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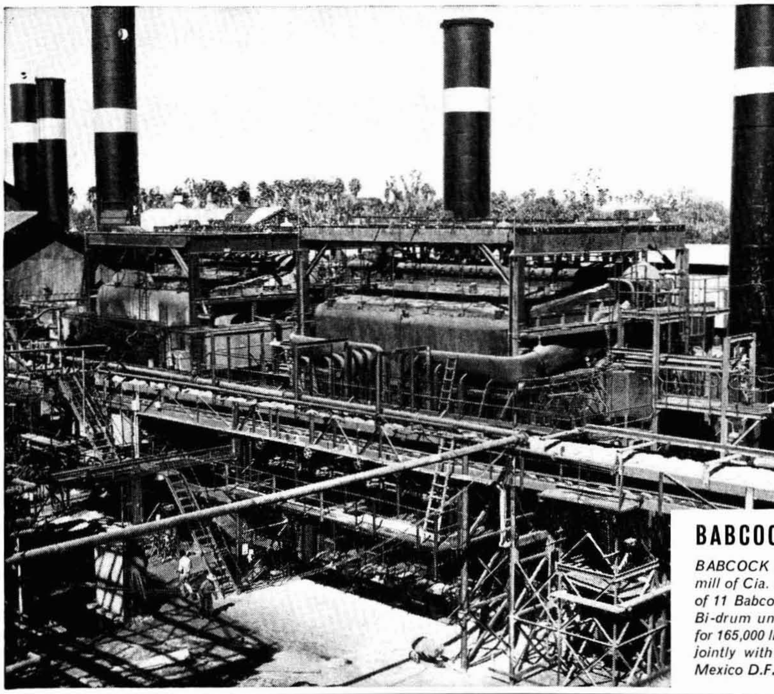

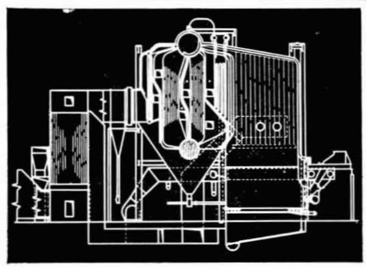

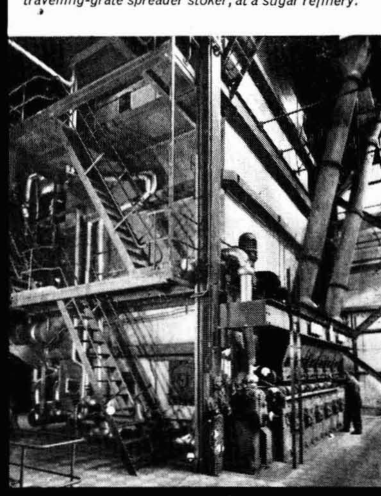

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NOTES AND COMMENTS

The world sugar market.

Brazil sold a total of 530,000 tons of raw sugar at the beginning of June on pricing terms which did not stipulate final destinations, and so killed the efforts of the Exporters' Group to raise sugar prices. These efforts had admittedly not yet affected the world price appreciably but the Group had recognized that this would be the case until the second-hand sugar available in March had been disposed of. With the fall of this sugar to 100,000 tons it had been hoped that first-hand producers could ask higher prices, but with the Brazilian sales, dealers' stocks rose to over 600,000 tons. The market price immediately crumbled and reached a record low of £17.10s. per long ton c.i.f. U.K., sinking later to £16.15s.

The Director of the Brazilian Institute for Sugar and Alcohol announed that Brazil would be out of the world market for the remainder of 1966 and possibly for the first part of 1967; the 1966/67 sugar crop plan reduced production by 13% while consumption was expected to rise by 5% so that the export quota would be reduced to 860,000 metric tons plus 120,000 tons produced in the 1965/66 crop. From this total of 980,000 tons, Brazil had already sold 530,000 tons and the remainder was for the U.S. quota in 1967.

Of course, the Institute had an acute problem; last season's production increase of 1,200,000 tons increased Brazilian stocks to 2,300,000 tons and, aside from the cost of financing these, warehouse space was needed urgently for the new crop which begins at the end of June. But the effect on the market was disastrous and emphasizes the need to cut overproduction and to transfer stocks to importing countries until increasing consumption, both per caput and by population growth, can bring supply and demand into balance again.

* * *

UNCTAD sugar meeting.

A three-day informal meeting took place in Geneva during the 17th–18th May to discuss the prospects of a conference for a new International Sugar Agreement. The meeting was called by Dr. RAUL PREBISCH, Secretary-General of the U.N. Conference on Trade and Development, and was attended by delegates from 22 countries. C. Czarnikow Ltd. reports[1] that "with so many difficulties still facing the sugar industry it is generally considered that it would be unwise at this stage to risk a further inconclusive Conference but clearly there is considerable advantage in examining what the problems are and how best they may be solved.

"A preparatory working group of the UNCTAD sugar consultative committee is to be constituted which will work together with the ISC, UNCTAD and FAO, to examine and report on the possibilities for a long-term International Sugar Agreement. The group will consider whether it would be wise first to conclude an interim agreement and, if so, it will prepare the basis for such an agreement."

* * *

South African sugar production, 1965/66.[2]

Sugar production from the 1965/66 crop ceased at the beginning of April with a total of 1,006,665 short tons from a total of 9,266,324 tons of cane crushed. This was almost 400,000 tons less than the 1964/65 output of sugar which was produced from nearly 12 million tons of cane.

The season will be remembered because of the unprecedented drought which struck the crop in its optimum growing season and the cold weather which followed the drought. As a result of these adverse conditions the cane was short and ripened prematurely; the sucrose content of the cane also started to drop much earlier than usual.

The operational results of the mills in the 1965/66 season were also not satisfactory; at the beginning of the season a number of factories had to postpone their starting dates because reconstruction of the factory plants had not been completed. Though the milling tandems, in general, maintained their high standards of performance, this could not be said of the boiling houses. As a result of a greater quantity of final molasses than commensurate with the juice purity and, in addition, a final molasses with a high purity, the average Boiling House Performance figure was low.

[1] *Sugar Review*, 1966, (764), 97.

[2] *S.M.R.I. Final Summary of Lab. Rpts.*, 1966, (11).

This unsatisfactory result is to be attributed to an abnormal juice composition, another result of the adverse weather conditions. There was, however, another circumstance which affected the juice composition; owing to the prolonged drought the cane was short and because of this there was a tendency not to reduce the length further by removing the top. Green tops left on short cane have a greater detrimental effect on the mixed juice composition than tops left on stalks of normal length.

* * *

Australian sugar production, 1965/66.[1]

Since 1963 much effort has been put into large-scale expansion of the Australian sugar industry. In 1963 417,567 acres of cane were harvested and by 1965 the area had been increased to 503,276 acres, although the crushing season was cut short in a few mill areas by wet weather in December. Hope of the industry's reaching its production target of 2·2 million tons of sugar was frustrated by seasonal factors including the after-effects of the excessively wet conditions in late 1964 in Northern areas, severe drought and frosts in Southern Queensland and in some parts of the Central district, and a very poor season in New South Wales.

Despite this very unusual seasonal pattern, Australian 1965 raw sugar production is estimated at 1,953,000 tons, 94 net titre, exceeding by about 3000 tons the record production achieved in 1964. Queensland's output of 1,883,500 tons 94 N.T. was slightly above the 1964 level of 1,854,376 tons, while production in New South Wales, at 69,900 tons, compared badly with 95,172 tons in 1964.

The Queensland cane crop averaged only 27·80 tons per acre, with a sugar yield of 3·86 tons 94 N.T. per acre, in both cases the lowest yields since 1961. The cane:sugar ratio of 7·20 was worse than in any season since 1958, apart from the extraordinarily bad ratio of 7·72 in 1964.

The aggregate tonnage of 14,156,446 tons of cane crushed by Australian mills was nearly a million tons below the 1964 record of 15,070,051 tons. Queensland mills crushed 13,547,126 tons of cane and N.S.W. mills 609,320 tons. The 1966 crop is expected to be a very large one, providing a substantial increase in exports availability.

* * *

Verenigde H.V.A.-Maatschappijen N.V. 1965/66 report.

Production of the Wonji and Shoa sugar factories during the 1964/65 milling season amounted to 61,698 metric tons, about 1000 tons less than in the previous milling season. In the 1965/66 season it is anticipated that some 65,000 metric tons of sugar will be produced, and it is intended in the future to obtain an annual production of 70,000 tons, to be attained by improvements in agricultural methods as well as by a slight increase in acreage.

Sugar consumption in Ethiopia has increased considerably; when the Wonji factory was started in 1954 consumption was less than 30,000 metric tons but it has now risen to over 60,000 tons. Sales of confectionery and lump sugar have shown increases. In view of this rapid expansion in sugar consumption it has been decided to aim at putting the Metahara sugar factory into operation in November 1969, provided that agreement will be reached on the set-up of the financing scheme in the not-too-distant future. The planning of the new sugar plantation is based on a production of 45,000 metric tons of sugar a year.

Research is to be undertaken in the Netherlands on development of new products based on sugar and molasses.

The Company has been appointed Managing Agents for Kilombero Sugar Co. Ltd. of Tanzania; this company produced 24,813 tons of sugar in the 1965/66 milling season as against 20,497 tons in the previous campaign. Extension of cane fields and factory is progressing entirely according to plan.

* * *

Booker Group 1965 report.

The 1965 crop at the Booker sugar factories in Guyana, formerly British Guiana, at 252,000 tons, showed a welcome recovery over the 210,000 tons produced in the strike year of 1964 but was less than the acreage under cane should have produced in a trouble-free year. The factories are again faced with drought and the discouragement of a world price stagnating at a level at which nobody can make sugar.

Inswood Estate in Jamaica has 5500 acres under cane and its factory has been expanded so that it can process over 30,000 tons of sugar from estate and farmers' cane. Last year the full crop could not be reaped, owing to labour and factory problems. so that this year a bumper crop is being reaped. But the estate is having its share of troubles from the labour difficulties which have affected the whole Jamaican sugar industry. Holland Estate has been affected by the same problems but, because of its small size, financial consequences have been most distressing; the future of this small estate is being reassessed.

After a bad start to the life of the Nigerian Sugar Company, its second crop produced over 12,000 tons as against 5000 in 1964. The worst of the agricultural difficulties at Bacita seem to have been surmounted, but the serious pioneering difficulties and delays of the first crop have brought grave financial problems.

Fletcher & Stewart Ltd. sales at £4·2 million were slightly below the record of the previous year but margins were much thinner and profits almost halved. Exports of sugar machinery accounted for 73% of sales, of which 13% was for sales to other Booker companies.

[1] *Australian Sugar J.*, 1966, **57**, 927–929.

SUGAR CANE RESEARCH IN SOUTH AFRICA

Annual Report of the Sugar Experiment Station of the South African Sugar Association, 1964-65

THIS informative report of over a hundred pages gives a good idea of the many aspects of research and investigation that are being carried out at the South African Sugar Association's experiment station at Mount Edgecombe near Durban. Reference is made to the implementation of the development programme of the previous year and to the acquisition of a further 225 acres of land for a new central field station and an extension to the Experiment Station farm. This is regarded as the first stage in the development of a new cane-breeding programme, which will lead ultimately to the propagation of up to 200,000 seedlings per year and to the release of more commercial varieties—the life-blood of the industry.

New Root Observation Laboratory

An underground laboratory (illustrated with photographs) has been built in which the root systems of different sugar cane varieties will be studied in relation to their tops and to different cultural or fertilizer treatments. The main function of this laboratory or chamber is to make roots accessible for direct experimentation *in situ*. The windows on one side of this long narrow chamber rest against undisturbed soil and those on the other side against imported or treated soil. In addition to physiological studies it is intended to use the chamber or parts of the chamber, for other research projects, e.g. the study of growth in relation to soil moisture regimes, the effects of herbicides on root elongation, the study of root diseases and studies involving the use of radio-active tracers. The design of the chamber, which is 96 feet long, 7 feet wide and about 7 feet deep, is based on the root observation laboratories at the East Malling Research Station in England. Forty-eight glass windows in the walls rest against the soil. Some are backed by clear plastic sheet, so that portions of the windows can be moved and operations carried out on the undisturbed roots through a slit in the underlying plastic.

Soil Compaction

A soil compaction experiment carried out in conjunction with a local sugar company provided a good deal of useful information. The growth of cane in the compacted plots was notably inferior to that obtained in the uncompacted controls, in spite of the greater number of shoots which emerged in the compacted plots. Subsoiling caused a spectacular increase in the rate of shoot emergence and this initial advantage was maintained.

No statistically significant differences were found between the nutrient content of leaves obtained from any of the plots, so that the observed differences in growth may legitimately be attributed to factors other than fertility. It seems probable, from various physical measurements carried out on soils, that a reduction in macro-pore space brings about a decline in the infiltration rate of water. This decline extends from a rate of almost 5 inches/hr to 2 inches/hr and it is the most important factor responsible for reduction of cane growth on compacted soil.

Radioisotope Studies

Sugar cane roots are able to penetrate considerable depths into the soil, particularly in uniform sandy soils, suggesting that cane can utilize moisture at these depths. An investigation was started to study the extent of nutrient absorption at various depths and distances in the soil and, if possible, to attempt to relate this to soil moisture utilization and depletion.

A replicated field trial using ^{32}P was put down under newly planted cane on sandy soil. Treatments involved injecting ^{32}P at 7 depths and 4 distances, measured from the centre of the cane row. This gave a total of 28 treatment combinations, each of which was replicated 3 times. Owing to radioactive decay ^{32}P injections were repeated every 10–12 weeks. Polyethylene pipes had been previously inserted to the required depths.

Results (given in a graph) showed that early in the life of the cane plant the roots are concentrated at a depth of 6 inches, the roots extending laterally to a distance of about a foot from the sett. The roots grow most quickly in a lateral direction within the top foot of soil and growth is particularly rapid near the surface, especially near the sett. It was only after the 16th week that the roots started taking up significant quantities of nutrient from the 3-ft depth. Uptake at 5 ft occurred between 18 and 21 weeks after planting and was greatest at a distance of 36 inches from the row centre.

A prolonged drought rendered the surface roots inactive to a depth of approximately a foot, but uptake from the 3 ft and 5 ft depths increased a great deal during this period as plant moisture still remained available at these levels. Uptake of nutrients at depths increasing to 5 ft was small but statistically significant. This may be due to the more diffuse root system in this region, fewer roots gaining contact with the ^{32}P injected.

Another radioisotope study was initiated on factors affecting the translocation of "Paraquat" in water-grass or nut-grass (*Cyperus rotundus* and *C. esculentus*). Factors investigated were: (1) application at various times of day, (2) application at various stages of growth,(3) the effect of a wetting agent on absorption by the plant, (4) the effect of adding to "Paraquat" a photosynthesis inhibitor, "Bromacil". Autoradiographs showed massive translocation from the point of application to the tip of the treated leaf, confirming that the main transport system is the xylem. There is also a sizeable downward translocation to the base of the plant into the roots and from there through the rhizomes into the adjoining tillers. The translocated "Paraquat" appears to accumulate in greatest quantities in the basal bulbs at the base of the tillers and in the lower leaves. Virtually no "Paraquat" accumulates in the tubers or rhizomes unless these are producing new tillers. Translocation was slightly greater when "Bromacil" was added to "Paraquat".

Cane Varieties

The variety N:Co 310, raised in Natal and adopted in so many other cane growing countires, provided nearly half the season's crop but is steadily declining in popularity or giving way to other varieties, having reached its pinnacle in 1957/58. In Natal it is being replaced largely by N:Co 376. The variety N:Co 382 continutes to increase in popularity, although slowly. The hardness of its stalks makes it unpopular with cane cutters.

Two varieties released for use in 1963—N51/168 and N51/539—are still being propagated by farmers for bulk planting. During the year the variety N53/216 (Samson) was released for commercial cultivation. It has shown promise under the higher altitude conditions.

Herbicides and Weed Control

It has been shown that a number of the chemical weedkillers now available can be used effectively and economically on sugar cane provided they are used under the right conditions, certain precautions are taken and due consideration given to moisture conditions. "Bromacil" gave outstandingly good control of weeds in a number of field trials. It must be used with care and at the recommended rates as it can severely damage cane leaves, particularly on sandy soils which have a low organic matter content. In both dryland and irrigated trials $1\frac{1}{3}$ lb "Bromacil" was sufficient to give good weed control in the row until the canopy closed. Recommendations are that "Bromacil" should be used at rates of $\frac{1}{2}$–$\frac{2}{3}$ lb/acre, applied on the row only, where the organic matter content of the soil is less than 3%. On soils with a higher organic matter content $1\frac{1}{3}$ lb/acre "Bromacil" is recommended.

"Paraquat" used under the right conditions ($\frac{2}{3}$–$1\frac{1}{3}$ pint/acre in the row) has been successful in controlling water-grass (*Cyperus esculentus*), or suppressing it for a month, in very young cane. "Diuron", used with a wetter and applied after the emergence of the cane, gave good results when soil moisture conditions were at an optimum. The weedkillers "Ametryne", "Prometryne" and "Linuron" gave fair results when applied after emergence. Pre-emergence herbicides were generally disappointing.

Insect Pests

The activities of the Entomology Section were largely concerned with the Numicia pest of sugar cane (*Numicia viridis*) which first became troublesome a few years ago. Much information on the biology and ecology of the insect and on alternative host plants has now been collected. A list is given of 21 grasses including maize, the common reed and Guinea grass, that are now known to be alternative host plants. A number of indigenous parasites and predators which attack the pest at various stages during its life have been isolated. The possibility of their being used for control and of introducing additional possible parasites is being actively explored. In the Pongola area dusting of some 5000 acres became necessary in 1965 because of the pest. It is felt that Numicia is likely to be a pest of cane for some time yet, if not permanently.

Investigations on the rôle played by nematodes in sugar cane fields were continued. The root-knot nematode (*Meloidogyne javanica*) and mycelium of a fungus, not yet identified, were found on nodules of cane roots from poor patches of cane near the Experiment Station.

Diseases

Selection for resistance to mosaic in single seedlings was continued, resort being made to interplanting with mosaic-infected maize plants. Work on the method of assessing mosaic resistance is continuing on a larger scale and with a wider selection of crosses. In connexion with ratoon stunting disease, trials were carried out to test the effects of hot water treatment on the subsequent germinating ability and growth of a number of different cane varieties. Germination was stimulated by hot water treatment in some varieties, but was adversely affected in others.

The stem rot disease, now known as Wartberg disease, was studied in some detail. So far the causal organism (a fungus) remains unnamed, having failed to sporulate under laboratory conditions. Present indications are that there is little likelihood of the disease causing extensive losses and that some varieties of cane are more susceptible than others. Treatment of planting setts with a mercurial fungicide affords reasonable protection.

F.N.H.

Italian sugar factory for Pakistan[1].—An Italian firm is reported to have signed a contract with Pasrur Sugar Mills Ltd. of Pakistan, which provides for the construction of a cane sugar factory to the value of 2,000,000,000 lire.

* * *

Japanese beet sugar production, 1965/66[2].—Beet sugar production in Japan in the 1965/66 campaign reached 262,019 metric tons, compared with 173,565 tons in 1964/65. This is an increase of 88,454 tons or 51%. In the beet sugar factories of Hokkaido and Aomori a total of 1,765,916 tons of beets were sliced, giving a yield of 14·83%. For the 1966/67 campaign in Hokkaido a sugar beet area of 59,200 hectares is planned and it is hoped to produce a beet crop of 1,691,000 metric tons and, based on a yield of 14·6%, a sugar production of 246,900 metric tons.

[1] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (9), 18.
[2] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (10), 17.

THE EFFECTS OF MECHANICALLY LOADED CANE ON SUGAR FACTORY RESULTS

By JUAN E. MAYORAL and MANUEL CRUZ VARGAS

(Central Mercedita, Mercedita, Puerto Rico)

Paper presented to the 12th Congress, I.S.S.C.T., 1965.

THIS paper represents an accumulation of data and experience since 1954 on the effect of trash brought to the mill by mechanically loaded cane on the recovery of sugar and the cost of maintenance of the factory equipment.

One of the most serious disadvantages of grinding cane mechanically loaded is the extraneous matter brought to the mill, such as green or dried leaves, sugar cane tops, soil, stones, water sprouts (mamones) and any other material which is not cane. Those who have had experience with the grinding of this type of sugar cane and the processing of their juices are familiar with the damage caused to the cane knives, mill rolls and pumps, and also the loss of sugar in the bagasse, cane mud, and final molasses.

During the 1964/65 crop several sugar mills in Puerto Rico ground cane which had been mechanically loaded. Of 700,000 tons of cane ground at one of these sugar mills, 100,000 tons were mechanically loaded using Thompson loaders. This cane, as loaded, would bring a considerable amount of extraneous matter to the factory. The percentage of extraneous matter in this cane varies according to the site of origin and weather condition, i.e. if it is dry or wet. In the State of Hawaii in 1952[1] extraneous matter ground per cent cane averaged 10·5%, fluctuating between 2·7% and 26·1%.

The economic losses caused by the grinding of these canes and the manufacture of sugar from its juices will be analysed in this paper. Based on actual experience, it was found that, owing to the inclusion of stones and rocks, the grinding of these 100,000 tons of cane at Central Mercedita caused the breakage of six sets of cane knives, of forty knives each, making a total of 240 knives. These knives cost $40.00 each, making a total cost of $9,600.00.

Also owing to wear, six mill rolls over and above the usual replacements had to be changed. This required that five new rolls be bought in addition to those already in stock, at a cost of approximately $15,600.00. Ten centrifugal pumps had to be replaced, six maceration juice pumps, two for mixed juice from the first and second mills, and two for limed juice at a cost of $26,000.00. One pump made of bronze and used for pumping raw juice used to last eight years, and if made of stainless steel would last fifteen years.

Experience shows that, with juices from canes with extraneous matter, a pump will not last one year, either made of bronze or stainless steel. We have had to resort to the use of pumps made of stainless steel alloys and designed to resist abrasion.

When cane containing extraneous matter is ground there is an increase in the sucrose lost in the bagasse. The extraneous matter entering the mill contains no sucrose at all but, when leaving the mill with the bagasse, contains the same sucrose content as the bagasse. ARCENAUX and DAVIDSON[2] found by experiment that cane with no extraneous matter showed a loss in bagasse of 10 pounds per ton while cane with 7·5% of extraneous matter had a corresponding loss of 13·3 pounds per ton, or a loss increase of 3·3 pounds per ton of cane, when the trash was dry. With green trash the increased loss of sucrose per ton of cane was 1·9 pounds, owing to its lower absorption ability than that of dry trash.

In Table I we have calculated the increase in sucrose loss in bagasse when grinding 100,000 tons of cane with different percentages of extraneous matter.

The weight of diluted juice from 100,000 tons of cane with extraneous matter would be increased by a quantity of soil which has been washed out by water and juices for imbibition. The weight of this soil would affect the extraction mill calculation and undetermined losses. This soil, besides increasing the weight of mud, would increase its sucrose loss. If in this sugar mill, the mud % cane was 4·6% and, assuming that the 600,000 tons of clean cane ground had 3·4% mud (the average of mud % cane for previous years), the percentage of mud (y) in the 100,000 tons of mechanically loaded cane is calculated as follows:

$$600{,}000 \times 0{\cdot}034 + 100{,}000 \frac{y}{100} = 700{,}000 \times 0{\cdot}046$$

$$\text{where } y = \frac{32{,}200 - 20{,}400}{100{,}000} \times 100 = 11{\cdot}8\%.$$

With 2% pol in mud produced, the increase in 96° sugar lost in the mud due to extraneous matter would be:

$$\frac{100{,}000\ (0{\cdot}118 - 0{\cdot}034)\ (0{\cdot}02)}{96} = 175 \text{ tons of } 96°$$

$$\text{sugar or } \frac{175 \times 2{,}000}{100{,}000\ (11{\cdot}8 - 3{\cdot}4)} = 0{\cdot}42 \text{ lb } 96° \text{ sugar}$$

[1] *Rpts. Hawaiian Sugar Tech.*, 1952, 67.

[2] "Some Effects of Trash in Cane on Milling Results." Publication of the Divn. of Sugar Plant Investigations, Bureau of Plant Ind., Soils, and Agric. Eng., Agric. Research Admin., U.S.D.A.

Table I

Increase in sucrose lost in bagasse

Tons of cane with extraneous matter	*% extraneous matter*	*Tons extraneous matter*	*lb sucrose lost per ton cane*	*Increase in sucrose loss* *lb sucrose*	*tons sucrose*	*tons of 96° sugar*
100,000	3	3,000	1·03	103,000	51·50	53·6
100,000	5	5,000	1·71	171·000	85·50	89·1
100,000	7	7,000	2·39	239,000	119·50	124·5
100,000	9	9,000	3·08	308,000	154·00	160·4
100,000	11	11·000	3·76	376,000	188·00	195·8
100,000	13	13,000	4·45	445,000	222·50	231·8
100,000	15	15,000	5·13	513,000	256·50	267·2
100,000	17	17,000	5·82	582,000	291·00	303·1

lost per ton of cane for each percent of extraneous matter, assuming that the percentage of mud in cane varies in the same proportion as the percentage of extraneous matter.

The impurities introduced into the process of sugar manufacture by the extraneous matter in the cane would lower the purity of mixed juice. ARCENEAUX and DAVIDSON in their investigations[2] report considerable drops in the purities of mixed juices as the amount of extraneous matter in the cane increases. When milling cane with 75% of dry trash they found a drop in purity of 1·63, i.e. 0·217 for each percent of extraneous matter; and when milling cane containing green trash, they found a drop of 0·302 for each percent of extraneous matter.

In Table II the purity of mixed juice from the 100,000 tons of cane ground is given for different contents of extraneous matter. The extracted impurities in the form of soluble solids pass through the entire manufacturing process, leaving the factory in the final molasses. ARCENEAUX and DAVIDSON[2] found an increase of 8·7 pounds of ash per ton of cane containing 7·5% dry trash and 38·9 pounds per ton of cane with 18% green trash. We will assume that when this sugar mill ground clean cane, it produced final molasses which, like the molasses from many

Table II

Purity of mixed juice from canes containing extraneous matter

Purity of juice from clean cane	*% extraneous matter*	*Purity drop*	*Purity of juice from cane containing extraneous matter*
81·0	3	0·78	80·2
81·0	5	1·30	79·7
81·0	7	1·82	79·2
81·0	9	2·34	78·7
81·0	11	2·85	78·2
81·0	13	3·37	77·6
81·0	15	3·89	77·1
81·0	17	4·41	76·6

mills on the southern coast of the island, had approximately 2·0 glucose:ash ratio, 10% of ash and an apparent purity of 31. With a production of 5·5 gallons of molasses per ton of cane, weighing 12·68 pounds per gallon, this sugar mill would produce 69·7 pounds of molasses and 6·97 pounds of ash per ton of cane ground. The glucose per ton of cane would be: 2 × 6·97 lb, that is 14 lb. When grinding cane containing 7·5% trash there is an increase of 8·7 pounds of ash per ton of cane; that is, the ash per ton of cane would be 15·7 pounds. Also the glucose:ash ratio of final molasses produced would be $\frac{14}{15{\cdot}7}$ or 0·9.

MCCLEERY[3] in Hawaii has found that factories with a low glucose:ash ratio cannot exhaust final molasses as well as those with a high glucose:ash ratio, and graphically has represented purity of final molasses *versus* glucose:ash ratio. In this graph we find that the difference in purity of molasses with a glucose coefficient of 2·0 and 0·9 is 5·65 points; that is 0·75 for each percent of extraneous matter.

In Table III is shown the purity of final molasses proceeding from 100,000 tons of cane with different contents of extraneous matter.

Table III

Purity of final molasses

Purity of final molasses from clean cane	*% extraneous matter*	*Increase in purity % extraneous matter*	*Purity of final molasses from canes with extraneous matter*
31·0	3	2·3	33·3
31·0	5	3·8	34·8
31·0	7	5·3	36·3
31·0	9	6·8	37·8
31·0	11	8·3	39·3
31·0	13	9·8	40·3
31·0	15	11·3	42·3
31·0	17	12·8	43·8

In Table IV, the theoretical recovery of pol and of 96° sugar that would be obtained from the juice of the 100,000 tons of cane with different percentages of extraneous matter is tabulated, using the purity of the juices from Table II, the purity of final molasses from Table III and assuming the purity of sugar to be 99·0.

Table IV

Theoretical recovery in cane juice with different percentages of extraneous matter

% extraneous matter	*Purity of mixed juice*	*Purity of final molasses*	$\frac{100\,s(j-m)}{j\,(s-m)}$	$\frac{100\,s\,(j-m)}{0{\cdot}96j\,(s-m)}$
3	80·2	33·3	88·1	91·8
5	79·7	34·8	86·9	90·5
7	79·2	36·3	85·5	89·1
9	78·7	37·8	84·1	87·6
11	78·2	39·3	82·5	85·9
13	77·6	40·3	81·1	84·5
15	77·1	42·3	78·8	82·1
17	76·6	43·8	76·8	80·0

[3] SPENCER & MEADE: Cane Sugar Handbook, Eighth Edn. (Wiley, New York). 1945, p. 625.

Let us suppose that this sugar mill had the folllowing analytical data in its Final Crop Report:

First Extracted Juice:	
Brix	20·0%
Pol	16·6%
Purity	83·3
Dilute Juices:	
Pol	12·6%
Purity	81·0
Dilute Extraction	98·0%
Sugar Purity	99·0%
Final Molasses	
Purity	31·0
Tons of 96° sugar made and estimated	80,360
Yield of 96° sugar	11·48%

Then the theoretical recovery of 96° sugar would be:

$$\frac{100 \times 99{\cdot}0\,(81{\cdot}0 - 31{\cdot}0)}{96 \times 81{\cdot}0\,(99{\cdot}0 - 31{\cdot}0)} = 93{\cdot}6$$

If the extraneous matter content of the 100,000 tons of cane is 11%, the theoretical recovery, from Table IV is 85·9% so that we have 100,000 (0·98) (0·126) (0·936 — 0·859) = 950·8 tons of 96° sugar that would not be recovered owing to the low purity of the mixed juice and to the increase in purity of the final molasses. In the same way the tons of sugar that would be lost when grinding the 100,000 tons of cane have been calculated for different percentages of extraneous matter and are presented in Table V.

Table V

Recovery losses

% extraneous matter	*% recovery loss of 96° sugar*	*Tons 96° sugar lost*
3	1·8	232·3
5	3·1	382·8
7	4·5	555·7
9	6·0	740·9
11	7·7	950·8
13	9·1	1123·7
15	11·5	1420·0
17	13·6	1578·3

Table VI

Summary of increase in sugar losses

%	*Tons of 96° sugar lost*				*Correction*	
extraneous matter	*Bagasse*	*Mud*	*Final molasses*	*Total*	*for 3% extraneous matter*[4]	*Net loss*
3	53·6	63·0	222·3	338·9	338·9	—
5	89·1	105·0	382·8	576·9	338·9	238·0
7	124·5	147·0	555·7	827·2	338·9	488·3
9	160·4	189·0	740·9	1090·3	338·9	751·4
11	195·8	231·0	950·8	1377·6	338·9	1038·7
13	231·8	273·0	1123·7	1628·5	338·9	1289·6
15	267·2	345·0	1420·0	2002·2	338·9	1663·3
17	303·1	357·0	1679·3	2339·4	338·9	2000·5

Table VII

Yields of 96° sugar and liquidation factors of sugar cane mechanically loaded with different extraneous matter contents

								Liquidation factor		
% extraneous matter	*Tons of extraneous matter to be deducted*	*Tons of cane with extraneous matter deducted*	*Total tons normal cane ground*	*Tons of 96° sugar to be deducted*	*Tons of 96° sugar produced and corrected*	*Yield of 96° sugar (normal cane ground)*	*Yield of 96° sugar (cane with extraneous matter deducted)*	*normal canes ground* (1)	*canes with extraneous matter deducted* (2)	*Conversion factor* (2) ÷ (1)
3	—	100,000	700,000	—	80,360·0	11·48	11·48	1·083	1·083	1·00
5	2,000	98,000	698,000	238·0	80,598·0	11·55	11·29	1·090	1·065	0·98
7	4,000	96,000	696,000	488·3	80,848·3	11·62	11·08	1·096	1·045	0·95
9	6,000	94,000	694,000	751·4	81,111·4	11·69	10·87	1·103	1·025	0·93
11	8,000	92,000	692,000	1038·7	81,398·7	11·76	10·65	1·109	1·005	0·91
13	10,000	90,000	690,000	1289·6	81,649·6	11·83	10·42	1·116	0·983	0·88
15	12,000	88,000	688,000	1663·3	82,023·3	11·92	10·05	1·124	0·948	0·84
17	14,000	86,000	686,000	2000·5	82,360·5	12·01	9·65	1·133	0·940	0·80

The summary of the weight of 96° sugar that would be lost in the bagasse, filter mud (cachaza) and in final molasses in the 100,000 tons of cane at different extraneous matter content will be found in Table VI.

L. A. MULLINS[4] in a publication which deals with the determination of trash or extraneous matter in cane deductible to the mill, and applied to Louisiana, disposes that extraneous matter in excess of 3% of the gross weight of the sugar cane delivered to the mill must be determined. It is understood that sugar cane with a content of about 3% of extraneous matter does not require any determination. Sugar cane with 3% of extraneous matter is considered normal cane. This accounts for the correction made on Table No. VI in the column of weight of 96° sugar which would be lost. In addition, MULLINS disposes that payments in the liquidation of sugar cane should be made after the deduction of extraneous matter. The results in the use of these dispositions are found on Table VII, which should be interpreted

[4] *Sugar Mill Letter* (Production and Marketing Administration U.S.D.A.), 1947, (4).

Table VIII

Comparative data of crops 1951–1964 inclusive

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
Pol extracted % pol in cane	95·876	95·261	94·970	94·626	94·349	94·165	93·533	93·926	94·156	94·033	93·959	93·247	93·405	93·737
Pol in sugar % pol in juice	90·900	90·852	89·220	88·159	89·824	89·942	89·577	87·493	87·808	86·595	87·581	88·056	87·043	85·665
Pol lost in bagasse % cane	0·608	0·611	0·681	0·705	0·750	0·771	0·864	0·765	0·735	0·713	0·775	0·843	0·836	0·830
Pol lost in final molasses % cane.............	0·913	0·957	1·072	1·068	0·984	1·036	1·042	1·115	1·088	1·111	1·141	1·105	1·169	1·368
Pol lost in cachaza % cane	0·037	0·052	0·062	0·093	0·065	0·077	0·063	0·076	0·070	0·074	0·085	0·083	0·071	0·071
Undetermined pol loss % cane	0·191	0·115	0·176	0·108	0·225	0·212	0·200	0·288	0·286	0·320	0·271	0·202	0·295	0·341
Total pol lost % cane ..	1·749	1·735	1·991	2·174	2·024	2·096	2·169	2·244	2·179	2·218	2·272	2·233	2·371	2·610

as per the following example. Let us suppose that the 100,000 tons of cane mechanically loaded had an extraneous matter content of 11%.

Then, 100,000 (0·11 — 0·03) = 8000 tons of excessive extraneous matter to be deducted. If from the 700,000 tons of cane ground we deduct 8000 tons of excessive extraneous matter, this leaves 692,000 tons of "clean" cane. If these 692,000 tons of cane were ground alone, that is, without grinding the 8000 tons of excessive extraneous matter, they would produce 80,360 plus 1,038·7, or 81,398·7 tons of 96° sugar. The yield of 96° sugar from these 692,000 tons of cane would be:

$$\frac{81,398 \cdot 7}{692,000} \times 100 = 11 \cdot 76\%.$$

The liquidation or yield factor (F) of these 692,000 tons of cane ground would be calculated as follows:

$$11 \cdot 76 = F(16 \cdot 6 - 0 \cdot 3 \times 20 \cdot 0), \text{ so that}$$

$$F = \frac{11 \cdot 76}{10 \cdot 6} = 1 \cdot 109.$$

On grinding 100,000 tons of cane with 11% of extraneous matter content, the weight of clean cane is 700,000 — 100,000, or 600,000 tons, which gives a yield of 96° sugar of 11·76%.

The sugar that the clean cane would produce plus the sugar that this cane with extraneous matter (reduced to normal cane of 3% extraneous matter or less) would produce, would be equal to the sugar made and estimated. That is:

$$600,000 \times 11 \cdot 76 + (100,000 - 8000)\frac{y}{100} = 80,360$$

$$y = \frac{80,360 - 70,560}{92,000} \times 100, \text{ that is, } 10 \cdot 65\% \text{ yield}$$

of 96° sugar of the canes with 11% of extraneous matter content. The liquidation factor of the 100,000 tons of cane mechanically loaded with 11% of extraneous matter (F_m) would be given by:

$$10 \cdot 65 = F_m(16 \cdot 6 - 0 \cdot 3 \times 20 \cdot 0), \text{ so that}$$
$$F_m = 1 \cdot 005.$$

To convert the liquidation factor of normal cane to cane with 11% of extraneous matter we should multiply by $\frac{1 \cdot 005}{1 \cdot 109}$ or 0·91.

At the present time the Sugar Board of Puerto Rico and the Agricultural Stabilization and Conservation Service of the United States Department of Agriculture allow, without penalty, a tolerance of 5% on the gross weight of the cane. Also they apply a trash correction factor to the formula for determining the yield of raw sugar for each producer which varies inversely with the amount of trash contained in the sugar cane of each producer, from 1·0 for sugar cane which contains an amount of trash not in excess of 5% of the gross weight of sugar cane to 0·76075 for sugar cane which contains an amount of trash in excess of 25% of the gross weight of sugar cane[5].

The formula for determining the yield of raw sugar for each producer does not take into consideration the fibre in the cane. The Sugar Board of Puerto Rico is now recommending the direct analysis of cane of samples taken by a cane sampler, but there is only one cane sampler of the Hawaiian type operating in Puerto Rico.

To reduce the amount of extraneous matter entering the factory, this sugar mill has a cane feeding table floor consisting of standard steel floor grating panels built up of ¼-in deep × ¼-in thick bars with ¾-in clear opening between bars and stiffening cross bars of ⅜-in diameter at 4-in centres. Part of the earth, small stones and some trash is removed through the clear opening of the table bottom.

The flow of mixed juice from the first and second mills enters at the bottom of the mixed juice tank and overflows at the top of this tank to another tank that feeds the mixed juice pump. In the mixed juice tank the velocity of the mixed juice is decreased and part of the earth is decanted and removed by a slat conveyor that travels at 2⅓ feet per minute.

Table VIII shows the effect on milling and recovery data during the years of 1951 and 1952 when this sugar mill ground hand loaded cane as compared with data from the years of 1953 to 1964 when mechanically loaded cane was ground.

Table IX shows data of the extraneous matter in the canes ground during the period 1958–64 in this sugar mill.

The experience of eleven years of grinding cane mechanically loaded corroborate the loss in sucrose, the lower liquidation factor of the cane ground, and the wear of the machinery already mentioned above.

[5] Rule Number 6, Sugar Board of Puerto Rico.

It is not the purpose of this paper to present an unfavourable picture of the mechanically loading of cane, but to offer a method for calculation of the sugar losses and an estimate of other losses that a factory could suffer, as well as the drop in the yield factor when canes of different percentages of extraneous matter are ground, owing to the use of mechanical loaders or to other causes.

Table IX

Comparative data of the extraneous matter in the canes ground during 1958–1964

	1958	1959	1960	1961	1962	1963	1964
Gross weight of cane ground	510,000	760,000	780,000	800,000	730,000	730,000	710,000
% Mechanically loaded cane	44%	56%	64%	75%	74%	79%	81%
Extraneous matter determination	874	903	957	982	924	988	1193
% Extraneous matter on gross cane	7·02%	8·35%	7·82%	8·90%	9·40%	8·85%	8·90%
Maximum % of extraneous matter	21·91%	34·96%	26·82%	39·23%	42·17%	46·65%	40·28%
Maximum % of earth and stones	12·36%	14·60%	20·46%	15·38%	22·56%	26·88%	14·85%

THE EFFECT OF SOME NEW CHEMICAL HERBICIDES ON SEEDLINGS OF SUGAR CANE, SOYBEANS AND PEANUTS*

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PART II

The characteristics of phytotoxicity by herbicides on cane seedlings

(*a*) *Pre-emergence*: Mathematical counting and measurement of the treated plants in order to show the extent to which a pre-emergence herbicide caused phytotoxicity in leaves of cane plants were made on 19th June and 1st July—65 and 75 days after spraying. It was found that the number of affected leaves per plant for each concentration of each herbicide did not either increase or decrease as concentrations of herbicidal suspensions changed. However, measurements taken of the length and width of affected leaf-blades showed a proportional decrease as concentrations of one herbicide increased. Variety N:Co 310 was more sensitive than variety F148; plants treated with "Linuron" were injured more than plants treated with the other two chemicals, and plants in sandy loam soils were injured more than plants in clay soils.

(*b*) *Post-emergence*.—A similar examination was also made on 1st July—50 days after the post-emergence spray of herbicides. The following facts resulted: The number of affected leaves per plant also did not change proportionately with change in concentrations of the herbicides. The average length and width of affected leaf-blades were less than control plants but did not change as rates of chemicals changed. No association between herbicidal effect and soil type was noted. The elongation of leaves in cane variety F148 was less influenced than in cane variety N:Co 310. This could be explained by the fact that the straighter leaf-blades of variety F148 and the smaller angle with which its leaf blades meet the stems present a smaller surface for interception of the herbicides. Thus, the greater tolerance of variety F148 to the herbicides may be due to the smaller chance of its leaves being wet by droplets of spray.

(*c*) *Combined pre- and post-emergence*.—With this type of application, only "Linuron" appeared to cause increased leaf injury as concentrations of the herbicide in double dosage were increased, whereas "Afalon" and "Ametryne" showed a rather confused situation. In general, variety F148 appeared also to be more tolerant to toxicity of chemicals than variety N:Co 310 on account of its relatively slower accelerated shrinkage of leaf blades due to phytotoxicity.

DISCUSSION

For intensive utilization of arable land, a system of simultaneously growing other short-season crops such as soybeans and peanuts between rows of sugar cane has been prevalent in Taiwan in recent years. Although chemical weed control for sugar cane cultivation has been practised for many years, a chemical programme for weed control in an intercropping system has not been developed so far. A practical way to control weeds for this special cultivation system might be to apply different herbicides in band sprays for each crop grown. It would be better, however, to find a herbicide which could be used as a single broadcast pre-emergence spray. As demonstrated in this experiment, an application rate of 20 litres per hectare (1 to 600 dilution) of "Tok E-25" might be effective for satisfactory weed control as a broadcast pre-emergence spray to sugarcane interplanted with soybeans. For cane interplanted with peanuts, application rates of 20 litres per hectare for cane and 10 litres per hectare for peanuts should be used separately as band sprays at time of planting each crop. During the writing of this article, other chemicals in wide use for weed control in horticultural crops in the United States and in European countries, such as "Amiben", MCPA, MCPB and "Sesone", have been under trial for this purpose and have given promising results.

Most of the soil-applied herbicides, at rates which are least toxic to crops, are less effective or ineffective in controlling weeds when they have emerged and have produced several leaves. This disadvantage has limited the use of such herbicides as "Diuron" and "Atrazine", which have been recommended for general use in cane fields in Taiwan for many years, to an application time of from one week to ten days immediately after planting. However, in this region where generally knapsack sprayers are used to spray a large area, the pre-emergence spray of herbicides often may not be done in time owing to lack of labour and sometimes of good weather for spraying. Thus areas of lands may be open to encroachment and infestation by weeds. It is therefore necessary for this region to find herbicides that will be equally effective for killing weeds whether applied pre-emergence or post-emergence so that optimum period of application may be lengthened and the acute problems resulting from labour shortage for spraying may be reduced.

Another problem is the adequate residual life in soils of the active components of soil-applied herbicides applied at the rates required for sufficient weed control. These two objectives of weed control in sugar cane are being sought not only in Taiwan but also in other regions such as Hawaii, Philippines and Mauritius [6,7,8]. In this experiment, "Ametryne" and "Linuron" have been shown to be such prospective herbicides capable of giving satisfactory weed control whether used pre-emergence or post-emergence and generally have longer residual life in the soil. Since at least 5 months are needed before the close-in of the top growth of cane shades off sunlight and inhibits weed growth and infestation, an additional post-emergence application of herbicides is always necessary even though a pre-emergence application has given effective early weed control. A herbicide such as "Linuron" or "Ametryne" might therefore be useful to be arranged either for pre- or for post-emergence application on account of its versatility in controlling weeds.

Another problem which concerns most of the cane planters in Taiwan in using chemical herbicides is the occasional occurrence of phytotoxicity on cane plants due to unaccountable causes. This may deter them from using such chemicals for further large-scale applications and they may instead prefer inefficient hand hoeing to control weeds in cane. Knowing what characteristics of herbal toxicity might be expected is therefore important in order to persuade the planters to use such herbicides. As demonstrated in this experiment, the fact that tillering of cane plants was not affected by herbicides except at excessively high concentrations may convince the cane planters to use "Linuron" or "Ametryne" without fear of toxicity due to improper spraying. Since growth of cane plants was the least affected and scorching of leaves was short-lived, the herbicides tested could be used safely in future whether prior to or after emergence of cane and weeds if suitable application rates are used.

Summary

Six new chemical herbicides: "Afalon", "Ametryne", "Linuron", "Fenac", "Triherbide CIPC" and "Tok E-25" were evaluated in these experiments with pot-planted sugar cane (varieties F148 and N:Co 310), soybeans and peanuts to test their phytotoxicity to young plants and their efficiency in killing weeds. Different application rates per hectare were used, three types of soil, i.e. clay, sandy loam and sandy soils, and three types of application, i.e. pre-emergence, post-emergence and a combination of both the pre- and post-emergence applications.

"Fenac" and "Linuron" were the best pre-emergence chemicals for sugar cane because of their relatively lower rates of application required for effective weed control, longer persistence in soils and the wider spectrum of weed species controlled.

"Ametryne" and "Linuron" were the best post-emergence chemicals.

"Tok E-25" and "Triherbide CIPC" could be used to control weeds for soybeans and peanuts effectively if suitable rates were used for different soil types. When sugar cane is intercropped with each of them, two different chemicals for each crop should be used as a band spray for weed control. For example, in sandy soils for sugar cane (variety F148), "Linuron" at 2500 p.p.m. and, for peanuts, "Tok E-25" at 10 litres per hectare (1 to 600 dilution) should be used for this intercropping system. However a single broadcast pre-emergence spray of "Tok E-25" at 20 litres per hectare could be used for both cane and soybeans growing in association.

When "Afalon", "Ametryne" and "Linuron" were used to spray cane seedlings, phytotoxicity was liable to occur, the characteristics of which differed according to concentrations of chemicals and types of applications. In general, tillering of cane plants was by no means affected except at too high rates of herbicides. The scorching effect on leaves was less when chemicals were sprayed prior to emergence of plants and greater when sprayed post-emergence. Growth of plants was influenced more by pre-emergence than post-emergence application and was more significantly in proportion to concentrations of chemicals. In the case in which cane plants received both a pre- and post-emergence spray of one chemical at one application rate, the toxic effect was the combined effects of the two applications.

Except for "Tok E-25" and "Triherbide CIPC," all the chemicals tested injured or killed germinating soybeans and peanuts even at very low concentrations when applied as either pre- or post-emergence sprays.

Acknowledgments

Acknowledgment is made to the following companies who gratuitously supplied the commercial formulations of these herbicides: "Afalon"—Hoechst Chemical Company; "Linuron"—E. I. du Pont de Nemours and Company; "Ametryne"—Geigy Chemical Company; "Fenac"—Amchem Products, Inc.; "Tok E-25"—Rohm and Haas Company; "Triherbide CIPC"—Vondelingenplaat Chemical Company.

[6] SHOJI and SUND: *Proc. 11th Congr. I.S.S.C.T.*, 1962, 247.
[7] DE DIOS: *Proc. 11th Conv. Philippines Sugar Tech.*, 1963, 75.
[8] ROCHECOUSTE: *Annual Reports Mauritius Sugar Ind. Research Inst.*, 1961 and 1963.

TUBE SPACING IN HEATING APPARATUS

By L. A. TROMP, A.M.I.Mech.E.

PART II

Equidistant Concentric Tube Spacing

Some designers prefer this type of tube spacing for the inherent advantage of having equidistant concentric lanes for the steam flow between the circular rows of tubes, thus having a well-defined steam path, giving access to the whole bank of tubes in the same way.

Outside rows nevertheless require more steam than the inside ones as the number of tubes in one row decreases from 158 at the outer pitch periphery to 46 on the one nearest the downtake.

When a drilled division chest for steam distribution inside the calandria is provided, as shown in Fig. 5, the number of holes for each row should be in accordance with the number of tubes in each row also considering that at the upper end of the tubes more steam is required than at the lower end.

The length of the mean steam path for this type of tube spacing is about equal to that for the previously mentioned spacing.

The tube spacing being asymmetric, the tracing of the hole centres for drilling is more troublesome than in the previous cases, as each row must be marked separately.

Through the well defined steam paths, incondensable gases are guided in right and left hand directions to the side opposite the steam entrance on the calandria, and to avoid eddy currents a partition plate should be provided for efficient flow towards the gas vents.

Within the 2600 mm shell diameter there may be located 2038 tubes with a heating surface of 471 sq.m. (5070 sq.ft.) or 90% of that for the spacing of Fig. 2.

Varying Pitch Tube Spacing

This system, shown in Fig. 6, has been developed to obtain easier access of the heating steam to the tubes more distant from the calandria steam inlet.

To achieve this purpose, about two thirds of the tube bank have the normal 60° rhombic pitch of 47 mm, whereas the remaining section nearest the steam inlet, has a pitch of $47 \div \sin 60° = 1{\cdot}155 \times 47 = 54{\cdot}3$ mm.

Obviously the steam lanes between the rows of the latter spacing are wider (19·3 mm) than those (12 mm) for the 47 mm pitch section.

Between the two sections a straight crossing lane facilitates the redirection of the steam flow from one section into the other.

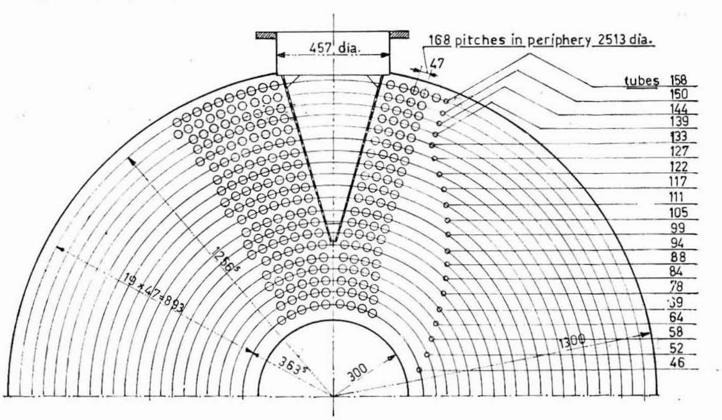

Fig. 5. Equidistant concentric (asymmetrical) tube spacing. Number of tubes = 2038; heating surface = 471 sq.m.

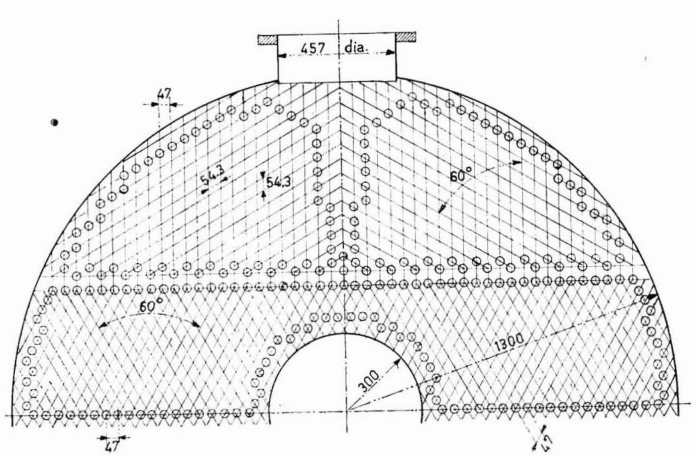

Fig. 6. Varying path (symmetrical) tube spacing. Number of tubes = 2000; heating surface = 462 sq.m.

The steam flow through the lanes of the rhombic tube spacing is not well defined and incondensable gases may not be vented completely.

The number of tubes as compared with that in Fig. 2 amounts to 2000, corresponding to a heating surface of 462 sq.m. (4970 sq.ft.) or 89% of the maximum obtainable.

No template can be used for marking the tube hole centres and the whole pitch design must be traced on the tube sheets, just as for the equal pitch rhombic spacing.

Radial Concentric Tube Spacing

This design gives the shortest steam paths and is sometimes used for vacuum pans as shown in Fig. 7, but only a few designers have used it in evaporators.

The tubes are arranged in concentric circles, the number of tubes decreasing, according to the smaller pitch diameters, towards the downtake.

An annular steam chest around the calandria shell is required to admit the heating steam equally over the shell periphery.

Because the local steam requirement decreases in proportion to the decreasing number of the innermost tubes, a better steam flow is achieved than with the conventional rhombic spacing as shown on the right-hand half of the figure.

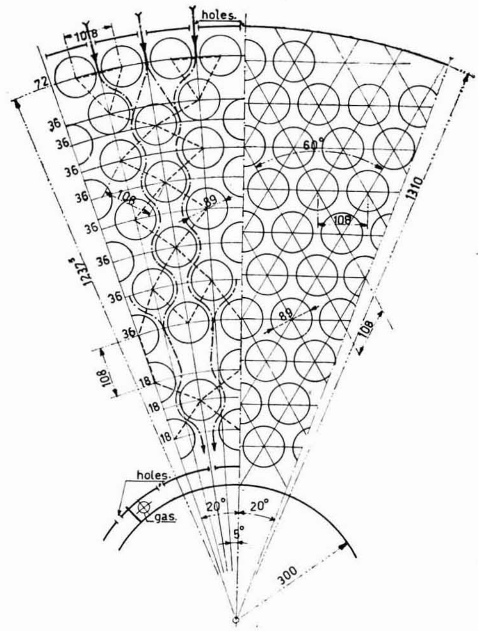

Fig. 7. Radial concentric tube spacing

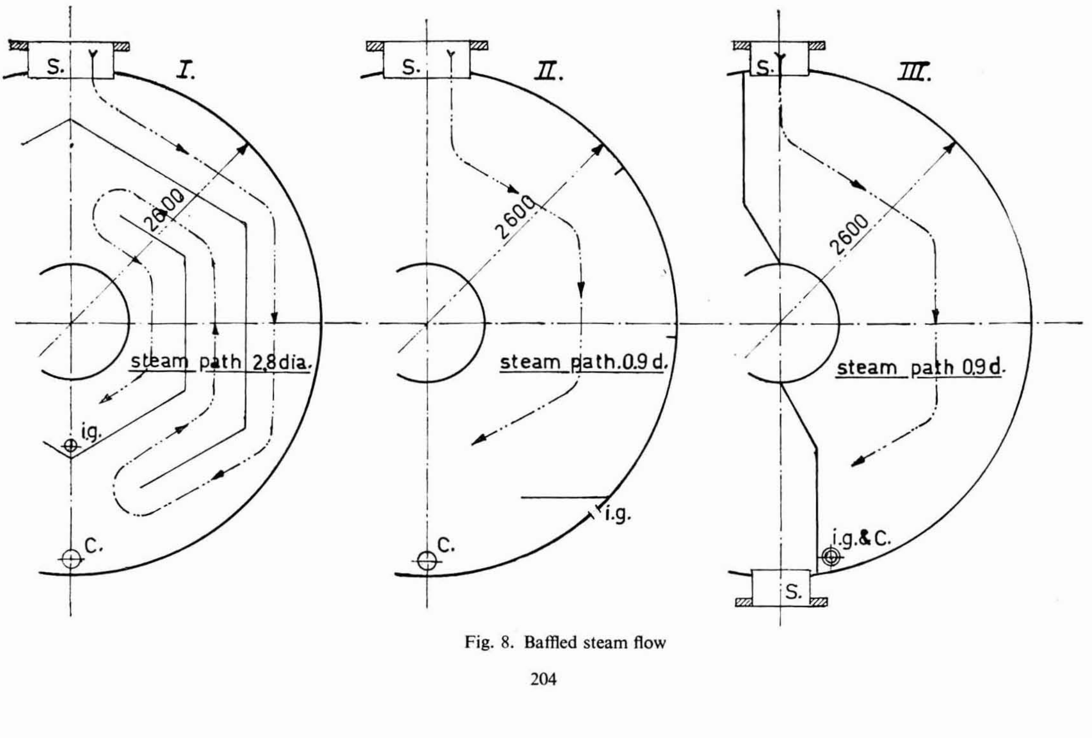

Fig. 8. Baffled steam flow

Incondensable gases as well as condensate must be released at the downtake periphery, requiring tube connexions above or below the calandria, which are more troublesome than withdrawal points on the shell periphery.

The marking of the tubes for drilling can be efficiently done by means of a template, gyrating on the centre of the tube sheet, covering a 10° section. The heating surface with such an arrangement can reach about 96% of that for the conventional spacing.

It should not be overlooked that the velocity of the steam flow is low, which may affect the heat transmission, although the steam has good access to all the tubes.

Steam Flow Baffling

Many designs of heating apparatus have baffles arranged in the lanes between the tubes, their principal or sometimes sole purpose being to direct the incondensable gases towards a definite spot for withdrawal outside the calandria. Some systems are shown in Fig. 8.

The first one (I) has a complicated accumulation of partitions to extend the path of the steam flow, although incondensable gases might remain at random.

This system has however been abandoned, because the zig-zag flow through a steam path length of about 2·8 times the shell diameter for each half section of the calandria did not give the expected result. Apparently the resistance to the steam flow was too high and thus handicapped the latter.

Another arrangement is shown in part II of the figure, where only two short baffles are placed opposite the incondensable gas vents on the shell periphery. Accumulation of the incondensable gases may take place around the downtake when the rhombic tube spacing is applied as customary, as there is no definite steam path.

A third system (III) divides the calandria into two compartments with individual steam entrances. Designers' opinions differ as to whether the venting should be around the downtake or at the shell periphery on account of the doubtful flow at the end of the steam path.

Moreover for apparatus of welded steel construction, as is now usual, the erection of baffles inside the calandria is cumbersome, for which reason some designers prefer their omission.

To sum up, little attention is usually paid to the steam flow because of insufficient knowledge of the prevailing steam currents between the heating tubes with rhombic spacing.

A definite steam flow may result in higher heat transmission, because there is renewed contact with the steam and thus stagnation of the steam flow is avoided.

AN IMPROVED SUCROSE/REFRACTIVE INDEX CORRELATION

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REFRACTOMETRY is a convenient and quick method for the quantitative determination of sucrose in water. Such an analysis is carried out using an empirical correlation between refractive index and concentration, using the 1936 International Sugar Scale. The trouble is that the 1936 scale[1] is a polyglot accumulation of the results of many experimenters, none of which is entirely consistent with any of the others. In fact, it is not a scale at all but a table of discrete values, as if sugar solutions were somehow quantized. Some values are reported to five significant figures, others to six. Refractometers have to be built with slightly discontinuous scales to comply with the International Scale. Users have complained[2], apparently not realizing that the fault was with the table, not with the manufacturer. Even more awkward was the manner of interpolation; Bates[3] uses a linear interpolation for a scale which is fundamentally non-linear.

A review of the construction of the 1936 table can be found in the Referee's Report on Subject No. 7 of the 1962 Session of the International Commission for Uniform Methods of Sugar Analysis (ICUMSA)[4] and need not be presented here. Some changes in the Scale were made at this 1962 meeting but without in any way overcoming a fundamental objection: there is still no single mathematical function which expresses the relationship between refractive index and % sucrose.

There seems to be little justification for this state of affairs and the object of this little paper is merely to provide the best continuous curve than can be obtained from existing data. Nevertheless, there seems to be a significant body of opinion, obviously including the International Commission, which does

[1] Landt: *Proc. 9th Session ICUMSA*, 1936; *I.S.J.*, 1937, **39**, 22s–25s. Note that some references ([9,14]) have copied the typographical error found in Circular 440[3] which lists the page number as 225 instead of 22s.

[2] Charles & Meads: *Anal. Chem.*, 1955, **27**, 373–379.

[3] *Nat. Bureau Standards Circ.*, 1942, (C-440).

[4] Rosenhauer: *Proc. 13th Session ICUMSA*, 1962, 21–24.

not perceive the sugar table as a simple, smooth, continuous function but rather as a collection of separate and independent pieces of data.

The dichotomy is simply put: HILL and ORCHARD[5] in discussing whether a continuous function can be applied to essentially discontinuous and inconsistent data say that "Continuity must be justified, if at all, by some definite or theoretical advantage." I maintain quite the opposite: I believe that *dis*continuity must be justified, say, by the observation of some corresponding *physical* discontinuity. To my knowledge, none has ever been observed.

Construction of a new Scale

The selection of the "best" data is somewhat arbitrary. Certainly the SCHÖNROCK/LANDT values[6] should be included, although the source of some of the data is obscure: in his paper, LANDT refers to "new" SCHÖNROCK data but gives no indication as to where these values came from. So far as the reader is concerned the values have no verifiable origin.

SCHÖNROCK's 1933 data[6] are inconsistent with his own 1911 data[7] so that one is inclined to be chary of his early measurements (even though they are the basis of the current International Scale in the range 25% to 53% sugar.) MAIN's data[8] were descredited may years ago *except* in the region above 71%; not that his data were any better above 71%, only that for many years there simply was no other information in this range. Since CHARLES[9,10] and SNYDER[11] have now provided new values above 25% there seems little reason to retain these older data.

EMMERICH[12] lists a few selected points which he reports to seven significant figures. Here, at last, an experimental technique is being used which is capable of providing the desired accuracy. Many of the inconsistencies of the past (and present) can be attributed to the use of critical angle refractometers; they are convenient; they are commercially available; they provide reasonable accuracy for values close to that of the test pieces; but they were never intended as primary standards for measurements of refractive index and instead rely on the test piece, itself a secondary standard, for their accuracy.

To be consistent with TILTON & TAYLOR's data[13] for distilled water, the curve was adjusted to go through 0% sugar at 1·3329877. The last two digits have little or no significance but to choose any other number would leave an apparent discrepancy . . . and invite confusion.

By fitting a third order polynomial to the above data by the method of least squares, one arrives at an expression

$$n = 1{\cdot}3329877 + 0{\cdot}00142520\%S + 0{\cdot}00000554171\,(\%S)^2 + 0{\cdot}0000000159955\,(\%S)^3 \ldots . (1)$$

If % sugar is treated as the dependent variable,

$$\%S = -10398{\cdot}342 + 19841{\cdot}967n - 12735{\cdot}999n^2 + 2777{\cdot}7949n^3 \ldots\ldots (2)$$

where n is $n_D^{20°}$.

Table I

Index of refraction for integral values of weight percent sucrose in water as computed from polynomial

% sucrose	*Index of Refraction* (n_D^{20})	*% sucrose*	*Index of Refraction* (n_D^{20})
0·00	1·3329877	43·00	1·40579
1·00	1·33442	44·00	1·40779
2·00	1·33586	45·00	1·40980
3·00	1·33731	46·00	1·41183
4·00	1·33878	47·00	1·41387
5·00	1·34025	48·00	1·41593
6·00	1·34174	49·00	1·41801
7·00	1·34324	50·00	1·42010
8·00	1·34475	51·00	1·42221
9·00	1·34628	52·00	1·42433
10·00	1·34781	53·00	1·42647
11·00	1·34936	54·00	1·42863
12·00	1·35092	55·00	1·43080
13·00	1·35249	56·00	1·43299
14·00	1·35407	57·00	1·43519
15·00	1·35567	58·00	1·43741
16·00	1·35728	59·00	1·43965
17·00	1·35890	60·00	1·44190
18·00	1·36053	61·00	1·44418
19·00	1·36218	62·00	1·44646
20·00	1·36384	63·00	1·44877
21·00	1·36551	64·00	1·45109
22·00	1·36719	65·00	1·45343
23·00	1·36889	66·00	1·45579
24·00	1·37061	67·00	1·45816
25·00	1·37233	68·00	1·46056
26·00	1·37407	69·00	1·46297
27·00	1·37582	70·00	1·46539
28·00	1·37759	71·00	1·46784
29·00	1·37937	72·00	1·47030
30·00	1·38116	73·00	1·47278
31·00	1·38297	74·00	1·47528
32·00	1·38479	75·00	1·47780
33·00	1·38663	76·00	1·48033
34·00	1·38848	77·00	1·48289
35·00	1·39034	78·00	1·48546
36·00	1·39222	79·00	1·48805
37·00	1·39412	80·00	1·49066
38·00	1·39603	81·00	1·49329
39·00	1·39795	82·00	1·49594
40·00	1·39989	83·00	1·49860
41·00	1·40184	84·00	1·50129
42·00	1·40381	85·00	1·50399

A table of integer values of % sugar calculated from equation (1) is listed in Table I. Typographical errors of the sort found elsewhere[14] were carefully eliminated. Equation (1), and by extension, Table I, is proposed as the new International Sugar Scale. A comparison of this scale with the experimental data used to generate this scale is shown in Table II.

[5] Private communication dated 14th April 1964.

[6] LANDT: *Z. Ver. deut. Zucker-Ind.*, 1933, **83**, 692–716.

[7] *ibid.*, 1911, **61**, 421–425.

[8] MAIN: *I.S.J.*, 1907, 9, 481–487; *Z. Ver. deut. Zucker-Ind.*, 1907, **57**, 1–8.

[9] *I.S.J.*, 1959, **61**, 236–240.

[10] *Anal. Chem.*, 1965, **37**, 405–6.

[11] Referee's report on Subject No.7, U.S. National Committee on Sugar Analysis, 1957; *Proc. 12th Session ICUMSA*, 1958, 23–26.

[12] *Proc. 13th Session ICUMSA*, 1962, 23.

[13] *J. Research* (Nat. Bureau Standards), 1938, **20,** 419–477.

[14] MARTIN: Referee's report on Subject No. 7, U.S. National Committee on Sugar Analysis, 1962.

Table II

Tables of Differences

(Index as found in literature minus index calculated from polynomial)

% Sucrose	*Authority*	*Difference*	*% Sucrose*	*Authority*	*Difference*	*% Sucrose*	*Authority*	*Difference*
0·0000	SCH	0·000002	23·7138	EMM	0·000006	66·6210	C	—0·000082
0·0000	L	0·000012	23·7360	EMM	0·000005	66·6260	C	—0·000024
1·0000	SCH	0·000012	23·8820	C	—0·000013	66·6470	SN	—0·000104
1·0000	L	0·000022	24·0000	SCH	—0·000016	66·6610	C	—0·000057
2·0000	SCH	0·000020	25·5630	C	0·000021	66·6650	C	—0·000056
2·4800	L	0·000024	27·4480	C	—0·000012	66·6690	C	—0·000026
3·0000	SCH	0·000016	28·1190	C	—0·000020	66·7010	C	—0·000012
4·0000	L	0·000012	31·8030	C	—0·000023	66·7120	C	—0·000118
4·0000	SCH	0·000022	34·4960	C	—0·000022	66·7420	C	0·000011
4·9200	L	0·000014	34·5570	C	—0·000026	66·8050	SN	—0·000009
5·0000	SCH	0·000016	37·8220	C	—0·000044	67·0100	SN	—0·000008
6·0000	SCH	0·000018	40·6970	C	—0·000016	67·3750	C	—0·000029
6·0000	L	0·000018	40·7240	C	—0·000038	67·8330	C	0·000015
7·0000	SCH	0·000019	41·3350	C	—0·000026	68·1670	SN	0·000093
7·3100	L	0·000022	41·4810	C	—0·000044	68·2070	SN	0·000127
8·0000	SCH	0·000018	44·4700	C	—0·000042	68·2520	C	—0·000001
8·7200	L	0·000013	47·1590	C	0·000039	68·3580	SN	0·000004
9·0000	SCH	0·000015	49·0470	C	0·000032	68·7640	C	0·000015
9·6500	L	0·000019	53·1440	C	—0·000021	68·9690	C	0·000020
10·0000	SCH	0·000020	53·9990	C	—0·000015	69·0360	SN	—0·000002
10·5800	L	0·000015	54·6680	SN	0·000014	69·1560	SN	—0·000013
11·0000	SCH	0·000013	54·9060	SN	0·000026	69·3410	SN	0·000019
11·4900	L	0·000021	55·0940	SN	—0·000034	69·7070	C	—0·000019
12·0000	SCH	0·000014	56·1520	SN	0·000099	69·8810	SN	0·000077
12·4100	L	0·000022	56·7120	C	—0·000015	70·3290	SN	0·000005
13·0000	SCH	0·000013	58·8750	C	0·000010	70·4760	C	0·000046
13·3200	L	0·000018	58·9970	SN	—0·000014	70·6580	SN	—0·000109
14·0000	SCH	0·000010	60·0700	SN	—0·000003	70·7520	C	0·000001
14·2100	L	0·000015	61·0590	SN	0·000039	70·7860	C	0·000077
15·0000	SCH	0·000004	61·5510	SN	0·000035	71·6660	SN	0·000024
15·5000	L	—0·000009	62·0120	SN	—0·000002	72·5380	C	—0·000003
16·0000	SCH	0·000005	62·2380	C	0·000028	72·8970	SN	0·000035
16·4400	L	0·000003	62·6760	SN	0·000029	73·2370	SN	0·000178
17·0000	SCH	0·000004	63·2910	C	—0·000084	73·2570	C	0·000028
17·5000	L	0·000009	63·8020	SN	—0·000031	73·2730	C	0·000048
18·0000	SCH	0·000000	64·0340	C	—0·000002	73·7670	C	0·000053
18·6200	L	0·000011	65·0380	SN	0·000009	74·3860	SN	0·000070
19·0000	SCH	0·000003	65·2010	SN	0·000086	74·4170	C	0·000082
20·0000	L	0·000004	65·2770	SN	0·000087	75·4890	SN	—0·000086
20·0000	SCH	0·000004	65·5040	SN	—0·000038	76·3870	C	—0·000020
21·0000	SCH	0·000001	65·6490	SN	0·000070	77·8100	C	—0·000030
21·1900	L	0·000002	65·7130	C	—0·000021	77·8510	SN	0·000105
21·8050	C	—0·000025	66·1620	SN	—0·000003	78·4230	SN	—0·000173
22·0000	SCH	—0·000005	66·2540	C	—0·000081	78·4860	C	0·000013
23·0000	SCH	—0·000013	66·3790	C	—0·000027	79·3400	C	—0·000016
23·6846	EMM	0·000003	66·4540	C	0·000015	79·9310	C	—0·000170
23·7000	L	—0·000011	66·5660	C	—0·000081	80·4310	C	—0·000021
23·7010	EMM	—0·000003	66·5870	C	—0·000001	80·9700	C	0·000031

AVERAGE DIFFERENCE = 0·0000019 STANDARD DEVIATION = 0·0000462

SCH: SCHÖNROCK[1] C: CHARLES[9,10] EMM: EMMERICH[12]
L: LANDT[1] SN: SNYDER[11]

From inspection, it is obvious that there is some residual non-random error which is attributed to experimental bias of some observations.

With some misgivings, values of % sugar are listed by extrapolation to 85% sugar. Such extrapolation is experimentally unjustified and must surely be in error. It was felt, however, than an artibrary scale between 81% and 85% would be preferable to none at all. It might be noted that sugar values between 85% and 95% sugar are sometimes used[15] but without any indication as to where these values came from nor what experimental justification exists for them.

It should be noted that the modifications adopted at the 1962 Session of ICUMSA applied to the 20° sugar table but not to the 28° table. Some effort should be made to make the two scales consistent.

Acknowledgement

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Summary

A formula correlating refractive index measurements to weight percent aqueous sucrose solutions leads to the expression $n_D^{20} = 1·3329877 + 0·00142520$ $\%S + 0·00000554171\ (\%S)^2 + 0·0000000159955\ (\%S)^3$. It is recommended as a replacement for the 1962 International Sugar Scale.

[15] *Bulletin* 50110/11-E (Carl Zeiss Inc., 444 Fifth Ave., New York, N.Y., 10018 U.S.A.), 1960.

More horsepower—less manpower. L. L. Lauden. *Sugar Bull.*, 1966, **44,** 132.—There is greater interest among Louisiana cane growers in the more powerful high-clearance type tractor capable of drawing multiple-row equipment. Where new fields have been ploughed some growers now open 3 rows at a time, cover 3 rows after planting and cultivate and fertilize 3 rows at a time.

* * *

Steel-framed bullcart favours harvesting operations. Anon. *Victorias Milling Co. Inc. Expt. Sta. Bull.*, 1965, **12,** (10 & 11), 2.—The efficiency of the rubber-tyred steel-framed cart, drawn by water buffalo, in removing cut cane from the field in wet conditions is stressed. The "Toft Loader" was used in loading.

* * *

The structure of vessels, tracheids and cell-wall pits of the sugar beet root—some comments. O. Wiklund. *Socker Handl. II*, 1965, **20,** (1), 1–18.—A historical sketch is given of the study of the anatomy of the sugar beet root. The findings presented are claimed to give detail to matters dealt with in a more brief manner by earlier observers. Numerous photographs and drawings are included.

* * *

Fertilizer application: need for testing service. J. L. du Toit. *S. African Sugar J.*, 1965, **49,** 954–957. The pros and cons of soil analyses are discussed. Soil analyses have been criticized and even ridiculed but nevertheless remain one of the main methods used in determining fertilizer application in the most progressive agricultural countries. The value of soil analyses for phosphorus in South African soils is stressed. Soils with 14 p.p.m. or more gave no response with applied phosphates whereas soils containing 5 p.p.m. or less gave an average response of about 7 tons of cane per acre with the same application of superphosphate.

* * *

What can we expect in the foreseeable future? G. S. Bartlett. *S. African Sugar J.*, 1965, **49,** 960–969. The need for increased mechanization in cane cultivation and production in South Africa is emphasized. Although the country may be better off for manual labour than many cane-growing countries, the supply is often uncertain and is liable to worsen rather than improve. Methods whereby labour can be saved in such operations as planting, weed control, fertilizer application and cultivation, apart from harvesting, are discussed.

The protectant effect of BSM-11 on sugar cane seed-pieces. M. B. Lopez, S. C. Lojo and C. R. Mora. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 39–44. Experiments at three centres on dipping setts before planting are recorded. Dipping reduced incidence of root rot. It also increased germination percentage and number of tillers and consequently yield (by an average of 2·45 tons per hectare). The concentration of BSM-11 recommended is 0·45–0·50% by volume in water, dipping being for 2 minutes; 10,000 setts could be dipped in 100 litres of solution.

* * *

Some essential considerations for improving sugar cane irrigation practices in the Philippines. A. P. Aglibut. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 45–51. The writer points out that about 10% of Philippine cane is now irrigated, mainly in Negros Island and to a less extent in Luzon. He deplores the lack of basic information in the Philippines essential to secure maximum benefit from the expensive equipment used. Moisture relations, quality of water, method and frequency of irrigation are discussed.

* * *

The effect of different herbicides in the control of *Aeginetia indica* **Roxb.** M. E. Lopez and R. L. Barile. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 61–71. This parasitic flowering plant can cause heavy reductions in cane yield in the Philippines. Tests were carried out with several different weedkillers ("Karmex", "Telvar", "Gesaprin 50W", 2,4-D, and 2,4-D plus sodium TCA). All proved effective, giving kills of 70–88% after 70 days.

* * *

Study of the sterilization of the germinating medium for sugar cane seedlings. A. M. Galvez and L. P. Medel. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 78–81.—Although heat treatment gives satisfactory results it is regarded as time consuming and expensive in fuel (firewood). Formaldehyde, in the form of one part 40% commercial formalin to fifty parts water, applied at the rate of ¼ gal per seedbox, proved satisfactory. No harmful effect on the germination of the cane seeds was observed.

* * *

Optimum plot size for field experiments on sugar cane. M. B. Lopez and G. E. Banashihan. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 210–221.—The optimum plot size is considered to be 645 square metres i.e. an area large enough to yield cane sufficient to be loaded on one cane truck or vehicle of about 5 tons capacity as generally used in the Philippines.

A preliminary report on the investigation of nematodes associated with sugar cane. J. R. RIVERA and I. B. CANO. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 93–98.—From 40 soil and root samples from fields with stunted cane, on 16 different estates, 25 genera of nematodes were found. These are named and their distribution indicated in tabular form. The nematode population varied with different areas.

* * *

Preliminary studies on the use of "N-Serve" in the conservation of nitrogen in soils. A. M. LOJO, R. R. COVAR and C. R. MORA. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 229–233.—"N-Serve" (2-chloro-6-trichloromethyl-pyridine) is a nitrogen conserver, i.e. it acts on the organisms responsible for nitrification and so delays nitrification. Field or plot experiments are reported using urea or ammonium sulphate. Areas fertilized with ammonium sulphate treated with "N-Serve" gave higher yields than those treated with urea and "N-Serve". 2% "N-Serve" mixed with either urea or ammonium sulphate gave relatively high recoveries with respect to ammonia nitrogen.

* * *

The comparative performance of different fertilizers as sources of nitrogen. F. B. AMBOJIA *et al. Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 266–270.—Seven commercial fertilizers were used as sources of nitrogen. With plant cane no differences in sugar production were noted but they occurred in ratoon cane, perhaps because of the better developed root system. Calcium ammonium nitrate came out best, ammonium sulphate second and urea third.

* * *

A review of variety trials in central Luzon. C. R. MORA *et al. Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 296–312.—A total of 17 variety tests are reported. H37-1933 proved to be one of the best yielders. Phil 53-33 was the most outstanding of the Philippine-bred canes. Four Coimbatore varieties showed promising yield potential.

* * *

A viability test of sugar cane seeds. J. T. TAPAY. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 358–365.—Results of storage tests of sugar cane seed kept at low temperatures are given. In several sowings with seed kept at 0°C, treated seed gave a higher germination test than untreated seed. However there is a belief that seedlings from seed stored for a long time at 0°C may lack the vigour of normal seedlings.

* * *

Factors affecting sugar cane production in the Philippines. F. T. AALA. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 411–422.—Special emphasis is given to water relationships (irrigation) and to "biotic factors", notably weeds. A list is given of the common sugar cane weeds. Two introduced cover crop plants, *Calopogonium muconoides* and *Centrosema pubescens* both twining legumines, have become weeds in sugar cane.

Liming studies with Victorias sugar cane soils. T. R. ESCOBER and M. V. LACSON. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 423–464.—Results are given of 10 years of study on the lime problems of the acid soils of the Victorias Mill District. Liming often failed to show beneficial results and gave depression in juice quality. Presumably this is due to stimulation of microbial activity which increases conversion of nitrogen from organic to inorganic forms.

* * *

Delayed shaving reduced ratoon yield. I. P. FERRARIS *et al. Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 465–466.—Tests were made in shaving (close cutting) cane stubbles in the rows 5, 10, 15 and 20 days after the trash had been burned. This resulted in losses of 22, 32, 45 and 65 piculs of sugar/hectare respectively, indicating that shaving should be carried out immediately after the trash is burned.

* * *

Mechanized sugar cane harvesting in Australia. A. M. ATKINSON, G. QUAID and R. DEICKE. *Sugar J.* (La.), 1965, **28**, (6), 20–26.—The harvesting problems in Australia are discussed and the various kinds or makes of mechanical harvester in use described. A table shows the crop harvested mechanically from 1956 (2%) to 1964 (20%), as well as the number of harvesters in use (112 in 1961 rising to an estimated 410 in 1964).

* * *

Yields of commercial varieties in Louisiana. R. J. MATHERNE, T. J. STAFFORD and H. P. FANGUY. *Sugar y Azúcar*, 1965, **60**, (12), 30–33.—Plant cane, 1st and 2nd ratoons were analysed from 11 different plots or areas on light soils. The varieties CP 36-105, CP 44-101, CP 48-103 and N:Co 310 were selected for comparison. Graphs depict yields. As large variations occur from year to year in the same variety, it is thought that at least 10 years are needed to show significant differences.

* * *

Conservation of labour by modern methods of weed control in sugar beet. C. WINNER. *Zucker*, 1965, **18**, 593–598.—Tests carried out in South Hanover over a number of years showed a 44% reduction in singling expenses with monogerm seed. The saving to be expected from chemical weed control is partly governed by the density of the stand of the sugar beet plants.

* * *

Producing sugar cane in Louisiana without putting it on the off-bar. S. J. RODRIGUE. *Proc. 10th Conf. Amer. Soc. Sugar Cane Tech.*, 1963, 39–43.—An account is given of cane cultivation on a 890-acre Louisiana farm on which livestock (cattle, pigs and sheep) are kept and other crops (maize, peas, soybeans) grown in rotation with the cane. Sheep greatly assist Johnson grass control. A new method of applying fertilizer deeply, so that the cane gets it instead of the grass, is described.

Studies of the physical properties of selected soils in the sugar cane area of Louisiana. W. H. PATRICK R. WYATT and E. C. SIMON. *Proc. 10th Conf. Amer. Soc. Sugar Cane Tech.*, 1963, 12–18.—Chemical and physical properties of important sugar cane soils are discussed as well as the effect of various rotations on the yield of cane and on soil organic matter and structure. Rotation crops included clover, soybeans and *Melilotus indica.*

* * *

Cultural practices in sugar cane. L. P. HEBERT. *Proc. 10th Conf. Amer. Soc. Sugar Cane Tech.*, 1963, 19–24.—Results are presented of experiments on cultural practices which have been conducted at the Houma experiment station for several years and recommendations made for their applications by U.S. sugar cane growers.

* * *

The storage of sugar cane pollen. J. R. KING. *Proc. 10th Conf. Amer. Soc. Sugar Cane Tech.*, 1963, 38. The success achieved so far in the storage of sugar cane pollen by the freeze-drying method is briefly described.

* * *

Harvesting trends of the future. M. MITCHIE. *Proc. 11th Conf. Amer. Soc. Sugar Cane Tech.*, 1964, 6–13. The difficulties of mechanical harvesting of cane in Louisiana, especially lodged cane, or cane affected by frost, are discussed. Emphasis is placed on the fact that a harvester suited to one area or one set of conditions may prove unsuitable in another cane area; the importance of varietal characteristics of the cane, e.g. brittleness of stalk, is also underlined.

* * *

Sugar cane, pesticides and water in Louisiana. G. J. LAUER. *Proc. 11th Conf. Amer. Soc. Sugar Cane Tech.*, 1964, 46–52.—"Endrin" applied to sugar cane fields for borer control was found to have entered streams and pools in run-off water and to have killed fish. Concentrations were found to vary from nil to 360 parts per trillion.

* * *

Difficulties encountered in harvesting the 1964 sugar cane crop. R. E. BILLEAUD. *Proc. 12th Conf. Amer. Soc. Sugar Cane Tech.*, 1965, 1–5.—The terrible state of the cane after hurricane Hilda and the manner in which it was salvaged are described. Two other articles deal with the same topic, viz. harvesting of badly lodged cane in other parts of the American sugar cane belt.

* * *

The use of legumes as green manure (with cane). D. O. HERNÁNDEZ. *Bol. Azuc. Mex.*, 1965, (196), 14–21.—The following green manure crops and their utility under Mexican conditions are discussed: sword bean (*Canavalia ensiformis*), cowpea (*Vigna sinensis*), pigeon pea (*Cajanus indicus*), *Sesbania* and *Crotalaria.*

Mosaic disease situation. M. J. GRANGER. *Proc. 12th Conf. Amer. Soc. Sugar Cane Tech.*, 1965, 20–23. The improved situation in St. Mary's Parish is described, and the need for continued effective rogueing of seed cane to control mosaic disease is mentioned.

* * *

The use of chemical herbicides in the culture of sugar cane for sugar production in Louisiana. E. R. STAMPER. *Proc. 12th Conf. Amer. Soc. Sugar Cane Tech.*, 1965, 66–83.—Sugar cane cultivation in Louisiana goes back 200 years. This and early methods of weed control are discussed. The menace of Johnson grass and other grass weeds in sugar cane is dealt with. What progress has recently been made with chemical control, especially pre-emergence herbicides such as "Fenac" and the uracils, is pointed out.

* * *

Mexican sugar cane pest and its control. ANON. *Bol. Azuc. Mex.*, 1965, (197), 18–23.—This is a continuation of earlier papers[1] on the insect pest of sugar cane called "el salivazo" (*Aenoelamia postica*), the second most important cane pest of Mexico. Results of tests with various insecticides are given; some give good control.

* * *

The root system of sugar cane. A. V. SOBREPEÑA. *Sugarland* (Philippines), 1965, **2,** (7), 8–13.—The nature of the sugar cane root system and the contributions that have been made by various well known workers in this field are discussed.

* * *

Australian harvester beats storms. ANON. *Sugarland* (Philippines), 1965, **2,** (7), 49.—Reference is made to the amount of Australian-made or Australian-designed agricultural machinery now imported into the Philippines. Eight Australian cane harvesters (MF 515) have performed well in the Philippines, especially with lodged cane.

* * *

Filter cake as a basic manure. P. M. GOVITRIKAR. *Proc. 20th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1965, 1–4.—Fertilizer trials with sugar cane over three seasons in which farmyard manure was replaced by filter press mud from the factory are reported. Differences in yield of cane or sugar were small, not exceeding 5%.

* * *

A note on sugar cane scale. V. V. TEMBHEKAR. *Proc. 20th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1965, 60–65.—Sugar cane scale (*Melanaspis glomeratus*) is considered a minor cane pest because of its somewhat restricted distribution. Nevertheless it can reduce yield up to 63% and adversely affect milling quality of cane. The biology of the pest, the damage it causes and control measures are discussed.

[1] *I.S.J.*, 1964, **66,** 313; 1966, **68,** 113; *see also* CÁCERES: *I.S.J.*, 1966, **68,** 112.

SUGAR HOUSE PRACTICE

Several characteristics of granular active carbon "Adster". T. MIKI and T. ANDO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1965, **16**, 11–15. Decolorization tests with "Adster" granular active carbon (manufactured by the Adosu Kasei Co. Ltd.) are reported. Washed raw sugar liquor of 60·5°Bx and 4·5°St colour content was passed through two columns after heating to 80°C. The resins were regenerated when colour adsorption had fallen to 65%. In one column, by the 5th cycle the decolorizing capacity was only 50% of that in the first cycle, after which it tended to level out at slightly below 50% up to the 9th cycle, by which time liquor equivalent to 50 times the volume of the column had been treated. The carbon was regenerated with N/4 NaOH solution and then washed with N/45 HCl and water to bring the pH to 6·5–7·0. Doubling the strength of the NaOH solution in the last cycle considerably raised the decolorizing efficiency. Washing the carbon to a pH slightly on the alkaline side prevented a considerable drop in pH, attributed to the large quantity of SO_4^{--} eluted from the carbon, which was observed at the beginning of the first cycle.

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(Effect of) Pneumatic conveying calcination of lime sludge on burning efficiency. K. NOZAWA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1965, **16**, 32–37.—Investigations are reported in which lime sludge was fed at 25 kg/hr by a screw conveyor into a tower where it was fluidized with hot gas at 1000°C and blown into a kiln at 3 m/sec. The CaO recovery was 50–65% (averaging 60·6%), but a second treatment increased this to 70–80% (averaging 74·6%). Pressure loss in the fluidization chamber was very small.

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Recent advances in sugar technology in India. S. C. GUPTA. *Indian Sugar*, 1965, **15**, 317–320.—A survey is made of technological reports by Indian authors during 1964.

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A further improvement on "Suggestion for improving the exhaustibility of final molasses" (clarification of penultimate or B-heavy molasses). J. M. SAHA, G. S. LAL and V. SINGH. *Indian Sugar*, 1965, **15**, 321–323. In the authors' original suggested process, *B*-molasses was diluted to 20°Bx at 40°C, limed and carbonatated to 1600 mg CaO/litre, filtered, heated to 70°C, again carbonatated to a light pink end-point on phenolphthalein paper, again filtered, neutralized with superphosphate solution, heated to 85–90°C, and filtered a third time before passing to the evaporator. Tests are reported in which dilution is to 10–12°Bx and the juice after the 2nd carbonatation is neutralized without filtering. Slightly more superphosphate is needed, but the purity rise (about 8 units) is almost the same, indicating that the second filtration may be omitted without harm.

Treatment of sugar factory effluents—self oxidation and purification. D. R. PARASHAR. *Indian Sugar*, 1965, **15**, 325–333.—A survey is made of effluent treatment systems at certain Indian factories, with details of the wastes involved and their sampling and analyses for B.O.D., pH, etc.

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Determination of the critical rate of fluidization of granular adsorbents. YA. O. KRAVETS, A. K. KARTASHOV, YU. D. GOLOVNYAK and M. V. OSTAPENKO. *Sakhar. Prom.*, 1965, **39**, 813–820.—The flow rate of water and sugar solutions of varying viscosity and density at which the bed of granular active carbon in a counter-current continuous column is fluidized was determined in experimental glass columns. The critical fluidization rate (w_{crit}) was determined visually from the change from static conditions to fluidization and vice versa and from the expansion of the bed as measured by a vertical scale. Column diameter and bed height had no effect on w_{crit}, while its value fell with increase in the kinetic viscosity of the test fluid and rose with increase in particle size. Hence a wide range of particle sizes is not desirable, and the particles should preferably be spherical. An empirical formula for calculation of w_{crit} was found to give results in satisfactory agreement with the experimental data processed by the least squares method. The results have been used to design a counter-current column for sugar solutions which was to be tested in the 1965/66 campaign.

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Examination of an industrial unit for drying and cooling granulated sugar in a fluidized bed. D. S. SHEVTSOV and B. F. MILYUTENKO. *Sakhar. Prom.*, 1965, **39**, 820–825.—Tests are reported in which refined sugar was passed through a Soviet-built fluidized bed dryer at the rate of 16–18 metric tons/hr. The sugar was fed into the drying chamber, whence it passed into the larger cooling chamber. The screens in both chambers sloped downwards at an angle of 2° in the direction of sugar flow, the sugar being discharged from the cooling chamber at a point on the opposite side to and just below the feed point. The moisture content was reduced from 0·4–0·5% to 0·05–0·06%. While the temperature of the sugar was reduced in the cooling chamber by 24–27°C at an average initial air temperature of 15–20°C, the final temperature was still high (40–48°C). To cool further necessitates increasing the surface of the sugar bed, and hence the length of the cooling chamber. While the amount of air consumed in drying and cooling was the same as in a twin-drum dryer (1·5 cu.m./kg of dried sugar), the amount of electricity used to drive the fans was higher in the fluidized bed dryer at 5·3–5·8 kW per ton of dried sugar. The treated sugar had a good external appearance and was suitable for export. Crystal breakage was about 6·3%, while a maximum of only 0·5% of the sugar fines (on weight of dried sugar) was carried into the cyclones. Of the sugar in the cyclones, 97·7% consisted of crystals measuring less than 0·5 mm. Other advantages over a conventional twin-drum dryer lie in the smaller dimensions and lower metal consumption. The cooling and drying chambers may be used independently.

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Features of granulated sugar storage in a sealed bag. G. A. BELOUSOVA. *Sakhar. Prom.*, 1963, **39**, 825–828.
Tests are reported in which 99·75 purity sugar containing 0·09–0·13% moisture was stored in three types of bags for 40 months in a temperate climate zone and for 18 months in three other zones. The moisture, colour and reducing sugars contents were checked every 5 months and the smell, taste and contamination tested organoleptically. While all three types of bag stood up to transporting (over a distance of 500–5000 km) and handling satisfactorily, the best proved to be a 5-layer bituminized paper sack with a glued bottom and an outer jacket of boiling cloth. While the seal of the two types of bag with polyethylene linings (one a 5-layer paper bag and the other a linen sack) was as good as that of the bituminized paper bag, the quality of the sugar in the last type over 40 months' storage did not alter and the moisture content even fell slightly from the initial value. Slight caking was found after 10 months in the bags towards the bottom of the stack, but did not increase further and eventually disappeared. On the other hand, in the other types of bag increase in moisture content and consequent caking were more marked, so that if polyethylene-lined bags are used it is recommended to separate the plastic lining from the sugar by two or three layers of paper. The bituminized paper bags are highly recommended.

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Bulk storage of sugar. P. JACQUES. *Sucr. Belge*, 1965, **85**, 93–99.—Aspects of white sugar storage in bulk are discussed with 27 references to the literature. They include sugar-air moisture equilibrium, sugar properties and avoidance of physical, chemical and bacteriological changes.

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Cane handling at Cajun Sugar Cooperative. L. A. SUAREZ and F. SERRATE. *Sugar J.* (La.), 1965, **28**, (6), 27.—An account is given of the Hilo-type system used at Cajun Sugar Cooperative, where 25- and 36-ton trailers are unloaded by one of two series of five unloading hoists which raise a 3-in pipe at one side of the trailer, to which are attached a series of five chains running beneath the cane to fixing points on the other side of the trailer. One set of hoists unloads the cane onto a feeding table which takes it into the mill while the other set unloads it into a cane yard from which it is recovered by an overhead travelling crane carrying a 5-ton capacity grab.

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Silver ring diffuser at Pioneer Mill Co. proves as successful. B. T. TOWNSLEY. *Sugar J.* (La.), 1965, **28**, (6), 35.—During the first 5 months of the 1965 sugar crop, diffusion had proved superior to milling from all measurable aspects, maintenance costs being only one-third to one-quarter of those for a milling tandem, and power costs about 20% less. Liming the cane for clarification in the diffuser appears to be practical.

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Evaporator topics. ANON. *Sugar J.* (La.), 1965, **28**, (6), 36–40.—Basic aspects of evaporator operation and design are reviewed; they include forward feeding of juice, heat transfer in the individual vessels, vapour bleeding from vessels of equal heating surface, vapour pressure differences between vessels, the pre-evaporator, evaporator design for bleeding, and the use of a preheater for juice feed to the first vessel of a set.

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Studies on the use of flocculating agents during sugar cane juice clarification. IV. A preliminary trial of "Separan AP-30" in a sugar factory. S. BOSE, K. C. GUPTA, S. MUKHERJEE and A. N. SHRIVASTAVA. *Sharkara*, 1964, **6**, 50–53.—Addition of 2 p.p.m. of "Separan AP-30", in the form of a 0·05% solution, to the juice line at a distance of 4 ft before its entry into a Dorr clarifier produced good settling and a marked decrease in mud volume. Mud filtrate volume was reduced by 19%.

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Modification in the design of the vapour line juice heaters for obtaining higher overall heat transmission coefficients. S. C. SHARMA. *Sharkara*, 1964, **6**, 88–93.—Overall heat transfer coefficients in vapour line juice heaters are quoted from the literature, and factors influencing their values are discussed. The effect of vapour velocity is shown to be significant and it is considered that this factor should be included in formulae for calculation of the coefficient. Resistance to heat transfer due to a film of condensate on the vapour side of the heater should be minimized and the usual design with a verical baffle (involving drainage of condensate against an upward vapour flow in one half of the heater) should be changed to provide horizontal baffles, a vapour inlet at the top of the heater and vapour outlet at the bottom.

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Diffusion of cane. H. BRÜNICHE-OLSEN. *Sharkara*, 1964, **6**, 134–146.—The sugar industry of Denmark and development of the DDS diffuser for beet and cane are described, with especial and detailed reference to the unit in operation in Tanganyika.

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Review of trends in sugar technology in the Philippines in the last ten years. C. M. MADRAZO. *Sugar News*, 1965, **41**, 607–610, 643.—A survey is made of developments in equipment, processing and by-product utilization, etc., by reference to papers presented at conferences of the Philippines Sugar Technologists between 1955 and 1965.

BEET FACTORY NOTES

A modern centrifugal drive. W. HORN. *Zucker*, 1965, **18**, 598–604.—The advantages of semi-conductor drives for centrifugals are discussed. D.C. drives with regulated silicon rectifiers, known as "thyristors", are considered more adaptable than pole-change 3-phase motors, the different speeds, even those exceeding 1500 r.p.m., being more easily regulable. Among the other advantages are: more favourable load on the public electricity supply system, smoother running and higher efficiency. The wiring of the motor assembly and cycle control are described and compared with conventional motors. A Siemens thyristor drive and a number of AEG semi-conductor drives have been installed in various sugar factories on *A*- and *B*-product centrifugals. The motors are designed for a capacity of 24 charges/hr (1000 kg of *A*-product or 750 kg of *B*-product) with a total charging and discharging time of 40 sec, filling and discharging speed of 50 r.p.m. and a maximum speed of 1500 r.p.m. Even lower maximum speed times and braking times than the rated 60 and 50 sec respectively, have been achieved. For *A*-product it is shown that with regenerative braking something like half of the power requirement is returned to the public system and that, with 1000-kg charges, the total consumption is 1 kWh per charge, compared with 2½ kWh per charge with pole-change motors, representing an approx. saving of 2600 DM (over £230) per motor in a campaign.

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Application of BHS-Fest pressure filters in the sugar industry. E. FEST. *Zucker*, 1965, **18**, 604–606.—Information is given on the performance of a BHS-Fest B 14 rotary drum pressure filter[1] of 5·04 sq.m. filter surface, installed in Uelzen sugar factory in the 1964/65 campaign for the treatment of 1st carbonatation juice. Operating under a pressure of 3 atm, the filter yielded an absolutely clear juice while the muds were easily removed and sweetened-off. In the treatment of thickened muddy juice containing an average of 90·8 g of solids per litre and having an F_k value of 1·86, the mud capacity was 295 kg/sq.m./hr, equivalent to an F_k of about 1·4. The solids content of the separated mud was 50·1%, which was lower than the value of 60% achieved in pilot-plant trials because, it is suggested, of the inadequate capacity of the compressor used to blow out the cake before its removal. The residual sugar content was 0·26 pol and sweet-water amounted to 100–110% on weight of cake at a Brix of 14·6°. At an F_k of about 1 and a solids content of 100 g/litre, a mud capacity of 400 kg/sq.m./hr is anticipated.

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General principles of steam economy in a sugar factory and their application at Alpullu sugar factory. H. ATESER. *Seker*, 1965, **14**, (55), 6–19.—The fundamentals of vapour bleeding are described and illustrated by a detailed scheme of the steam and vapour distribution at Alpullu white sugar factory, which has a quadruple-effect evaporator and slices 4000 tons of beet per day. A solids balance is given for the boiling-house, which produces 75 tons of cube sugar and 525 tons of white sugar daily. A proposed scheme is also shown in which 100 tons of the white sugar is re-melted and used to make refined sugar of the same purity (99·9). The live steam consumption is thereby raised from 44·56% to 47·85% on beet.

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Characteristic changes in the weight, quality and sugar content of stored sugar beets. M. MUTLUAY. *Seker*, 1965, **14**, (56), 13–22.—Tests are reported in which beet were stored in piles 22 metres long, 6·5 metres wide and 3·5 metres high. The storage period was 27 days during the 1963 campaign and 82 days during the 1964 campaign. Where a system of forced ventilation was used, the beet pile being provided with a large number of branch air pipes and the main air channel having a system of gates to restrict air flow to particular sections of the pile, the total sugar losses were 3·75% and 2·1% over 27 and 82 days, in 1963 and 1964, compared with 4·31% and 9·25% in the other pile. Full details of the beet analyses are tabulated.

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Effect of beet quality on technology. I. SALÁNKI. *Cukoripar*, 1965, **18**, 217–230.—A survey is presented of the effect of various factors on beet quality and the subsequent effect on technological processes. Among the most significant are the changes in beet quality after lifting, particularly during storage. The characteristics of Hungarian beet and tests conducted during the 1960–1964 period are examined. A number of measures are recommended, and attention of both agriculturalists (including beet breeders) and factory workers is drawn to the need for improving beet quality and reducing storage losses.

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Modern process control in the sugar industry. D. PARDON. *Zeitsch. Zuckerind.*, 1965, **90**, 630–634. A brief survey is presented of electro-pneumatic controls, particularly the GEACONT and GEAPNEU process controllers manufactured by Allgemeine Elektricitäts-Gesellschaft. Automatic pH and density measurement is also described. Examples cited of automatic control in the sugar industry include a system of pH control for diffusion water (fresh and press), pre-liming and 1st and 2nd carbonatation, and a Brix control scheme for thick juice leaving the evaporator and melt liquor and *B*-molasses in the pan station. In the pH control system, the maximum deviation is ± 0·13 units, and in the Brix scheme the mean deviation is ± 1·3°Bx compared with approx. 10°Bx without automatic regulation. The installation of central control panels for a beet factory is exemplified by an illustration of the switchboard controlling

[1]Manufactured by Bayerische Berg-, Hütten-und Salzwerke A.G.

the carbonatation and evaporator stations at the Ochsenfurt factory of Zuckerfabrik Franken G.m.b.H. Because of the satisfactory results obtained, a switchboard for the diffusion plant was to be installed for the 1965/66 campaign.

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Effect of formalin and chloride of lime on juice quality. F. N. DOBRONRAVOV and R. A. VOSKOBOINIKOVA. *Sakhar. Prom.*, 1965, **39**, 828–832.—The effects of formalin and chloride of lime, used as disinfectants, on pure sucrose solutions and sugar juices were studied. Carbonatation of aqueous formalin solutions containing varying quantities of formaldehyde showed that methyl alcohol and formic acid present in technical formalin had a negligible effect on the optical density of the solutions. Formalin added to pure sucrose solution subsequently carbonatated increased the invert content compared with the initial content. Increase in the colour is regarded as basically a result of polymerization of the formaldehyde under the influence of calcium hydroxide, with formation of a mixture of sugars (hexoses) subsequently decomposed in alkaline medium, rather than a consequence of sucrose inversion. In the case of 2nd carbonatation juice, the colour increase was also due to reaction between the formaldehyde (and its polymers) and amino acids. Chloride of lime had a negligible effect on the colour, and increased the lime salts content to a lesser extent than did formalin. To reduce the adverse effect of formalin, it is recommended to add a solution containing 25% formalin and 75% methanol (15–20 kg/100 tons of beet) to the diffuser every 2 hr. The methanol is oxidized to formaldehyde by the bacteria present and costs half the price of technical formalin. Alternatively, SO_2 solution of pH 6–6·2 and press water heated to 85°C will act as sterilizers.

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Experiment in reception, storage and processing of mechanically-harvested sugar beet. A. Z. KLEINERMAN and D. I. KAPELYUSHNYI. *Sakhar. Prom.*, 1965, **39**, 845–850.—Information is given on the arrangement at "Bolshevik" sugar factory for reception and storage of mechanically-harvested beet. Recommendations are given, based on experimental results, regarding the forced ventilation of the piles, the dimensions of the latter and their protective coverings (according to time of harvest), and the various types of equipment required. The need for a machine to separate beet pieces from the residue after preliminary cleaning is emphasized in view of the fact that some 0·4% of the residue (on weight of beet) is in the form of pieces which could be processed. Beets harvested in September contained more than 1% invert and presented some difficulties in processing. The measures taken to overcome these are detailed. It is considered that mechanical harvesting is suitable only for beets going directly to process, while beets containing 1·8% trash (by weight) and up to 60% damaged roots when piled can be stored satisfactorily with forced ventilation. Among the sugar-house recommendations is a suggestion that the low-grade pan and centrifugal capacities be increased by 20%.

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Increase in the weight of beet being fed to the factory. V. N. SHCHEGOLEV, G. M. KORBUT, M. P. SHAPRAN and I. K. CHERNEGOVA. *Sakhar. Prom.*, 1965, **39**, 852–856.—Among the factors affecting the amount of water adhering to beet during fluming[1], the most significant were found to be the beet surface area and extent of bruising of the beet. Temperature had a negligible effect, while there was no difference in the increase of weight between manually cleaned and mechanically-harvested beet. The main factors affecting the extent of swelling caused by water absorption were found to be length of time in the water, temperature and condition of the beet. Advice is given on means of avoiding excessive water uptake.

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Glandless centrifugal pump. V. M. PROKOF'EV. *Sakhar. Prom.*, 1964, **39**, 857–858.—Details are given of a vertical glandless centrifugal pump used at a Soviet sugar factory instead of two plunger pumps for milk-of-lime feeding to defecation. The 1460 r.p.m. impeller is mounted at a level below the feed line and is connected by vertical shaft to the electric motor above the reservoir. Thus, greasing is eliminated and there is no gland or ring seal. The pump is claimed to have a high delivery.

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Flushing TG-80-1,6 gas turbo-blowers during operation. I. YA. GORBULIN. *Sakhar. Prom.*, 1965, **39**, 858–859.—The operation involves spraying oil into the blower, followed (1 hr later) by sodium bicarbonate and subsequently condensate. Rinsing finishes when the water discharged from the blower is free of oil.

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Refractories for sugar factory lime kilns. J. THEDREL. *Sucr. Franç.*, 1965, **106**, 275–290.—The susceptibilities of various types of refractories to the action of moisture, abrasion, temperature, chemical action and thermal shock in lime kilns are discussed and the characteristics of bricks containing less and more than 58% alumina are summarized. The advantages of "basic" bricks having magnesia as the principal constituent are presented.

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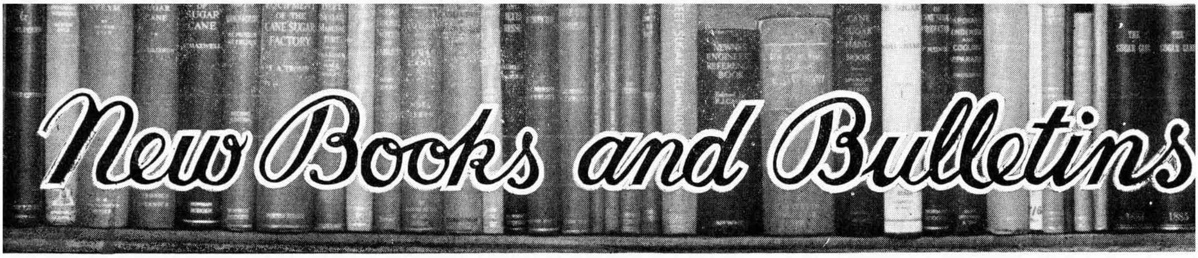
Technological value of stored sugar beet. K. VUKOV. *Ind. Sacc. Ital.*, 1965, **18**, 263–270.—Results of storage on sugar beet characteristics have been determined and are tabulated for short-term (7–8 days) and longer-term periods (40–80 days), and at various temperatures. Losses occurring in technological value, expressed as white sugar available, are calculated. It is shown that the loss of yield is greater than the fall in polarization.

[1] *See also* GRIZODUBOV: *I.S.J.*, 1962, **64**, 269.



Advances in Carbohydrate Chemistry. Vol. 20. M. L. WOLFROM and R. S. TIPSON. 551 pp.; 6×9 in. (Academic Press Inc., 111 Fifth Avenue, New York, N.Y., 10003 U.S.A.; Academic Press Inc. (London) Ltd., Berkeley Square House, Berkeley Square, London W.1). 1965. Price: 148s 0d.

The latest edition of this book is about one-third as long again as the previous edition. Apart from nine monographs, it contains an appreciation of JOHN C. SOWDEN, Chairman of the Chemistry Dept. of Washington University and from 1948 to 1953 engaged as regular consultant to the American Sugar Refining Co. research laboratories in Philadelphia, who died in 1963. The monographs include a discussion of deoxyinositols, a review of the present status of olefin chemistry as applied to sugars, the chemistry of osazones, sulphate half-esters of the simple sugars, a summary of the structure and reactivity of the important and useful cyclic acetals of the glycosides and aldoses, a discussion of reactions between amino sugars and β-dicarbonyl compounds, aspects of the carbohydrate chemistry of plant phenolics, a treatment of *C*-glycosyl compounds of plants, and a discussion of the polysaccharides accompanying cellulose in wood. The book concludes with an author and subject index to Vol. 20 and a cumulative one to Vols. 1–20.

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Kristallizatsiya Sakhara (Crystallization of Sugar). A. A. GERASIMENKO. 316 pp.; 5¾×8¾ in. (Izd. "Naukova Dumka", Repina 3, Kiev, U.S.S.R.). 1965.

This book contains information on the theory and practice of sucrose crystallization from pure and impure solutions based on material in Soviet and non-Soviet literature and work carried out in the Institute of Organic Chemistry of the Ukrainian Academy of Sciences. The ten chapters deal with: general information on sucrose crystals and crystallization; aqueous sugar solutions (sucrose solubility in water, physical properties of aqueous solutions, the effect of prolonged heating and the electrical conductivity of water); nucleation; kinetics of sucrose crystallization; physico-chemical properties of impure sugar solutions; kinetics of sucrose crystallization from impure solutions; boiling, crystallization and manufacture of white sugar; treatment of low-grade products; viscosity of intercrystalline molasses and massecuite fluidity; and molasses formation. References to the literature are given at the end of each chapter. The book is intended for sugar factory personnel as well as research workers and presents the subject matter in clear and concise terms.

Tecnologia da Celulose de Bagaço de Cana-de-Açúcar para Papel: Estudos relativos à Influência da Medula (Technology of sugar cane bagasse cellulose for paper: studies on the influence of the medulla). O. VALSECHI. 228pp.; 8¼ × 9 in. (Escola Superior de Agricultora "Luis de Queiroz", Universidad de São Paulo, Piracicaba, São Paulo, Brazil.) 1964.

This book is an account of a study carried out on preparation of paper from bagasse. The raw material, stored for various lengths of time, was disintegrated and sieved to separate the pith and fibre, each of these fractions being analysed. Mixtures were then prepared containing 0, 7½, 15, 22½ and 30% of pith, respectively, and these converted into bleached pulp by the Celdecor-Pomilio process. The amounts of chemicals needed and pulp yield were measured and are expressed in terms of whole bagasse, mixed bagasse and pulp. Test sheets prepared from the pulp were examined and their chemical and physical properties noted. Conclusions drawn include: the fibrous fraction is best for manufacture of paper in terms of reagents used, smoothness of the process and paper quality; yield of pulp on raw bagasse is greater if the fibre separation is omitted, but, if separated, the fibre fraction gives a better pulp yield in the absence of pith; further work is needed to establish the influence of cane variety; and the choice of a bagasse pulping process will need consideration of factors such as pulp qualities desired, reagent consumption, possibility of using pith as a by-product and process smoothness as well as the cost of obtaining pith-free bagasse fibre.

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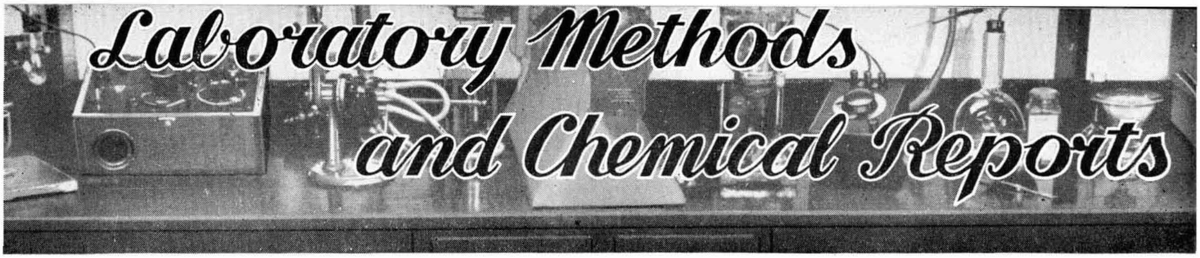
The Australian Sugar Year Book. Vol. 25, 1966. 436 pp.; 7¼ × 9¾ in. (The Strand Press Pty. Ltd., 236 Elizabeth St., Brisbane, Queensland, Australia.) 1966. Price: $A 3.00; 24s 0d.

The latest edition of the Year Book follows very much the same pattern as previous ones, with the first section devoted to information on the various sugar organizations, names of officers and staff, and sugar factory addresses. The second section comprises a collection of articles and reports, mainly on cane agriculture but also including some of the material from the 1965 Conference of the Queensland Society of Sugar Cane Technologists. Section three includes statistics on cane and sugar production in Queensland, chiefly up to and including 1964 but in some cases 1965 as well. The main section, the pages of which are interspersed with interesting black-and-white photographs, gives information on the Australian sugar mills and districts and on the towns and tourist attractions.



Studies on betaine. III. The behaviour of betaine in the treatment of ion-exchange demineralization of sugar beet juices. S. Iwashina, Y. Yamamoto and Y. Egashira. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1965, **16**, 70–80.—Experiments with various ion-exchange resins and techniques showed that when a standard solution of betaine was passed through a strongly acidic cation exchanger its leakage from the resin began at about 35 litres/litre of resin in the case of gel-porous type resins and at about 22 litres/litre in the case of macroreticular resins. Determination of this point indicates the saturation point of the resin (up to which high quality effluent is obtained) and the point at which betaine recovery begins. Because of betaine's weak affinity for resin, most of it was easily eluted by rinsing with water, and completely eluted by reagents such as HCl, aqueous ammonia, NaCl and NaOH. The modified process patented by Biondiou[1] was found to be the most suitable one for betaine recovery.

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Factory-scale tests on qualities of Cuban raw sugars. The Technical Committee, Japan Sugar Refiners' Association. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1965, **16**, 118–119.—Tests on 18 refineries in 1964 showed that Cuban raws imported into Japan had a higher reducing sugar content, a lower ash content and a considerably higher colour content than Taiwan raws. They also had a higher C.V. (coefficient of variation) i.e. greater lack of uniformity in grain size, than the Taiwan raws. However, they had higher filtrability than raws imported from other countries. Generally, the refining properties of the Cuban raws were almost identical to those of the Taiwan raws.

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Factory-scale tests on qualities of Indian raw sugars. The Technical Committee, Japan Sugar Refiners' Association. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1965, **16**, 120–121.—Tests in 14 refineries in 1964 showed that Indian raws imported into Japan had lower pol, higher ash content, considerably higher colour content and a higher C.V. than Taiwan raws, while the reducing sugar contents varied widely. Even after affination the colour contents were still higher than those of the Taiwan raws. The filtrability was generally higher than that of the Taiwan raws, although three refineries reported filtration difficulties.

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Quality determination of white consumption sugars. F. Schneider, A. Emmerich and J. Dubourg. *Zucker*, 1965, **18**, 571–574.—The Braunschweig points system has been modified to include only three separate tests instead of four previously, determination of coloration on heating being omitted for the following reasons: the result is of interest to only a limited number of consumers, it is most difficult to reproduce and, as found by evaluation of results over a number of years, it runs parallel with the conductimetric ash reading. To compensate for the omission, the number of points awarded for the ash content has been doubled. The value of a sugar with a low number of points is only slightly different with the three-test method as compared with the four test method while a sugar with a high number of points is somewhat higher in value. Hence, the differences between sugars of varying quality will be somewhat greater with the three-test method. Full details are given of the methods used for each determination.

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The effect of materials transfer on sucrose crystallization. D. Schliephake. *Zucker*, 1965, **18**, 574–582. It is shown that all processes taking place on the sucrose crystal during growth can be combined and represented by a first order reaction equation. Equations have been developed which express the relationship between the diffusion constant through a diffusion layer surrounding the crystallization surface and the total resistance to crystal growth (reciprocal rate constant), which is composed of two elements: the diffusion resistance and the reaction resistance, the former being of major importance at higher temperatures and the latter at lower temperatures. Values of the diffusion constant calculated from kinetic measurements are related to measurements of single crystal growth taken from the literature, and the theoretical changes in crystal size distribution are deduced and shown to agree with measured values. Limitations in the use of the results for factory practive are indicated.

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Juice acidity and gum content as measures of cane deterioration. J. E. Irvine and J. J. Friloux. *Sugar y Azúcar*, 1965, **60**, (11), 58–59.—Analysis of juice acidity and gum content during the 1964 harvest season confirmed that, unlike gum content, acidity was subject to variations before freezing of the cane, and high acidity due to varieties, soil type or time of harvest could lead to errors in judging post-freeze quality of cane or freeze-resistance in selection of new varieties. Gum content, on the other hand, appears to be a more sensitive and reliable measure of cane quality.

[1] French Patents 1,195,655 (1959) and 1,248,113 (1960).

Determination of the soluble polysaccharides in sugar cane products. E. J. ROBERTS and J. J. FRILOUX. *Sugar y Azúcar*, 1965, **60**, (11), 66–67.—To determine non-precipitable polysaccharides, the molasses dilution or solution of raw sugar or juice solids is applied to a column of 1 part of "Darco G-60" carbon mixed with 3 parts of "Celite 535" and washed under pressure with 10% ethanol to remove sucrose and invert and then with 50% ethanol to elute the polysaccharides, which are then determined colorimetrically. Two methods are described for determining the precipitable polysaccharides; in the first, juice or a dilution of molasses or raw sugar to 10 g solids in 65 ml water is dialysed through a cellulose dialysis tube against a flow of toluene-saturated water for 60 hours. The solution remaining is acidified with 1 ml of N sulphuric acid and made up to 100 ml, centrifuged at 18,000 r.p.m. (40,000 *g*) for 20 min to remove insolubles, including starch, diluted and polysaccharides determined colorimetrically by the phenol-sulphuric acid method. In the second method, raw juice, for example, is centrifuged for 6 min at 2000-3000 r.p.m. to remove starch and coarse suspended matter, and an aliquot treated with 3 volumes of absolute ethanol. After mixing and floc formation, the centrifuging is repeated for 6 min, the supernatant discarded and drained and the floc washed by mixing with 80% ethanol and re-centrifuging. After draining, the precipitate is dissolved in distilled water and determined colorimetrically. This method gives slightly lower but more consistent results than the dialysis method and is suitable for routine use.

* * *

Elimination of turbidity from a commercial sugar solution with a view to exact measurement of its colour. P. L. DEVILLERS. *Sucr. Franç.*, 1965, **106**, 247–249.—Sugar solutions were filtered through two types of filter membranes: Membranfilter G.m.b.H. Type Coli 5 (0·16 μ pores) and Millipore Filter Corp. Type HA (0·45 μ pores) and filtrate colour measured at various wavelengths. The results indicated that turbidity was removed completely and that colour absorption by the membrane was negligible.

* * *

An absorptiometer for the sugar industry. S. HILL and J. T. RUNDELL. *Analyst*, 1965, **90**, 681–691. Measurement of optical density is a commonly used test of purity in the sugar industry. Difficulty arises when the test is made on solutions of refined sugar because the optical density due to dissolved impurity is very small and because it is liable to be masked by traces of suspended turbid matter. Among recommendations designed to overcome the difficulty, the best is considered to be that of GILLETT, MEADS and HOLVEN[1], who suggested the definition: colour index = 1000 (a^*_{420} — 2 a^*_{720}). For reasons that are stated, a modified definition: colour index = 1000 (a^*_{420} — a^*_{690}), is proposed. The modified index should be well correlated with the concentration of residual dissolved impurity and with the departure from whiteness of the solution. An automatic absorptiometer has been developed to measure the colour index directly. Its readings have been compared with estimates made by a panel of visual observers who classified samples of "fine liquor" and solutions of refined sugar according to order of whiteness. Satisfactory correlations were obtained.

* * *

Improved thin-layer chromatographic separation of hexoses and pentoses using "Kieselgel G". P. G. PIFFERI. *Anal. Chem.*, 1965, **37**, 925.—Details are given of a method for separating lactose, sucrose, D-galactose, fructose, D-glucose, D-arabinose, D-xylose and L-rhamnose. A standard solution containing 2 μg of each of these sugars per μl was separated on a thin-layer plate prepared with "Kieselgel G" powder and sodium acetate (or boric acid) solution. Six solvents were used and the spots were sprayed with aniline-diphenylamine in acetone[2]. Good separation of all eight sugars was obtained with two of the solvents. One of these, 6:4 chloroform:methanol permitted very good separation of sucrose, glucose and fructose, as did one other solvent, 8:0·5:1:1 acetone:water:chloroform:methanol. The R_f values obtained are tabulated.

* * *

The Lange nephelometer for measuring sugar solutions. C. MADRAZO and A. G. VILLALUZ. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 24–28.—Turbidity measurements were made using an improved Kopke turbidimeter and a Lange nephelometer on 3000 samples of clarified juice and on raw sugars samples. The nephelometer proved to be a more accurate and reliable instrument, giving more steady and consistent readings, and it is recommended for use in Philippine sugar factories.

* * *

Precision control in spectrophotometric analysis. R. R. COVAR and G. E. BANASIHAN. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 32–38.—A statistical method for precision control work in spectrochemical analysis is presented and the statistical computation of the procedure involved is methodically outlined. Confidence limits at 95% as well as 99% levels of significance are given for various elements analysed in a number of Philippines Sugar Institute soils laboratories.

* * *

A progress report on some tests of muscovado sugar. J. K. DEMETERIO, M. OLIVEROS, A. S. ROXAS and I. KABRISTANTE. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 351–357.—Genuine samples of muscovado (open-pan) sugar, i.e. not mixtures of centrifugal sugar and molasses, were collected and their incomplete analyses tabulated. Generally they were of 70–88 pol but the data obtained were insufficient to establish a check to be able to tell if a given sample was a genuine muscovado or not.

[1] *Anal. Chem.*, 1949, **21**, 1228–1233; *I.S.J.*, 1950, **52**, 283.
[2] See BAILEY & BOURNE: *J. Chromatogr.*, 1960, **4**, 206–213.

BY-PRODUCTS

Studies on utilization of betaine in sugar beet. I. Synthesis of betaine alkyl esters and amides, and some properties of these betaine derivatives. H. MATSUNO and T. SANO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1965, **16**, 101–108.—Seven alkyl esters and three alkyl amides of betaine were synthesized and their bacteriological activity, surface-active properties and stability studied. Those compounds having long side chains of C_{10}–C_{18} showed good bacteriological capacity and surface activity. Betaine dodecyl ester chloride and dodecyl amide chloride were better than the others. However, in view of their instability and considerable hygroscopicity they are considered to have little application compared with more economical materials available.

* * *

Tests on the effect of different types of sugar and redox catalysts on the electro-chemically measured respiration of yeast. J. S. NAT and F. TÖDT. *Zeitsch. Zuckerind.*, 1965, **90**, 635–643.—The TÖDT electrochemical measurement of oxygen as a determination of the respiration rate of yeast suspensions[1] is compared with the methods of WINKLER[2] and WARBURG[3].

* * *

Biological treatment of bagasse enhances its value as a soil conditioner or (animal) feed. R. A. CRUZ, R. E. MACAISA, T. J. CRUZ and C. C. PUSAG. *Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 222–228.—Nitrogen in bagasse was increased by inoculation and fermentation with *Aspergillus oryzae, A. niger, Rhizopus nigricans and Daedalia* sp., *A. niger* having the greatest effect. The product was of improved value as a constituent of feed for ruminant or of compost.

* * *

Considerations on sucrochemistry today. C. R. BONATI. *Ind. Sacc. Ital.*, 1965, **18**, 271–288.—A review is made of the use of sucrose and sugar products—esters, glycerides, etc.—as surface-active materials, in plastics manufacture, etc.

* * *

Rayon from cane bagasse. L. FUENTES AGUILAR. *Ingeniería Quím.*, 1964, **9**, (97), 10–15; through *S.I.A.*, 1965, **27**, Abs. 782.—Depithed bagasse was converted to pulp of high α-cellulose content by hydrolysis at 140-190°C with H_2SO_4, HNO_3, water or steam. The best quality pulp, containing 95% of α-cellulose and 4·1% of pentosans, was obtained by hydrolysis with steam at 190°C for 14 min. The pulp was then digested with NaOH and Na_2S, bleached and purified, and converted into rayon by the viscose process. Some details of the latter are given. The quality of rayon yarn obtained from bagasse was satisfactory.

Suitability of bagasse hydrolysate medium for the production of riboflavin by *Candida utilis*. P. N. AGARWAL, T. N. RAWAL and A. K. GURTU. *Indian J. Technol.*, 1964, **2**, 246–247; through *S.I.A.*, 1965, **27**, Abs. 783.—Fermentation media were prepared containing 1% of reducing sugars as xylose derived from bagasse hydrolysate, or 1% of reducing sugars as glucose from clarified cane molasses. The media were supplemented with 0·1% of KH_2PO_4 and 0·1% of urea. The yields of riboflavin after 48 hr were respectively 55 and 25 μg/g of yeast (within the cells) for bagasse and molasses media respectively, and respectively 18 and 46 μg/100 ml of liquor in the case of extracellular riboflavin. Xylose therefore gave higher yields of intracellular and lower yields of extracellular riboflavin than did glucose. The effects of various N sources and growth factors were studied.

* * *

Effect of substituting dry sugars for molasses in calf starters on feed intake and growth response. S. R. ATAI and K. E. HARSHBARGER. *J. Dairy Sci.*, 1965, **48**, 391–394; through *S.I.A.*, 1965, **27**, Abs. 785. Calf starter (weaning ration) mixtures containing 8% of molasses, sucrose or glucose were compared with unsweetened mixtures containing lucerne leaf meal. Better weight gains and feed consumptions were obtained with the sweetened rations than with the unsweetened rations. Within the sweetened rations, slightly better results were obtained with molasses or sucrose than with glucose, but the differences were not significant.

* * *

Progress in the utilization of bagasse as a raw material for paper and pulp manufacture. J. E. ATCHISON. *Chem. Age of India*, 1964, **15**, 971–972; through *S.I.A.*, 1965, **27**, Abs. 989.—The continuous pulping process (see preceding abstract) is briefly described. The acid or bisulphite process is unsuitable for bagasse, and alkaline or neutral processes are used. Substitution of alternative fuels for bagasse is recommended, 1 metric ton of bagasse (50% moisture content) being equivalent to 0·333 tons of fuel oil (10,000 kcal/kg).

* * *

Multi-stage bleaching for bamboo and bagasse pulp: recent developments. M. D. VIJAYARAGHAVAN and V. G. DESAI. *Chem. Age of India*, 1964, **15**, 942–945; through *S.I.A.*, 1965, **27**, Abs. 990.—Multi-stage bleaching of paper pulp typically consists of chlorination, hot extraction with NaOH, and treatment with calcium hypochlorite liquor. The process requires less chlorine and causes a smaller loss of strength compared with a single-stage process. A typical flow diagram is given. There is some evidence that the bleaching of bagasse pulp requires ~ 25% less Cl_2 than does that of bamboo pulp.

[1] *Zeitsch. Elektrochemie*, 1952, **56**, 165.
[2] *Zeitsch. Analyt. Chemie*, 1914, **53**, 665.
[3] UMBREIT *et al.*: Manometric techniques and tissue metabolism. (Burgess Publishing Co., Minneapolis, Minn., U.S.A.) 1951.

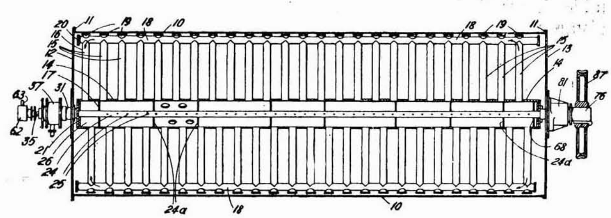
UNITED KINGDOM

Heat exchangers. (Crystallizers). J. LECLEZIO, of Saint Pierre, Mauritius. **991,206.** 19th October 1962; 5th May 1965.—Trough 10 contains a hollow rotating shaft 14 from which radiate a number of rows of hollow arms 15. The left-hand end arm 16 in each row communicates with the interior of the hollow shaft 14 to one side of a transverse partition 17. The outer ends of the arms 15 in each row communicate with a header pipe 18, the ends of each pipe being closed at 20. One end of the shaft 14 is closed by a disc 21 having a hole at its centre; the other end of the shaft has a ring attached to it. Pipe 24 extends the length of shaft 14, passing through its centre. This pipe has a number of holes 25 spaced apart, and extends through partition 17, the space between partition 17 and disc 21 acting as an outlet chamber 26. Cooling water enters a fixed inlet pipe 63 and flows by way of a rotating extension pipe 35 and bearing housing 31 into the rotating pipe 24. It passes through openings in pipe 14, which are so graded in size that a uniform flow of water passes out through the hollow arms 15 into the header pipes 18. It then flows along the pipe 18 and then in through hollow arms 16 into outlet chamber 26, after which it flows through an opening in closure disc 21 into a reduced extension 31 of the hollow shaft 14 into housing 37 and finally through the outlet pipe. The crystallized mass is withdrawn through an opening in the bottom of the trough which may normally be closed by a plug or valve-controlled outlet.

* * *

Production of L-glutamic acid. COMMERCIAL SOLVENTS CORP., of New York, N.Y., U.S.A. **991,510.** 8th November 1963; 12th May 1965.—An L-glutamic acid-producing strain (NRRL B-2620) of the micro-organism *Brevibacterium divaricatum* is cultivated, under submerged aeration conditions, on an aqueous nutrient medium containing a carbohydrate source (glucose, sucrose, molasses, etc.), a nitrogen source (urea, ammonium salts), a phosphate source and potassium source (dipotassium phosphate) and a growth promoter (biotin, corn steep liquor, etc.), at a pH of 6–8, at 28–33°C until maximum growth is achieved, thereafter conducting the fermentation at 36–40°C (38°C).

Centrifugal loading control mechanism. THE WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **991,796.** 30th January 1962; 12th May 1965.—The loading control mechanism is designed for a cyclical centrifugal having a rotary basket, a tank for holding massecuite, the fluidity of which is susceptible to variations, the tank having a spout through which material can be discharged into the basket, a gate at the outlet of the spout, and gate operating means for opening and closing the gate. The mechanism



comprises a pressure sensing device in the spout for sensing the static head of material in the spout when the gate is closed and for sensing the loss of head caused by frictional resistance to the flow of material in the spout when the gate is open. A mechanism responsive to changes in pressure head sensed by the sensing device is provided for actuating the gate operating means, and thereby causing the extent of opening of the gate to be varied in a sense so as to maintain a predetermined flow rate of charge into the basket during successive loading cycles.

* * *

Production of L-glutamic acid. AJINOMOTO CO. INC., of Tokyo, Japan. **992,833.** 5th November 1963; 19th May 1965.—A micro-organism capable of producing L-glutamic acid (*Brevibacterium lactofermentum* ATCC 13869) is cultivated on a medium containing beet or cane molasses, juice or raw sugar as carbon source, an assimilable nitrogen source, e.g. urea, necessary inorganic salts and in the presence of a saturated aliphatic carboxylic acid containing 8–18 carbon atoms or its salt or amide, e.g. stearic acid, sodium stearate or stearyl amide, or a monoamine in which the hydrocarbon radical is a saturated aliphatic radical of 8–18 carbon atoms, e.g. dodecylamine, hexadecylamine or octadecylamine.

* * *

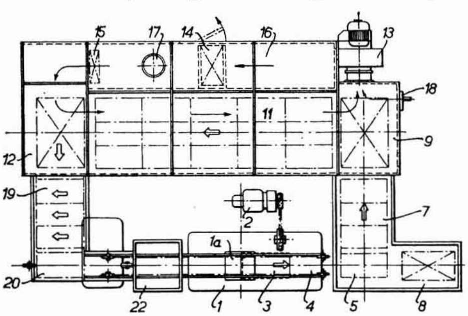
Producing L-glutamic acid by fermentation. ASAHI KASEI KOGYO K.K., of Osaka, Japan. **993,699.** 14th July 1962; 2nd June 1965.—*Microbacterium ammoniaphilum* nov.sp. is cultivated in an aqueous medium

Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent (price 4s 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. 20231 U.S.A. (price 50 cents each).

containing an assimilable carbohydrate source (glucose, sucrose, beet molasses, cane molasses, etc.) and an assimilable nitrogen source (ammonia, an ammonium salt, urea, peptone, etc.) at 27–33°C and pH 6·0–8·5 under submerged aerobic conditions. Ammonia gas may be continuously introduced into the medium as amino donor.

* * *

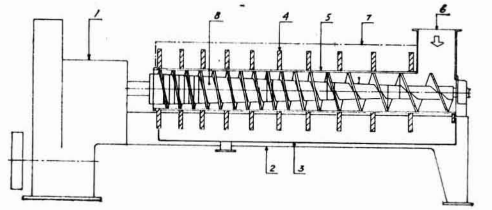
Manufacture of lump sugar. AKTIEBOLAGET SVENSKA FLÄKTFABRIKEN, of Nacka, Sweden. **994,488.** 30th April 1962; 10th June 1965.—A press 1 has a horizontal rotary pressing roller *1a* driven by motor 2. From the pressing roller the lumps are transferred to drying plates 3 carried on a conveyor 4 below the pressing roller. The plates, which are so designed that they may be stacked one upon the other, are transferred by a pusher from the conveyor to a feeding table 5, which is automatically lowered through a distance corresponding to the height of one plate



until 20 drying plates have been stacked. The stack is then pushed by a piston onto a roller conveyor 7 at right angles to conveyor band 4, and the emptied feeding table 5 moves straight ahead to a hoisting device 8 from which a similar feeding table is simultaneously transferred into the initial position for reception of new drying plates. When three stacks have been collected on conveyor 7 they are transported to an elevator 9 which raises and transfers them to one of four selected roller conveyors one above the other in a dryer 11 parallel to the press. The three stacks are moved forward the length of one plate and a further batch of three stacks placed on the conveyor, this operation being continued until the conveyor is full, when the first three stacks are transferred to a second elevator 12 at the discharge end of the dryer. During passage through the dryer the sugar lumps are exposed to hot air circulated by a fan 13 via a filter 14 and a heating battery 15 in a return duct 16. The stacks in elevator 12 are lowered to the level of roller conveyor 19 onto which the batch is moved sideways, after which the elevator 12 automatically rises to remove further batches of plates. Roller conveyor 19 has a device for tipping the dried sugar lumps from the drying plates into a suitable receptable. The emptied stacks are transferred one by one to an elevating discharge table 20, from which the drying plates are transferred in turn by a chain conveyor to an elevator 22, which consists of two vertical conveyors on each side of the press conveyor band 4. A pusher adjusts the position of the plates on conveyor band 4. Synchronization of all conveyors and movements is through a shifting device driven by the press.

* * *

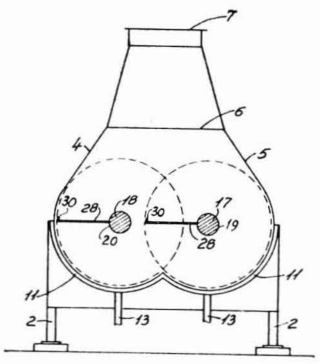
Screw presses. O. BRATEN, of Oslo, Norway. **996,647.** 5th September 1963; 30th June 1965.—A horizontal press for, e.g. beet pulp, comprises a drive 1 on a frame 2 supporting the trough for liquid 3 strained off through apertures in plate 5 which is supported by bearings 4. The pulp is fed by hopper 6 to a screw 8, which is made up of a number of axially separate sections; these may be disc-shaped or substantially



cylindrical and are arranged so that they can rotate relative to one another and to a common shaft. The sections can be fastened to the shaft by suitable means, e.g. set screws, and/or abutting edges of adjacent sections may be provided with keyways so that they interlock when pushed together on the shaft. The use of sections makes it possible to vary the pitch of the screw, and also to replace worn parts easily.

* * *

Lixiviating apparatus. (Cane diffuser.) A/S. DE DANSKE SUKKERFABRIKKER, of Copenhagen, Denmark. **996,731.** 30th December 1963; 30th June 1965.—A trough slightly inclined to the horizontal has a lower part of cross-section in the form of two adjoining circular arcs and an upper part consisting of inclined plates 4 and 5 and a cover 6. The prepared cane is fed through a funnel 7 at the lower end of the trough, the upper end of which merges into an inclined elevator funnel which at its top has an opening through which the exhausted cane is discharged. The lower part of the trough is provided with steam jackets 11 from which condensate is discharged through pipes 13. Diffusion liquid is supplies through a pipe at the higher end of the trough and the extracted juice is discharged through a port at the lower end of the trough. Any juice extracted in mills after the diffuser is supplied through a port partway down the trough from its higher end. Two screw conveyors 19 and 20 rotate on parallel shafts 17 and 18 in opposite direction to each other. They have screw blades 28 provided with a large number of holes 29 uniformly distributed over their area. A rim 30 is attached to the edge of the screw blade of each conveyor screw and carries a row of teeth 31. Any cane collecting



between the ridges of the screw blades and around the conveyor shaft is compressed by the screw blade of one conveyor in the intervals between successive runs or ridges of the screw blade of the adjacent conveyor. Provision is made for operation of the scrolls at different speeds relative to each other, so that instead of just making deep helical grooves in the compressed cane between the runs of the screw blades, the teeth on the screw blades will tear up the material that has collected around the scroll shafts.

* * *

Clarifiers and separators. J. DÍAZ-COMPAIN, of New York, N.Y., U.S.A. **999,023.** 3rd April 1963; 21st July 1965.—See *I.S.J.*, 1966, **68,** 117.

* * *

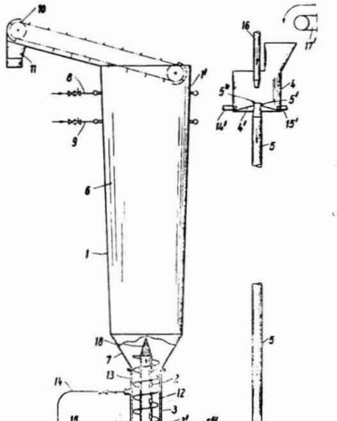
Polyoxyethylene derivatives of sucroglycerides. LEDOGA S.p.A., of Milan, Italy. **999,554.** 11th April 1962; 28th July 1965.—The derivatives, useful as surface-active materials, are condensation products of 1 part by weight of sucroglyceride (lard sucroglyceride) (obtained by transesterification of a natural or synthetic glyceride, e.g. lard oil, with sucrose in the presence of an alkaline catalyst) with at least 3 parts of ethylene oxide in the presence of about 0·05 parts of a glyceride, the condensation being carried out by heating the materials together in an autoclave at between 70 and 130°C in the presence of an alkali metal hydroxide as catalyst.

* * *

Purifying solutions containing sugars. THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **1,005,428.** 17th October 1962; 22nd September 1965.—The (60°Bx) sugar solution (70°Bx screened raw washings, diluted with sweetwater) is passed at an elevated temperature (180°F) downwardly through a column of strong cation exchange resin in monovalent salt form (the sodium salt of a sulphonated polystyrene resin cross-linked with 8% divinyl benzene, in 16/50-mesh particles) which is later regenerated with an upflow of regenerant (brine); the treated sugar solution is then passed downwardly, followed by water, through an ion exclusion column charged with a specially selected cation exchange resin in monovalent salt form (the sodium salt of a sulphonated polystyrene resin, cross-linked with 4% divinyl benzene, in 35/70-mesh particles), both the sugar solution and the water being at an elevated temperature (180°F). The ion exclusion column effluent is separated (as a function of the density and conductivity which are measured and used to control switches governing the operation of the appropriate valves) into five sequential fractions: waste containing ionized and high M.W. substances; an impure sugar solution; a purified sugar solution; a dilute sugar solution; and waste containing low M.W. substances. The second and fourth fractions are returned sequentially to the column after passage of a fresh amount of ion-exchange treated solution, while the third fraction is retained for further processing.

* * *

Cane diffuser. BRAUNSCHWEIGISCHE MASCHINENBAU-ANSTALT, of Braunschweig, Germany. **1,000,599.** 17th October 1963; 4th August 1965.—At the bottom of diffusion tower 1 is a conveying shaft 3 containing a hollow feed screw 2. The shaft 3 is connected by a pipe 5 to a mixing chamber 4 to which shredded cane is delivered by conveyor 17′ and circulation juice by pipes 14, 15 and 16. The cane is carried by this juice along pipe 5 to the shaft 3 and delivered into the tower by screw 2 in a continuous supply.



The somewhat compressed cane is loosened in the widened section 7 of the tower, is carried upwards against a counter current of extraction liquid supplied through pipes 8 and 9, and when exhausted, is removed from the tower by scraper conveyor 10. Raw juice from the tower passes through the screening cone 18 into screw 2 and out through apertures 19 under the conical shield 17 and so into pipe 20.

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.

Sugar cane harvester. Massey-Ferguson (Export) Ltd., Coventry, Warwickshire.

The new MF 61–5 cane harvester, which supe sedes the Australian-made MF 515, has a rigid undercarria e and is available in two basic forms to suit different tractors. The harvester is attached to the right-hand side of the tractor, the tractor wheel on this side being removed and placed on the right-hand side of the harvester to act as a drive wheel through a linkage to its housing on the tractor. The 28·5 h.p. diesel engine draws its fuel from the tractor's tank. A power gatherer (Fig. 1) is provided to help harvest

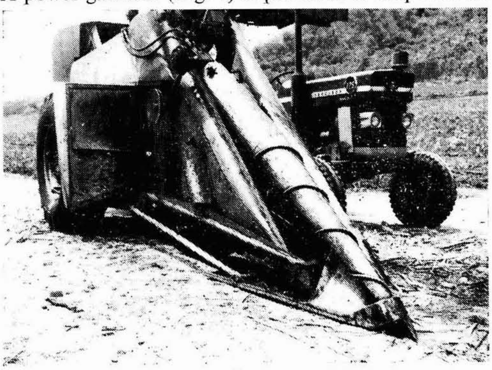


Fig. 1

flattened or tangled crops. It consists of a 9–ft conical powered auger which enters beneath the fallen cane, lifts it and combs out the tangle before feeding it to the harvester. The combination elevator shown (Fig. 2) avoids the need to hand-cut the first few rows

Fig. 2

of a new cane block by enabling the harvester to operate as a rear delivery unit until side delivery operation is possible when the cane block has been opened sufficiently. A storage device holds sufficient cane to enable a new bin to be positioned under the elevator without having to stop the harvester. The conveyor chain assembly on the MF 515 has been replaced by conveyor paddles (twin rotating cylinders) which carry the cane from the base cutter to the choppers. The topper assembly incorporates a parallel mechanism which maintains the topper cutting disc at the correct angle relative to the crop throughout the range of topping heights. The front end assembly has been strengthened, and other minor modifications have been made. Three versions of the MF 61–5—side delivery, rear delivery and with combination elevator and power gatherer—are available. During proving trials in Australia, 405 tons of cane were harvested in a 9½–hr day under ideal conditions (clean standing cane at 30 tons/acre). The improved MF 515 also incorporates the rigid undercarriage and diesel engine and is available as a side- or rear-delivery harvester.

* * *

PUBLICATIONS RECEIVED

ALL-METAL SCREENS. Locker Industries (Sales) Ltd., Warrington, Lancs.

Catalogue 664 gives details of the Locker "Rotex" Type A all-metal screens in which a patented system is used for applying screen cloths to the frames. Tension clips on the screen frames are pushed inward to engage eyelets in the edging strip of the cloth, while the cloth is readily removed by simply pulling away from the frame, the clips disengaging automatically. The tension clips keep the cloth taut, whatever the material (metal, nylon or silk). The screens are available in a wide range of single- and multiple-deck models for large or small capacities.

* * *

ION EXCHANGE. The Permutit Co. Ltd., Permutit House, Gunnersbury Ave., London W.4.

A new handbook, Publication IE.74a, has been compiled to assist those engaged in ion exchange studies. Much of the book has been devoted to complete detailed experiments dealing with fundamental characteristics of ion exchange resins, their ion exchange properties, common uses and applications. Notes are also given on the regeneration and re-use of resins and setting up of an ion exchange column. A useful bibliography is given and brief details are given of the Permutit range of portable "Deminrolit" water purifiers. Together with the Permutit "Lab-pack", the handbook will be of great use in a wide field of study, including ion substitution, separation, removal, catalysis and concentration.

* * *

PUMPS. Warren Pumps Inc., Warren, Mass., 01083 U.S.A.

A newly revised 4-page bulletin, 110-4021, describes Warren centrifugal, reciprocating, screw and gear pumps. It gives brief information on typical applications, capacities, head and viscosity ranges, and materials of construction. Reference is also made to additional literature on each type of pump.

* * *

MULTI-POINT RECORDING. Leeds & Northrup Ltd., Wharfdale Road, Tyseley, Birmingham 11.

The "Cleertrend" is a strip-chart recorder giving up to 12 points on a chart 6½ inches wide. The standard printing for each channel is a sequence of dots in one of six colours, with a numbered dot printed periodically, assuring clear readability of closely spaced or cross-over records. The number of points can be easily reduced.

U.S.S.R. Sugar Statistics[1]

		1965		1964
		metric tons, raw value		
Initial Stocks		2,695,700		2,542,400
Production		9,691,000		7,643,000
Imports		2,293,569		1,889,006
		14,680,269		12,074,406
Exports	730,632		432,930	
Consumption	9,571,980		8,945,776	
		10,302,612		9,378,706
Final Stocks		4,377,657		2,695,700
Imports				
China		37,220		162,780
Cuba		2,253,416		1,723,502
Czechoslovakia		—		291
Hungary		1,414		1,386
Poland		1,519		1,047
		2,293,569		1,889,006
Exports				
Afghanistan		57,621		47,672
Algeria		14,613		10,925
Bahrein		5,325		—
Bulgaria		—		43,703
Ceylon		33,021		22,132
Cyprus		1,023		—
Ethiopia		2,718		—
Finland		133,100		115,768
Ghana		26,701		17,105
Iran		84,020		83,709
Iraq		—		9,510
Italy		598		22,188
Jordan		11,032		—
Kenya		10,870		—
Kuwait		22,308		982
Lebanon		2,174		2,562
Libya		33,873		5,483
Mali		13,025		7,185
Malta		3,830		435
Mongolia		19,042		24,449
Nepal		3,243		—
Nigeria		3,834		—
Norway		2,663		—
Oman		3,064		—
Pakistan		31,794		—
Qatar		3,911		—
Saudi Arabia		20,166		—
Singapore		—		3,283
Somalia		6,766		3,424
South Arabia		10,248		—
Sudan		76,443		—
Sweden		14,771		6,013
Tunisia		3,261		—
U.A.R.		11,049		—
United Kingdom		1,794		—
Yemen		50,093		6,180
Yugoslavia		10,421		—
Other Countries		2,217		272
		730,632		432,930

Dutch sugar factories for Pakistan[2].—The Dutch engineering group that is already engaged on the construction of a sugar factory at Nilphamari in East Pakistan has recently won an order to supply factory equipment to a second mill at Panchagar, according to press agency reports. The costs in both cases will be financed within the framework of the Netherlands' share of the Development Aid Programme to Pakistan. In addition, the East Pakistan Industrial Development Corporation also plans to erect two more factories as part of an overall plan to increase sugar production in Pakistan.

BREVITIES

New sugar factory for Rumania[3].—A new sugar factory is under construction in Buzau in the Ploesti region. It will have a daily slicing capacity of some 3000 tons of beets, and is the first of four plants to be built during the 1966/70 Five Year Plan[4].

* * *

New sugar factories for Greece[5].—The Patras Union of Industrialists have requested that the first of three intended new sugar factories be erected in the Patras Industrial Zone. As a suitable area they propose the plain between Kato Achaia and Lappa which, among other advantages, is close to the port of Patras and to the Ilia area where beets are grown, will allow easy recovery of by-products by factories already established in Patras, has good land and sea communications and an abundance of labour.

* * *

Portuguese sugar imports[6].—Imports of sugar into Portugal in 1965 totalled 143,082 metric tons, as against 189,055 tons in 1964. The majority of this was made up by imports from Angola (24,718 tons in 1965 and 18,618 in 1964) and Mozambique (77,138 and 107,407 tons, respectively), while Cuba supplied 32,729 tons in 1965 but none in 1964.

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Corrigendum.—The triple roll mills referred to in a recent issue[7] and described in a brochure issued by The Pascall Engineering Co. Ltd., pulverize not dry materials but in the presence of liquids so that they are dispersion mills.

* * *

Polish sugar factories for Pakistan.—Contracts have been signed for the supply of two cane sugar factories to West Pakistan by Poland. Each will have a crushing capacity of 1500 t.c.d., easily expandable to 2000 t.c.d., an annual production of 20,000 tons of sugar being expected from each factory. Juice will be purified by double carbonatation and sulphitation. All the four mills in each tandem will be individually driven by 300 kW steam turbines and there is provision for inclusion of a fifth mill. All the steel building structures and 10% of the equipment will be manufactured locally, to Polish specifications, the assembly and erection work being carried out by local companies under Polish supervision.

* * *

International Food Products Exhibition.—The second International Food Products Exhibition is to be held in the Palais de la Défense (CNIT), Paris, from the 13th to 21st November 1966. Some 7000 products are likely to be exhibited by 1000 participants from 40 countries.

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B.W.I. Sugar Technologists' Association.—The next meeting of the B.W.I. Sugar Technologists' Association is to be held in Guyana, formerly British Guiana, during the week commencing 16th October 1966. Details can be obtained from the Secretary, P.O. Box 170, Bridgetown, Barbados.

* * *

South Puerto Rico Sugar Company.—In May 1966 the South Puerto Rico Sugar Co. acquired about 10,750 acres of cane lands adjacent to cane lands cultivated by its subsidiary, Okeelanta Sugar Refinery Inc., south of Lake Okeechobee, Florida[8]. It is proposed to discontinue sugar production at the Company's Fellsmere refinery which is in an area where citrus groves are being developed and some cattle are raised. The newly-bought land will be planted to cane which will be processed at the Okeelanta plant, the capacity of which is to be increased accordingly.

1 *I.S.C. Stat Bull.*, 1966, **25**, (3), 114–116.
2 C. Czarnikow Ltd., *Sugar Review*, 1966, (763), 93.
3 F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (11), 15.
4 C. Czarnikow Ltd., *Sugar Review*, 1966, (760), 80.
5 F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (13), 10.
6 F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (9), 12.
7 *I.S.J.*, 1966, **68**, 158.
8 *Willett & Gray*, 1966, **90**, 193.

BREVITIES

Dorr-Oliver filters to be built in Taiwan.—The Taiwan Machinery Manufacturing Corp. in Taipei is to build five 8 ft dia. × 16 ft stainless steel Oliver-Campbell rotary vacuum filters under licence from Dorr-Oliver Inc. Dorr-Oliver will supply certain critical components for the filters which are to be installed for the Taiwan sugar crop which will commence in November 1966.

* * *

New Syrian sugar factory[1].—The Czechoslovakian Foreign Trade Enterprise Technoexport has received an order for the construction of a sugar factory to be situated in Jisr El Choughour in the El Ghab district of Syria. It is to have a daily slicing capacity of 2000 tons of beet.

* * *

Beet payment in Spain.—At present beet payment is solely on a basis of weight but in the 1967/68 campaign will be introduced on a basis of sugar content as well as weight[2]. Sucrose analysis will be made by the factories, under the observation of growers' representatives, and automatic sampling and analysis equipment may be acquired by the sugar factories for this purpose.

* * *

Sugar factories for the Lebanon[3].—Lebanon and France are negotiating for building of a beet sugar factory at Akkar, in the northern part of the country, to cost an estimated $5,000,000. Another plant is envisaged for the central area; the two factories should meet Lebanon's domestic needs and will probably produce enough for export in about five years.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 17th June*, 1966)	s d
Anglo-Ceylon (5s)	5/4½
Antigua Sugar Factory (£1)	10/7½
Booker Bros. (10s)	22/9
British Sugar Corp. Ltd. (£1)	26/6
Caroni Ord. (2s)	2/–
Caroni 6% Cum. Pref. (£1)	16/6
Demerara Co. (Holdings) Ltd.	2/9
Distillers Co. Ltd. (10s units)	24/3
Gledhow Chaka's Kraal (R1)	16/3(x.d.)
Hulett & Sons (R1)	16/3
Jamaica Sugar Estates Ltd. (5s units)	3/6
Leach's Argentine (10s units)	9/–
Manbré & Garton Ltd. (10s)	35/9
Reynolds Bros. (R1)	18/9(x.d.)
St. Kitts (London) Ltd. (£1)	15/–
Sena Sugar Estates Ltd. (5s)	9/6
Tate & Lyle Ltd. (£1)	29/4½
Trinidad Sugar (5s stock units)	2/6
West Indies Sugar Co. Ltd. (£1)	7/6

CLOSING MIDDLE

New York Stocks (*at 16th June*, 1966)	$
American Crystal ($5)	17⅜
Amer. Sugar Ref. Co. ($12.50)	26⅜
Central Aguirre ($5)	28⅝
Great Western Sugar Co.	38
North American Sugar ($10)	12¼
South P.R. Sugar Co.	22¼
United Fruit Co.	30⅜

New Czechoslovakian sugar factories[4].—A new sugar factory is to be built at Rimavská Sobotá which will handle 200–300,000 tons of beet per year[1] and a further factory is to be built in East Slovakia. At Dunajská Streda, a new 4000 tons/day sugar factory is under construction; this will be the largest sugar factory in Czechoslovakia. The sugar factory at Trebnica is undergoing reconstruction, which started in 1965, and by 1970 a further 10 factories will have been modernized in the region of Slovakia. In the Czech region also ten factories are to be provided with modern equipment, and two further plants with a combined capacity of 4000 tons is envisaged.

* * *

Colombia sugar production, 1965[5].—Sugar production in Colombia reached a total of 453,240 metric tons during the calendar year 1965, which compares with final output figures of 396,626 tons and 339,255 tons, respectively, during the years 1964 and 1963.

* * *

Turkish beet crop, 1965[6].—The seventeen sugar factories processed a total of 3,421,000 tons of beet in the 1965 campaign, harvested from 157,733 hectares. This represents an average yield of 21·69 tons/ha.

* * *

Australian cane loaders for the Philippines[7].—The Bundaberg, Queensland, firm of Masterbilt Pty. Ltd. has won orders worth more than £20,000 for cane loaders to be supplied to the Philippines where, according to a Masterbilt spokesman, the sugar industry is undergoing a gradual change as growers swing to the Australian method of planting and cane handling.

* * *

Iran sugar expansion proposals.[8]—According to reports from the Economics ministry, half the sugar requirements of Iran will need to be met by imports during the next two or three years. Consequently more new sugar factories are to be built, one of these at Mamassani, south of Shiraz, being under construction, with an initial capacity of 1000 tons/day, later to be increased to 1500 tons/day. A second factory of 1000–1500 tons/day capacity is to be built at Jasuj and another of similar capacity at Marivan in Kurdistan. The capacity of three existing factories is to be raised: Abkuh from 700 to 1200 tons/day, Chenaran from 350 to 1000 tons/day and Bardsir from 500 to 1000 tons/day.

* * *

Synthetic rubber plant in Brazil[9].—A new synthetic rubber plant at Cabo, Pernambuco, is to use alcohol from cane molasses, produced by distilleries in Alagoas and Pernambuco, as raw material. The alcohol will be converted into butadiene, using the Union Carbide process, and this polymerized to polybutadiene. Production of this synthetic rubber will be 27,500 metric tons per year and will use 1,000,000 hl of alcohol.

* * *

Swaziland sugar crop, 1965/66[10].—Record production was achieved during the 965/66 season with a total of 123,655 short tons. During the period 1st May 1965 to 30th April 1966, 108,715 short tons of sugar were exported through the port of Lourenço Marques, principally to the U.K. against Swaziland's Negotiated Price Quota under the Commonwealth Sugar Agreement. Some 9300 short tons were shipped against the U.S. quota while some 15,800 tons were exported to South Africa and 13,850 tons were marketed locally.

[1] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (14), 10.
[2] *Bol. Inf. Sind. Nac. Azuc.*, 1966, (192), 38.
[3] *Sugar y Azúcar*, 1966, **61**, (5), 72.
[4] *Zeitsch. Zuckerind.*, 1966, **91**, 288.
[5] C. Czarnikow Ltd., *Sugar Review*, 1966, (764), 98.
[6] *Zeitsch. Zuckerind.*, 1966, **91**, 289.
[7] *Australian Sugar J.*, 1966, **58**, 55.
[8] *Zeitsch. Zuckerind.*, 1966, **91**, 289.
[9] *Sugar y Azúcar*, 1966, **61**, (6), 59.
[10] *Overseas Review* (Barclays D.C.O.), June 1966, p. 23.