300 tons, some 52,000 tons more than was manufactured in the previous campaign, according to Reuter. This was slightly less than was at one time anticipated, but output was reduced owing to frost.

BREVITIES

Malaya sugar industry expansion[7].—Construction of the new refinery at Prai in North Malaya has now commenced and production is expected to begin before the end of next year, according to Reuter. Two other refineries are in the planning stage and are scheduled to be built in Central Malaya. One is to be constructed at Port Swettenham and will have the capacity to produce 100,000 tons of refined sugar per year. The other will be built at Batu Tiga and will be able to refine 40,000 tons of sugar annually.

* * *

Sugar refinery for Guatemala[8].—Central Azucarera Chipo is to build a new sugar refinery, costing $3,000,000, with a production capacity of 30,000 tons annually. The plant will process about 300,000 tons of sugar cane a year which, it is hoped, will be produced locally, and it will reduce Guatemala's dependence on sugar imports from El Salvador, amounting to some 10,000 tons a year.

* * *

Sugar recovery from Townsville terminal[9].—So far, 9000 tons of raw sugar have been salvaged from the Townsville bulk sugar terminal which was extensively damaged by fire in May[10]. Indications are that a further 9000 tons may be recovered for refining. At the time of the fire there were 77,000 tons of sugar stored in the building. The work of restoring the terminal is proceeding satisfactorily and temporary loading facilities have now been installed to handle this season's output.

* * *

Citric acid factory in Poland[11].—A subsidiary plant has been established at the Racibórz sugar factory for the manufacture of citric acid. It has a capacity of 1000 tons/year, and uses molasses as raw material.

* * *

SOUTH AFRICAN SUGAR EXPORTS 1960-1962[12]

Destination:	1962*	1961	1960
	(*Metric tons, raw value*)		
Canada	48,982	38,396	20,930
Iran	29,645	0	0
Japan	111,282	0	0
Kenya, Tanganyika, Uganda	1,811	0	0
Korea	5,334	0	0
Nyasaland	8,351	0	0
Seychelles	560	0	0
Southern Rhodesia	18,400	28,155	31,750
United Kingdom	152,407	217,179	194,742
United States	117,415	0	0
Other Countries	174	13,085	36,821
Total	494,361	296,815	284,243

Tel quel.

[1] F. O. Licht, *International Sugar Rpt.*, 1963, **95**, (5), 59–60.
[2] C. Czarnikow Ltd., *Sugar Review*, 1963, (616), 116.
[3] *Sugar y Azúcar*, 1963, **58**, (7), 49.
[4] C. Czarnikow Ltd., *Sugar Review*, 1963, (617), 120.
[5] C. Czarnikow Ltd., *Sugar Review*, 1963, (617), 120.
[6] C. Czarnikow Ltd., *Sugar Review*, 1963, (617), 121.
[7] C. Czarnikow Ltd., *Sugar Review*, 1963, (617), 121.
[8] *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 628.
[9] *Queensland Newsletter*, 20th June 1963.
[10] *I.S.J.*, 1963, **65**, 162.
[11] *Zeitsch. Zuckerind.*, 1963, **88**, 339.
[12] *Lamborn*, 1963, **41**, 163.

BREVITIES

Morocco sugar expansion[1]. —The first sugar beet factory in Morocco, situated at Sidi-Slimane, went into operation in June. It has an annual capacity of 45,000 tons of refined sugar but is not expected to exceed 12,000 tons in its first season owing mainly to severe flooding in the beet growing areas. The Moroccan Government is expected shortly to invite bids for a second beet sugar factory at Beni Mellal[2] in the south of the country. More plants are planned, mainly in North Morocco, but schemes do not appear to have reached an advanced stage. About a year ago the Government announced that within ten years Morocco would be entirely self-supporting in sugar with ten factories having an aggregate output of some 400,000 tons of sugar per year.

* * *

Italian sugar factory closed[3].—The Eridania sugar company of Italy has decided to close the Oristano sugar factory in Sardinia because of an insufficient supply of beets for processing.

* * *

Cane flood in South Africa[4].—At the end of June heavy rains started to fall over the cane belt of South Africa. In the days following, cloudbursts continued over North Zululand, the Umfolozi river running so high that even the rail-cum-road bridge near Mtubatuba was in danger. Below the bridge the river burst its banks, cutting a new course through cane fields and covering other fields and the tramline to the factory with a thick layer of sand. Not only were thousands of acres of cane land covered with water, sand and silt, but the mill was at a standstill for several weeks before it could start crushing again. Only after the water had subsided was it possible to judge the loss of cane and cane lands, and it is estimated that this is equivalent to 38,000 tons of sugar[5].

Stock Exchange Quotations

	CLOSING MIDDLE
London Stocks (*at 19th August* 1963)	
Anglo-Ceylon (5s)	16/3
Antigua Sugar Factory (£1)	8/9
Booker Bros. (10s)	20/9
British Sugar Corp. Ltd. (£1)	31/9
Caroni Ord. (2s)	4/7½
Caroni 6% Cum. Pref. (£1)	13/6
Demerara Co. (Holdings) Ltd.	7/3
Distillers Co. Ltd. (10s units)	36/3
Gledhow Chaka's Kraal (R1)	19/3
Hulett & Sons (R1)	52/6
Jamaica Sugar Estates Ltd. (5s units)	4/6
Leach's Argentine (10s units)	18/–
Manbré & Garton Ltd. (10s)	51/–
Reynolds Bros. (R1)	20/9
St. Kitts (London) Ltd. (£1)	15/–
Sena Sugar Estates Ltd. (10s)	7/10½
Tate & Lyle Ltd. (£1)	50/9
Trinidad Sugar (5s stock units)	3/3
United Molasses (10s stock units)	36/6
West Indies Sugar Co. Ltd. (£1)	18/3

	CLOSING MIDDLE
New York Stocks (*at 17th August* 1963)	$
American Crystal ($10)	60¾
Amer. Sugar Ref. Co. ($12.50)	27
Central Aguirre ($5)	27
North American Ind. ($10)	17⅞
Great Western Sugar Co.	42¾
South P.R. Sugar Co.	34⅝
United Fruit Co.	25⅓

Japanese refining industry[6].—Plans for a drastic reorganization of the Japanese sugar refining industry are being studied by the Ministry of Agriculture and Forestry. There are now 17 major and 53 small refiners in the industry and it is feared that the latter group will be too small to stand up against a free competition when import liberalization comes into force. The Ministry's idea is reportedly to encourage the merger of these small refiners into several companies, giving them a special import quota as an incentive.

* * *

The Tropical Products Institute. Open days are to be held on the 19th and 20th September at the Tropical Products Institute in Gray's Inn Road, London W.C.1. The Institute is a part of the U.K. Department of Scientific and Industrial Research, a Government organization, and is devoted primarily to aiding the developing countries of the tropics by finding improved and extended uses for the renewable resources of these regions; at various times this has included sugar.

* * *

Bagasse building material in Barbados[7].—It has been announced that a factory is to be erected to use bagasse from the sugar factories in Barbados, mixed with local stone and suitable resins, for the manufacture of building materials. The product will be a new type of roofing material which will be weatherproof and have good insulation properties. A by-product is also claimed to be useful as animal fodder. In place of the bagasse, the sugar factories will need to use oil-burning equipment.

* * *

Japanese sugar factory for Bolivia[8].—The Bolivian Government has just concluded an agreement with C. Itoh & Co. Ltd. of Japan for the construction of a new $3,400,000 sugar mill at Bermejo, near the Argentine border. The plant will have a capacity of 1000 tons cane per day with potential expansion to 1500 tons. Equipment to be supplied from Japan includes machinery for harvesting as well as processing the cane, an alcohol distillation plant, spare parts and buildings. Bolivia is to receive credits for the full cost of the plant, the loan being repayable over 11 years from royalties paid to the Government by the Bolivian Oil Company and other oil concessions in the State of Tarija where the new sugar plant will be located.

* * *

New U.S. sugar refinery[9].—Godchaux Sugar Refining Co. of New Orleans plans to build a $4,000,000 sugar refinery at Louisville, Kentucky. It would produce 150,000 tons of granulated and liquid cane sugar a year, according to JULIO LOBO, President of the Company. The plant is to employ 125 to 150 people and construction was scheduled to begin by end-September. Raw materials are to be shipped to Louisville by barge and finished products distributed by road and rail.

* * *

Argentina sugar workers strike[10].—Sugar mill workers went on strike for two weeks in July throughout the cane belt of northern Argentina, paralysing the industry. An offer of 24% wage increases was turned down by the workers but a general increase of 35% has been agreed between the union leaders and sugar industry representatives[11].

* * *

New sugar refinery for France[12].—The building of a new sugar refinery at Arois-sur-Aube in the Department of Aube was licenced by a decree published in the *Journal Officiel* of 15th July. The refinery must be completed for the 1964/65 campaign.

[1] C. Czarnikow Ltd., *Sugar Review*, 1963, (615), 113.
[2] F. O. Licht, *International Sugar Rpt.*, 1963, **95**, (4), 55.
[3] F. O. Licht, *International Sugar Rpt.*, 1963, **95**, (Supp. 12), 161.
[4] *S.M.R.I. Monthly Summary Notes.*
[5] C. Czarnikow Ltd., *Sugar Review*, 1963, (620), 133.
[6] *Willett & Gray*, 1963, **87**, 286.
[7] *Chron. W. India Comm.*, 1963, **78**, 386.
[8] *Willett & Gray*, 1963, **87**, 304.
[9] *Wall Street Journal*, 27th June 1963.
[10] *Public Ledger*, 6th July 1963.
[11] C. Czarnikow Ltd., *Sugar Review*, 1963, (619), 128.
[12] F. O. Licht, *International Sugar Rpt.*, 1963, **95**, (Supp. 14), 193.