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NOTES AND COMMENTS

World sugar production, consumption, stocks and prices.

A survey of sugar production data for the two past and the current campaign years September–August has been carried out by F. O. Licht K.G.[1] who calculate that export requirements of some 19 million tons will be supplied with a surplus of 3·9 million tons by which figure stocks will increase.

Of this increase, about 880,000 tons is expected to be the increase for Western Europe and 1,520,000 tons for Eastern Europe (mainly in the U.S.S.R.) while the balance will be shared among countries of the Western Hemisphere, Africa and Asia. The stock increase in Europe is a consequence of the excellent European beet crop in autumn 1964. Sugar produced from this crop will be fully utilized neither on the domestic markets nor on the world market. Only small quantities of sugar were on hand in the Soviet Union at the end of the campaign year 1963/64, however, and the high 1964/65 production, together with imports, will make possible not only increased exports but also an adequate filling up of stocks. The other exporting countries of the Eastern block will also have higher final stocks.

World consumption is expected to be 2,164,000 tons higher, or 3·88% compared with 1963/64, when the increase was 2·19% compared with 1962/63. The increase for 1962/63 was 1·74% over the previous year's consumption. The anticipated increase seems rather optimistic but, on breakdown by area, it is seen that in Western Europe, North America and Oceania the increase is generally a consequence of population increase. In South America, Asia and Africa, however, the situation is quite different. Here the sugar market is by no means saturated; population is increasing considerably and other sweeteners have not gained so much ground as, for instance, in the U.S.A.

The high increase of consumption in Asia is partly due to the situation in Mainland China where in 1964/65 a considerably higher domestic sugar production has become available. This additional sugar will certainly be utilized for home consumption. And good increases in consumption have also to be expected in other Asian countries. It must also be remembered that the high prices of 1962/63 and 1963/64 caused a restriction of demand, reflected by the small rates of consumption increase, which has been removed by the low prices of 1964/65.

"With an additional production of nearly 7 million tons over 1963/64, the world sugar economy has made a very big step forward; one might say too big a step. An increase of production amounting to 4 million tons could have been utilized, because the stocks were very low so that a re-filling by 2 million tons would have been possible and some 2 million tons are required every year for consumption (by increased populations). Seven million tons, however, was too much, although one cannot say that the sugar economic policy has been generally wrong. There were some countries, however, especially in the beet sugar sector, which have planned too liberally and which, as a consequence of the favourable weather conditions, are confronted with an unusually high beet crop. The world is again over-supplied with sugar and prices are low."

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U.S. domestic sugar programme.

On the 16th December the U.S. Secretary of Agriculture confirmed his earlier proposal for the 1965 overall quota of 9,200,000 short tons, raw value. The quota for Hawaii was increased by 5479 tons but those for the other domestic areas were unchanged. The increase in the Hawaiian quota was balanced by slight reductions in the allotments for foreign territories, and in the tonnage reserved for proration. The quotas appear elsewhere in this issue.

It was also announced that total imports from foreign countries including the Philippines would be limited to 500,000 tons and 1,200,000 tons, respectively for the first and second quarters of 1965.

Lamborn & Co. are convinced that this was intended to be a strong move towards shoring up the price structure in the U.S. market[2]. They have calculated stocks as of 1st January 1965 to be 920,000 tons, about 120,000 tons more than normal, while receipts in the first quarter are normally about 850,000. Consequently the limitation to 500,000 tons will

[1] *International Sugar Rpt.*, 1965, **96**, (36), 1–4.

[2] *Lamborn Sugar Bulletin*, 17th December 1964.

produce a statistical tightness of about 200,000 tons for the first quarter. Similar calculations indicate a shortage of 350,000 tons for the first half-year.

"The Department (of Agriculture) has never made its price ideas entirely public, but many in the trade had felt that it was the intent of the Department to bring about an *average* price for the mainland cane crop at the parity level—6·63 cents per pound." Because of a low average for the beginning of the crop the price would have to be nearly 7·00 cents to achieve this average. But the Secretary had stated that the limitations on imports was necessary to insure that prices will be in line with the price objective of the Sugar Act, currently 6·6 cents per pound, and sugar circles in the U.S. are perplexed as to his wishes with respect to specific price levels. Lamborn & Co. emphasize that, when sugar legislation is lacking, the Department must make its objectives clear so that the trade has some idea as to how to act.

On the 30th December, the Department announced the quantities of sugar prorated to 17 countries for import to the U.S. in the first quarter, as follows, in short tons, raw value:

Philippines	187,196
Dominican Republic	53,974
Mexico	92,485
South Africa	31,169
Brazil	30,213
Peru	25,314
B.W.I.	14,739
Guatemala	11,995
India	11,995
Taiwan	9,332
Nicaragua	7,650
Haiti	5,998
Panama	5,820
Ecuador	5,712
Argentina	4,649
Colombia	1,686
Fiji	73
TOTAL	500,000

* * *

Modernization of the West German sugar industry[1].

After more than a year's deliberation, the Bonn Government has at last approved plans for the structural reform of the West German sugar industry. It is proposed that the Federal and Provincial Governments should each contribute DM.27·35 million towards closing down or amalgamating smaller sugar factories, mainly in Lower Saxony. The Government has set aside DM. 5 million for the current financial year, so that work can start at once.

The Federal Government's 25% share of amalgamation costs will be exclusive of legal charges. The grant of DM. 600 (£54) per ton for factories being closed down will be based on the average daily production capacity over the last three seasons. The Federal Government's maximum contribution towards the extension of amalgamated factories will be DM. 450,000 (£40,632) per factory replaced. This sum will not be used to cover the cost of dwelling houses and their contents, offices, or the purchase of land not strictly necessary for the improvement of the factory; only such work will be allowed as is required to enable the work of the replaced factories to be taken over and dealt with satisfactorily.

Various measures will be taken to ensure that reforms to the sugar industry will not be reversed during the next 30 years; among other precautions, improvement grants will have to be repaid if any sugar factory is put to a different use without Government sanction within six years of its enlargement. Applications for grants must be submitted to the appropriate Provincial Government in the first instance, and only work started after 1st January 1963 will be eligible.

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Declining yields in Puerto Rico[2].

Very early advices from first-hand observers say that 1965 Puerto Rico sugar production will be another in a series of disappointments. The crop probably will be late starting, perhaps around the end of January, and owing to drought will probably fall between 850,000 and 900,000 short tons. This provisional estimate would compare unfavourably with last season's final production figure of 978,128 short tons. Sugar production in 1964 concluded an unsatisfactory season for the industry as final outturn was considerably below the first estimate of 1,013,900 tons and failed to meet a modest second estimate of 991,500 tons. The yield in 1964, at 9·979%, was above the previous season's mark of 9·665%, but was below the 10·314% yield set in 1962.

Declining yields have been a pressing problem in the Puerto Rican sugar industry, with many growers expressing alarm as long ago as 1958, when the then all-time low yield of 10·171% was recorded. Since that time, the situation has deteriorated and Puerto Rico has failed to fill her mainland marketing quota for eight years and will not meet it in 1965, according to present indications. There is a great deal of speculation as to the cause of the overall decline in sugar yields over the years, but it seems reasonable to blame the weather for the prospective small 1965 crop. Another long-term problem is that workers are drifting away from sugar plantations to industrial and urban occupations. In any event, if 1964/65 production amounts to 900,000 tons it will be the smallest crop since 729,000 tons were produced in the 1943/44 season.

British Sugar Corporation Ltd.—The Minister of Agriculture, Fisheries and Food and Secretary of State for Scotland have appointed Mr. A. V. HILTON, J.P., to be a Government Director of the British Sugar Corporation in place of Lord CHAMPION who has resigned on appointment as Minister without Portfolio and Deputy Leader of the House of Lords. Mr. K. C. SINCLAIR, O.B.E., B.Sc., M.I.E.E. was recently appointed Commercial Director, and Mr. W. B. BOAST, B.Sc., Technical Director of the Corporation.

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[1] *Agra-Europe*, 18th November 1964.

[2] *Merrill Lynch*, 6th November 1964.

THE SPRINKLER IRRIGATION OF SUGAR CANE

By C. S. WRIGHT, M.I.Ag.E.

Paper presented to the Massey-Ferguson Mechanized Sugar Cane Production Conference, 1964

INTRODUCTION

The acceptance of sprinkler or overhead irrigation for sugar cane has been expanding rapidly in the last few years. Initially it was used by a few estates for a relatively low total water application supplementing rainfall. Experience and outstanding results achieved by these pioneers, together with rapid advances in equipment and refinements in technique, have seen more and more estates turning to sprinkler irrigation. This is not only for supplemental irrigation but for providing the major part of the water requirement, with rainfall merely an incidental. This increase is coupled with the need for expansion of sugar production, both in yields per acre and the expansion of acreage despite limited water supply.

SPRINKLER IRRIGATION LAYOUT AND OPERATION

A sprinkler irrigation system consists basically of a number of slowly rotating sprinklers set at intervals along a portable pipeline—the sprinkler line. The sprinklers are so spaced and the line is moved such a distance as to ensure adequate overlap of the wetted areas from each sprinkler, thereby giving an even distribution of water.

For supplemental irrigation, a number of sprinkler lines are connected to a portable main line which is fed from a portable diesel pump unit. Such a system is shown in Fig. 1. A system generally covers 100 to 150 acres (40 to 60 ha) and can be moved around to pump from a number of water sources. All pipes are of lightweight high strength aluminium alloy, with special quick action couplers to facilitate speedy repositioning with a minimum of labour. Pipes are in lengths of 20 or 30 ft (6·10–9·15 m).

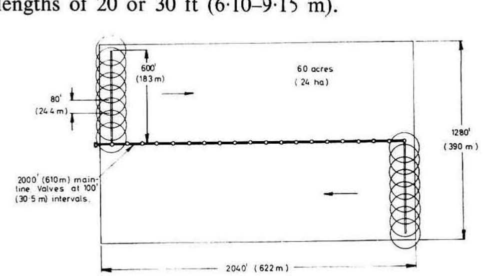

Fig. 1. Layout for 120 acres using "Master" sprinklers with a portable system.

Where irrigation provides most if not all the moisture requirements and the equipment operates for most of the season, the sprinkler lines operate from a system of underground mains. Connexion is made through hydrants spaced at approximately 240 to 300 ft (73 to 92 m) intervals on the mains and following roadways. Portable sub-mainlines provide for each sprinkler line to operate in three positions from each hydrant, giving a distance between sprinkler line positions of 80 to 100 ft (24·4 to 30·5 m).

Each sprinkler line operates in one position or setting for a period necessary to give the required application of water and is then moved to the next position along the main line. The operation of the sprinkler lines is arranged to a set schedule which facilitates supervision and checking. Having moved progressively through a number of settings to complete its "cycle", the sprinkler line ends up in a position ready to commence the next "cycle".

The application given and the "cycle" are dependent on the soil, root zone and climate. For areas where irrigation grows the crop and rainfall is of little significance and on a medium to heavy soil a nett application of 2 inches (50 mm) will be given every 7 to 9 days. The total annual application might be of the order of 60 inches (1520 mm). If the soil is very light or the root zone restricted, then an application of 1 to 1½ inches (25 to 38 mm) in a proportionately shorter cycle will be given.

For supplemental irrigation each application and cycle will be of the same order but since rainfall is greater, the amount of irrigation will be smaller—somewhere around 25 inches (630 mm) per annum is general.

The applications mentioned are nett—that is to say, the amount of water actually placed in the root zone after allowance for evaporation losses both in the air and from the soil surface and crop. Research has now proved that the loss of water in the air is surprisingly low. However, there are appreciable losses from evaporation from soil and crop when irrigation commences and these reduce as the area is wetted and cooled. Experience has led us to allow 20% to cover these losses when operating only in daylight. When operating for 24 hours, the figure can be reduced because of lower losses at night.

Types of equipment

Giant sprinklers: It is recognised that for the majority of field crops the greatest crop response and most economical operation are achieved with small medium-pressure sprinklers. These deliver 5 to 10 g.p.m. (23 to 45 litres/min) at a pressure of 40 p.s.i. (2·8 kg/sq.cm.) with the sprinkler lines being moved a maximum distance of 60 ft (18·3 m). However, cane presents a special problem in that, because of the large areas to be irrigated and the height and density of the crop, a close spacing with a large number of frequent sprinkler line moves is undesirable.

It is unfortunate that the throughput of a nozzle increases at a greater rate than the range. Large or giant sprinklers to be used on wide spacings, therefore, have a higher rate of water application than smaller sprinklers. Where giant sprinklers are used, a high application rate and high operating pressure must be accepted.

Initially, most sprinkler irrigation of cane was by means of giant sprinklers. The principal nozzle is the size of a fire nozzle and the damage it causes can be of the same order. This type of sprinkler has operating data as follows:

Discharge: 300 to 500 g.p.m. (1360 to 2270 litres/min)
Diameter: up to 425 ft (130 m)
Operating pressure: 90 to 120 p.s.i. (6·4 to 8·5 kg/sq.cm.)

The sprinkler line is moved approximately 180 ft (55 m) upon repositioning. This, however, is the only advantage and tends to be offset by the sprinkler line pipes having to be of large diameter. On the debit side, giant sprinklers are costly to operate because of the high operating pressure and high water losses. The application rate is higher than all but the lightest soils can take and this, together with the large droplet size which can break down the soil and seal it, results in appreciable water loss and soil damage. In windy conditions the distribution of water is seriously affected and results in many dry areas.

Medium pressure sprinklers: The disadvantages of the giant sprinkler led to the development of a smaller sprinkler having a lower operating pressure and application rate at the same time, still having a reasonably wide spacing. Operating data for such a sprinkler, e.g. the Wright Rain "Master", are as follows:

Discharge: 40 to 90 g.p.m. (182 to 410 litres/min)
Diameter: up to 238 ft (76 m)
Operating pressure: 50 to 90 p.s.i. (3·5 to 6·4 kg/sq.cm.)

Fig. 2 shows a typical field layout using this sprinkler.

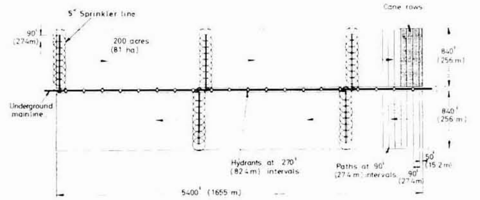

Fig. 2. Layout for 200-acre block using "Master" sprinklers.

Seven to eight of these "Master" sprinklers are spaced at intervals between 90 and 100 ft (27·4 to 30·5 m) along the sprinkler line. The sprinkler line is moved 90 to 100 ft (27·4 to 30·5m) upon repositioning. One sprinkler line will cover an area of approximately 40 acres (16 ha) depending on the application and hours of operation. As generally used, a 2 inch (50 mm) nett application for medium/heavy soils takes four hours and this allows three positions in 12 hours. Operation beyond 16 hours a day involves labour in moving equipment in darkness and is sometimes not possible. This type of sprinkler is in extensive use, both for supplemental and basic irrigation, and early installations with giant sprinklers have been re-engineered with them.

Recently what I believe will be an extremely important breakthrough has been achieved. By careful attention to nozzle and sprinkler design Wright Rain Ltd. have produced a sprinkler known as the "Lancer" with an exceptionally efficient nozzle, which, in effect, gives us greater range than has hitherto been possible for this size of sprinkler. The practical use of this is that the sprinkler can be used on a wide spacing without sacrificing evenness of watering. The spacing along the sprinkler line is 60 ft (18·3 m) and the line is repositioned 80 ft (24·4 m)—only 20 ft (6·1 m) short of the 100 ft (30·5 m) used with the "Master". The application rate is very low (5–15 g.p.m.) and thereby suitable for even the heaviest soils. The advantage of the low application rate will be seen in this example: The 2 inch (50 mm) nett application will take 10 to 11 hours to apply—therefore, after moving the equipment in the late afternoon it can operate throughout the night without attention. Operating for 24 hours can therefore be achieved, moving the equipment only twice—and always in daylight.

Operating data for the "Lancer" sprinkler are as follows:

Discharge: 5 to 15 g.p.m. (23 to 68 litres/min)
Diameter: up to 144 ft (44 m)
Operating pressure: 40 to 60 p.s.i. (2·8 to 4·2 kg/sq.cm.)

More sprinklers and sprinkler lines must be used but they are of smaller diameter. Furthermore, with 24 hour operation, the reduced flow permits smaller mains and pumps and prime movers. The overall capital cost is about the same. The sprinkler operates at a slightly lower pressure giving a useful operating economy. The layout and use of this sprinkler is shown in Fig. 3.

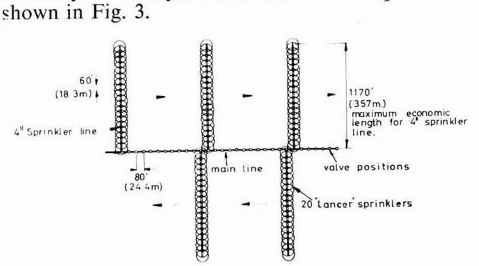

Fig. 3. Layout for 100-acre block using "Lancer" sprinklers.

An extension of the above technique is to use sprinkler lines twice as long although of smaller diameter pipe and to space sprinklers twice as far apart, i.e. 120 ft (36·6 m). Actually, outlets for sprinklers are provided at 60 ft (18·3 m) intervals. These outlets have automatic self-closing valves. After operating for 11 hours, each sprinkler on its riser pipe is moved up 60 ft (18·3 m) to the next outlet and irrigation continues for a further 11 hours. Note that only the sprinklers are moved and no control valves are closed or adjusted. This gives the facility to operate for 24 hours with pipe moving only once and in daylight. The layout and operation are shown in Fig. 4.

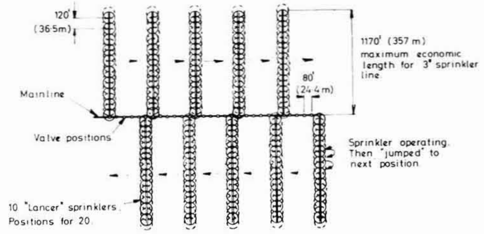

Fig. 4. Layout for 100-acre block using "Lancer" sprinklers

This system gives maximum utilization and efficiency with extreme simplicity of operation. The minimum of labour is required and can be easily organized and supervised. All equipment including pumps operates to maximum efficiency with no adjustment of control valves, pumps or prime movers necessary. It is practically as continuous and trouble-free as a good steady summer drizzle. I foresee a big future for this system.

COMPARISON OF SPRINKLER IRRIGATION WITH SURFACE IRRIGATION

Where irrigation is to be used—and there are few areas where it is not profitable—sprinkler irrigation is inevitably compared with surface irrigation methods. I shall therefore now cover the advantages of sprinkler irrigation for cane as we have observed them, and as they have been noted and recorded by actual users and research workers throughout the world. It should of course be remembered that since cane is grown under a wide variety of conditions and practices, the examples given may not be directly relevant everywhere, but it is almost certain that the general trend or observation will be applicable.

Area to be Irrigated

If land can grow cane it can be sprinkler irrigated. Virtually no land preparation in the form of levelling, grading, ditching or building channels or control works in the land is necessary. There is no movement of top soil and when this is shallow, this is of paramount importance.

With surface methods, a proportion of the land—from 7 to 10%—is lost to cultivation so as to accommodate supply channels, ditches and control works. Sprinklers ideally require narrow paths across the rows at intervals of 100 ft (30·5 m) or so, but where the sprinkler lines are laid with the rows, and particularly with supplemental irrigation where the cane requires no irrigation after it is 4 to 5 ft (1·2 to 1·5 m) high, no special paths are necessary.

Very light, non-uniform and "difficult" soils can all be sprinkled. No prior preparation is necessary and in-field management to allow for differing soil types and depths can be made simply by controlling the time the sprinkler line stays operating in a position.

Estate Layout

Where sprinkler irrigation is used, estates can be laid out in the block system without too much regard for contours and by selecting the best soils. Blocks can be sized and laid out according to cultivation and harvesting requirements. Roads can be spaced and made exactly where required. There being no obstruction from irrigation channels following contours, drainage can be simplified and arranged in an optimum layout.

A recent system for a Rhodesian estate using sprinklers is shown in Fig. 2. In this case, the estate has made a comparison of harvesting from this field layout and from that necessary for surface irrigation. The daily haulage is 6000 tons of cane. Because of furrows and checks, the maximum trailer load on surface irrigated areas is 3 tons and with each tractor making 20 journeys, the requirement is 100 tractors. For sprinklers, the more accessible unobstructed areas allow trailer loads of 5 tons requiring only 60 tractors. Wear and tear are reduced.

Water Use

Because water application rates can be matched to the soil and applied gently, there is no run-off or puddling. Water is evenly distributed over the entire area and exactly the right application to suit the soil and root zone is given, avoiding deep percolation, leaching and drainage problems. With sprinkler irrigation, therefore, a given quantity of water can properly irrigate a much larger area than surface methods. Conversely, less water is required to irrigate a given crop on a given area. The saving in water by sprinkler irrigation can be higher than 50%. Comparative trials in Puerto Rico showed the efficiency in terms of water use by sprinkler irrigation to be 54% greater than surface irrigation.

On an estate in Rhodesia with an ideal soil for surface irrigation, approximately the same crop is made with 40 inches (1016 mm) applied by sprinkler irrigation compared with 60 inches (1524 mm) applied by surface methods.

In the same region, surface irrigation allows 100 acres (40 ha) irrigated per cusec, and sprinkler irrigation averages 150 (61 ha) with a best of 190 (77 ha) acres/cusec. The smaller quantity of water required by sprinkler irrigation means that the water supply from source to the estate can sometimes be by pipeline rather than canal with its maintenance and unavoidable losses.

With a limited water supply, expansion can be realized only by turning to sprinkler irrigation with often an increase in yield per acre as a bonus.

Field Operations

Surface irrigation reduces the efficiency of tractors and machinery during tillage, cultivation and harvesting operations. Because of limited row length and numerous obstructions, the equipment spends a high proportion of its time stopping and manoeuvring and wear and tear are high. With sprinkler irrigation it is possible to arrange field layouts so that long straight runs are provided. In the example in Fig. 2, runs of approximately one mile (1·6 km) are possible. Inter-row cultivation is greatly facilitated.

Sprinkler irrigation enables the soil moisture to be accurately and quickly controlled to the right relationship for the cultivation operations to be carried out.

For pre-irrigation prior to planting, the application of water by fine droplets avoids capping or disturbing the tilth. Long straight planting furrows can be opened mechanically, roots quickly develop, and an even stand is ensured.

With sprinkler irrigation, mechanical harvesting is highly compatible and can be operated more easily and efficiently and throughput will be higher.

Labour and Supervision

Compared with surface irrigation, the labour requirement and supervision with sprinkler irrigation is smaller. The application rate of the sprinklers is fixed when the system is designed—all that is required in the field is to move the sprinkler lines at set intervals on a set schedule. The work involved is simply a mechanical operation and lends itself to easy training and simplified supervision. No labour is required to maintain channels or ditches.

In Natal a comparison between large-scale surface and sprinkler irrigation systems gave costs per effective acre foot as follows:

	Surface	*Sprinkler*
Field Labour	1. 16. 0	11. 3
Water	15. 0	7. 6
	£2. 11. 0	£0. 18. 9

In Rhodesia, one estate reckons its field labour to be:

Surface: 1 man to 10 acres
Sprinkler: 1 man to 18 acres
and potentially 1 man to 25–40 acres.

A recent equipment development now enables us to offer, without appreciable extra cost, systems to operate 24 hours a day with all moving of equipment in daylight hours. An extension of this at some extra cost allows pipe moving to take place only once in 24 hours and in daylight. With such systems, all the equipment is utilized to the maximum. Pumps can be selected for peak efficiency and will operate continuously at this point. There is no starting, stopping or adjustment of pumps, engines or controls.

Yield and Quality

The close control of soil moisture possible with sprinkler irrigation can, with good management, realise the crop's full potential giving more ratoons of greater consistent yield. New root growth can be encouraged and given ideal moisture conditions at crucial periods. An adequately designed sprinkler system will have capacity to meet the severest moisture demand, thereby preventing any stress and loss of condition and crop.

Sprinkler-irrigated cane will out-yield surface-irrigated cane, particularly under supplemental and difficult conditions. A report of trials in Natal indicated that, over a ten-year period, the increase in yield was 23·8% with surface, but nearly double this at 46·6% with sprinklers. This is verified by trials and results in Jamaica, Puerto Rico and elsewhere.

An estate in Rhodesia reports that during drying-off before harvesting, a light sprinkling can improve or maintain quality of the cane juice.

Costs

Comparative capital and operating costs for sprinkler and surface systems will, of course, vary widely according to a variety of conditions and particularly soil type and terrain. Opinion, until some years ago, tended to equate sprinklers only with supplemental irrigation—however, an ever-increasing number of estates are now using sprinklers for their main water requirement where rainfall is insignificant. This in itself is an indication of the economics and feasibility of sprinklers. From experience, it can be said that the capital cost of sprinkler systems will seldom be higher and generally appreciably less than the total cost of surface systems.

A report prepared by consultants for an estate in West Africa, where the nett moisture requirement was 61 inches (1549 mm) per year, gave the following comparison of costs.

Acreage	*Surface*	*Sprinkler*
Gross (including roads)	1220	1380
Nett cultivated	970	1250
% cultivated	79·5	90·6
Costs (£ per acre)		
Field distribution: sprinklers and pipes or furrows	19	57
Land preparation	45	20
Pumps, distribution channels and supply from source	89	69
	£153	£146

The large investment in earth-moving machinery and heavy tractors for surface irrigation operations is often overlooked when considering surface and sprinkler irrigation costing.

Critical factors affecting the comparison of running costs include the cost of labour and supervision, the relative efficiencies of the two methods and thereby the quantity of water that must be pumped, the cost of pumping, and, for surface irrigation, the frequency and extent of maintenace and investment in soil moving machinery. The running costs of sprinkler irrigation will compare favourably, especially remembering the other advantages of easier management and long term planning, better use of land and economy of water use.

SUMMARY

In areas where rainfall has been considered adequate, sprinkler irrigation has shown its ability to provide striking increases in yield. In fact, supplemental sprinkler irrigation is very often the most effective and economical way of increasing sugar production and of ensuring that this production is consistently maintained.

Where irrigation is a basic requirement, and even in conditions considered ideal for surface irrigation, sprinklers are increasingly the first choice. At lower cost, they offer consistently higher yield with minimum water usage. Estates can be arranged in the most economical layout simplifying management, machinery and labour requirements. Labour and supervision for the irrigation are modest and can be easily organized.

AGRICULTURAL ABSTRACTS

The sugar cane borer. L. L. LAUDEN. *Sugar Bull.*, 1964, **42,** 228.—Borer infestation in Louisiana is heavier than it was in 1963. Another chemical, "Thiodan 3%", has been added to the list of recommended chemicals to control the borer. It should not be applied more than 4 times in a season and 60 days should elapse before the last application and harvest.

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Louisiana sugar cane variety census for 1964. R. J. MATHERNE. *Sugar Bull.*, 1964, **42,** 230–231.—The variety CP 52-68 increased its lead over CP 44-101 as the most extensively cultivated variety: from 2·22 to 12·57%. Third place was taken by N:Co 310 with 16·3?% of the acreage.

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Yield, nutrient content and fertilizer needs of sugar cane in the lower desert area of California. A. J. MACKENZIE and K. D. BEATTY. *Sugar Bull.*, 1964, **42,** 234–238.—Good crops of sugar cane, of several varieties, have been produced experimentally from small plots in the hot dry lower desert area of California, with frequent irrigation. Samples of one of the most promising varieties (N:Co 310) were analysed for nitrogen and phosphorus.

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A new variety of sugar cane in Taiwan. ANON. *International Fertilizer Correspondent*, 1964, **5,** (7), Item 780.—The variety F-148, bred at Pingtung, is now regarded as one of the most promising new varieties, 9000 ha having been planted in 1963. It is superior to the conventional variety (N:Co 310) having given 9% increased yield of cane and 20% of sugar. Other details of this cane are given.

* * *

Pest and disease control in sugar beet culture. L. VAN STEYVOORT. *Pub. Vulg. Inst. Belge pour Amél. Betterave.*, 1963, (2), 23–33.—Information and recommendations in popular form for Belgian beet growers are given on the correct use of insecticides and herbicides under their conditions.

Sugar beet variety trials in Belgium, 1959-63. N. ROUSSEL. *Pub. Tech. Inst. Belge pour Amél. Betterave*, 1963, **31,** (4), 147–181.—Details are given of the method of carrying out these impartial trials, the scheme having been initiated in 1954. Results are given in a series of tables.

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Commentaries for sound and colour films on sugar beet prepared in 1963. R. VAN STALLEN and M. MARTENS. *Pub. Tech. Inst. Belge pour Amél. Betterave*, 1963, **31,** (4), 182–189.—Commentaries for two films prepared by the Institute are given in full, the films being concerned with present-day seed and new techniques.

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Physiology of hybrid seed obtained by crossing mono- and polyspermous sugar beets. A. V. TISHCHENKO and V. I. MOSKALENKO. *Agrobiologiya*, 1963, **4,** 617–619; through *Biol. Abs.*, 1964, **45,** 4682.—Experiments with seed from two hybrids showed that: (1) physiological processes occur at a more active pace in seeds obtained through cross breeding, (2) hybrid seeds have better moisture absorption characteristics, (3) leaching out of extractive substances of the pericarp proceeds faster in the hybrid seeds, promoting faster germination, and (4) catalase enzyme and respiratory intensity register greater activity in the hybrid seed.

* * *

Tractor noise. ANON. *Australian Sugar J.*, 1964, **56,** 130.—A high incidence of deafness among those exposed to tractor noise has been revealed in hearing tests conducted by the Commonwealth Acoustic Laboratory for the Queensland Cane Growers' Council. Of 300 volunteers 60% showed some degree of hearing loss, while 32% suffered significant loss. The left ear was generally more affected than the right, a suggested explanation being the location of the exhaust on the left side coupled with the fact that most operatives tend to drive with the head turned to the right. The need for an ear protection device is stressed.

The changed pattern of sugar cane varieties. ANON. *Australian Sugar J.*, 1964, **56,** 99.—The history of sugar cane varieties in Queensland is briefly outlined. It is pointed out how the quest was initially for bigger and sweeter canes, when the famous New Guinea cane NG 15 or "Badila" appeared, but today canes are being sought or bred to suit different localities, types of soil, for disease, drought or cold resistance, and, latest of all, to suit the mechanical harvester.

* * *

Mixed cropping effects on yield and juice quality of sugar cane. G. N. MISRA. *Indian Sugar*, 1964, **14,** (1), 11–17.—The results of a large number of cane intercropping experiments, with gram, pea, and mustard, in different parts of Uttar Pradesh, are given. Results do not appear to have been very conclusive. With 32 comparisons the intercropped autumn cane gave better juice quality in 18 cases and inferior in the remaining 14. The yield of cane was invariably depressed as a result of the intercropping. Results varied much from centre to centre. The non-intercropped cane gave earlier and better tillering.

* * *

How to place fertilizers. C. B. S. RAJPUT. *Fertiliser News*, 1964, **9,** (7), 16.—Some general principles in the application of N-P-K fertilizers, with different crops, are outlined. It is pointed out that no single method is applicable for all fertilizer materials and that such factors as soil, crop, kind of fertilizer, rate of application, method of irrigation, etc., must be taken into account.

* * *

Results of date-of-planting experiments with sugar cane in Louisiana, 1960–63. R. J. MATHERNE and L. P. HEBERT. *Sugar Bull.*, 1964, **42,** 246–251.—Date-of-planting experiments with sugar cane varieties have been conducted at the U.S. Sugar Cane Field Station, Houma, Louisiana, since 1927. This paper reports results for the 1960–63 period with the major varieties CP 44–101, CP 52–68, N:Co 310 and CP 55–30. Plots were 1/120 acre, each replicated 4 times, on light soil with planting dates August 1, September 1, and October 1. Varieties differed in their reactions but in general September plantings outyielded others.

* * *

Florida sugar cane seedling programme from crosses and seed produced at Canal Point. E. R. RICE and P. H. DUNCKELMAN. *Sugar Bull.*, 1964, **42,** 254–262. The Florida sugar cane seedling programme is a co-operative undertaking of four different concerns or bodies. Thousands of sugar cane seedlings are produced every year at Canal Point. With numbers increasing, the difficulties in housing seedlings and young plants and finding enough glass house or planting-out space are outlined.

* * *

A new type of spreader for broadcasting insecticide. R. B. MOLLER. *Cane Growers' Quarterly Bull.*, 1964, **28,** (1), 4–5.—In Queensland broadcast application of crude BHC is used for soldier fly and "grub" (borer) control, usually applied by broadcast fertilizer distributors or combine seed fertilizer drills, both of which have disadvantages. A promising new spreader is here described (made by W. H. Truscott & Sons, South Kalkie, Bundaberg). It consists essentially of an insecticide box mounted on the front gang of a set of off-set discs with a delivery outlet by hose to each disc. An agitator is driven by chain from the axle. Uniformity of application and coverage are claimed to be good. Three photographs illustrate the machine.

* * *

Severe BHC damage. I. T. FRESHWATER. *Cane Growers' Quarterly Bull.*, 1964, **28,** (1), 6–7.—The drastic results on cane of an excessive application of BHC to a small area, 2 years previously, are here well illustrated with photographs.

* * *

The menace of the great sensitive plant in new lands. L. G. VALLANCE. *Cane Growers' Quarterly Bull.*, 1964, **28,** (1), 11–14.—Interesting facts are given about this insidious noxious weed (*Mimosa invisa*) that can smother cane so easily. Some cane lands have, in fact, been abandoned because of it. Means of distinguishing it from common sensitive plant (*Mimosa pudica*) in the young stages are given (by leaf and stem). Because of the small seed the suggestion is made that machinery from an infected area be hosed down to remove mud before operating in a clean area.

* * *

Sooty mould on cane. B. E. HITCHCOCK. *Cane Growers' Quarterly Bull.*, 1964, **28,** (1), 15.—A general description of this fungus, which lives on the sugary excretion of the sugar cane aphis, is given. It is not regarded as serious for it disappears in time, when the aphid population dies down on account of predators. Some varieties of cane are affected more than others. The variety Q 57 was little affected in northern Queensland, not being favoured by the aphids.

* * *

Improved germinations in hot water treated cane. J. L. MCGEE. *Cane Growers' Quarterly Bull.*, 1964, **28,** (1), 16.—Methods adopted (reduced handling) for lessening injury to the soft eyes after 3 hours' hot water treatment, for ratoon stunting disease, are outlined. Suggestions are made for getting good seed cane, preference being given to harshly grown cane. Cane watered within 6 to 8 weeks of being cut should be avoided, the drier cane giving better germination. Canes with damaged or abnormal eyes should be discarded.

* * *

1964 sugar cane variety recommendations for Louisiana. ANON. *Sugar Bull.*, 1964, **42,** 270–271.—For the 1964 crop CP 52–68, CP 44–101 and N:Co 310 are the major varieties, comprising 80% of the State acreage. The characteristics of these and other varieties, particularly in regard to mosaic resistance, are discussed. Other varieties dealt with include CP 48–103, the earliest maturing variety available, CP 47–193, also early, and CP 55–30. Recommendations for different cane growing areas in Louisiana are given.

* * *

Resistance of *Streptomyces* to herbicides. H. C. BOUNDS and A. R. COLMER. *Sugar Bull.*, 1964, **42,** 274–276.—*Streptomyces* is an important group of soil bacteria, closely concerned with soil fertility. Experiments were carried out to test the effects of various well known herbicides on these bacteria. It was found that when used at the recommended rates of application they had no harmful effects ; in fact, the bacteria were found to be able to withstand concentrations many times greater than would normally occur in the field.

* * *

Foliar diagnosis. M. LAKSHMIKANTHAM *et al. Indian J. Sugar Cane Res. Dev.*, 1964, **8,** 239–256.—The full title of this paper is "Studies on the determination of index tissues for plant nutrients of sugar cane" and there are six authors. It reports studies over a 3-year period (1958–61) at the Anakapalle Sugar Cane Research Station (Andhra Pradesh) on foliar or tissue diagnosis in order to obtain basic information on the influence of irrigation and nitrogenous manuring on tissue composition as related to cane yield and quality. Leaves, leaf-sheaths and internodes were studied, not only in relation to N but to K and P also.

* * *

Time of application of 2,4-D for weed control in cane. P. S. MATHUR. *Indian J. Sugar Cane Res. Dev.*, 1964, **8,** 257–260.—Experiments at Shahjahanpur Sugar Cane Research Station (Uttar Pradesh) on spraying 2,4-D at different times and combined with hoeing are described, also the effect on different weed species such as *Convolvulus arvensis*, *Cyperus rotundus*, *Chenopodium album*, *Portulacca oleracea* and *Cynodon dactylon*. The last two mentioned were not affected. Three sprayings had a deleterious effect on the cane but not two.

* * *

Assessment of losses by sugar cane pests—loss caused by top borer of sugar cane. A. N. KALRA and J. P. CHAUDHARY. *Indian J. Sugar Cane Res. Dev.*, 1964, **8,** 261–264.—The top borer (*Scirpophaga nivella*) is a major cane pest in India and other eastern countries. In north India it has 4–5 distinct broods in a year. This work, carried out at the Indian Institute of Sugar Cane Research, Lucknow, during 1960–62, assesses cane losses caused by the different broods. The third brood (in July or August) caused the maximum loss of millable cane.

* * *

Tillering in sugar cane and mortality caused by borers and other factors. Z. A. SIDDIQI. *Indian J. Sugar Cane Res. Dev.*, 1964, **8,** 265–269.—In this work, carried out at the Sugar Cane Research Institute, Pusa, Bihar, a study was made of the rate of shoot production in spring-planted cane at weekly intervals. Mortality due to various borers (*Chilotraea infuscatellus*, *Scirpophaga nivella*, *Emmalocera depressa*) and to physiological causes in different classes of shoots was estimated. Mortality from borers was heavy.

* * *

Morphology of the pupa of the green borer of sugar cane. P. N. AVASTHY and J. P. CHAUDHARY. *Indian J. Sugar Cane Res. Dev.*, 1964, **8,** 271–273.—A detailed description, with drawings, is given of the pupa of the typically Indian borer *Raphimetopus ablutellus* ("green borer"), the object being to assist in distinguishing it from similar pupae of other cane borers.

* * *

Sugar cane rust—collateral hosts and physiologic specialization. K. SINGH and M. M. TIWARI. *India J. Sugar Cane Res. Dev.*, 1964, **8,** 275–276.—In an attempt to discover possible alternative hosts of sugar cane rust (*Puccinia erianthi*) various grasses were inoculated and studied. One grass (clone SES 66 of *Saccharum spontaneum* originally collected around Coimbatore) was successfully infected and produced normal rust pustules. Some other rusts on wild grasses were found to be capable of infecting sugar cane leaves.

* * *

Sugar cane wilt disease. A. GANGULY and J. N. CHAND. *Indian J. Sugar Cane Res. Dev.*, 1964, **8,** 277–287.—The title of the paper is "Comparative studies of the isolates of *Cephalosporium sacchari* and *Fusarium moniliferumi*" and it records observations on growing strains of these cane wilt fungi on different culture media. A survey has shown that strains of *C. sacchari* are distributed throughout cane growing areas of Bihar.

* * *

Studies on the physiology and pathogenicity of a virulent strain of red rot disease of sugar cane. M. S. CHATRATH and B. S. BAJAJ. *Indian J. Sugar Cane Res. Dev.*, 1964, **8,** 288–291—Details are given of observations on a light, highly sporulating and virulent strain of red rot fungus (*Colletotrichum falcatum*), that changed to a dark, avirulent one during the course of maintenance on culture media.

IMPROVEMENT OF WHITE SUGAR CRYSTAL QUALITY IN VACUUM PANS

By T. RODGERS and C. L. LEWIS

Paper presented to the 17th Tech. Conference, British Sugar Corporation Ltd., 1964.

PART II

Factors Affecting Individual Installations

Boiling technique

We have previously enumerated the stirrer installations operating in the Corporation in the 1963/64 campaign, and have mentioned a marked success with some, but not so good results with others. Although it remains true that the parallel-sided pans at King's Lynn give superior results to the low-head type, there was still an unmistakable improvement in the latter when equipped with stirrers. The fact therefore that all four pans equipped at Brigg and Ipswich are of the low-head design, should not, by itself, explain why no significant improvement is recorded at these factories. There is no doubt that the boiling technique has to be altered to get the best results from a stirrer installation—and it is possible that no factory has yet fully achieved this—so it may be significant that in two factories all installations have had a good degree of success, and the other two have shown very little improvement. Boiling techniques, which differ to a greater or less extent at all factories, have become established over many years, and it will take a little time to have them altered, where it is found necessary to do so.

As an example, we can compare the white pan boiling procedure at King's Lynn with Ipswich. By contrast, at the former, the pan is grained at a rather high supersaturation, and after the grain is set it is "brought together" as soon as possible and thereafter boiled relatively tight. At Ipswich, graining is at a low supersaturation, the pan is boiled loose, and not brought together until it is well established. Now it is becoming accepted that for fastest rate of boiling and minimum production of false grain and conglomerates, there is an optimum tightness of the masse during the whole period between graining and the final "Brixing-up" of the pan. That is to say there is an optimum crystal concentration or, another way, there is an optimum average distance between individual crystals. When a pan is grained, it is almost always too loose, i.e. there is too great a distance between crystals because of the size of graining charge that has to be used. The bringing-together is always the dangerous period, and at King's Lynn this has been done early so that any fines formed can be fairly easily removed—by the use of water if necessary! At Ipswich, the graining point is probably better chosen than at King's Lynn but the bringing together is left until much later in the boiling, when it is very difficult to remove the fines which, furthermore, are very different in size from the original crystals. When these fines comglomerate, as they will do if no stirrer is used, they are no longer recognized as fine grain. With a stirrer, they remain as individual small crystals, and this is the reason for Ipswich's observations that the grain is small at the end of the strike and that false grain forms midway through the boiling when a stirrer is used.

The foregoing has been used to illustrate how slightly different techniques may exist which, with a conventional pan, can serve their purpose equally well, especially as Ipswich has generally produced a finer crystal than King's Lynn. The introduction of stirrers has resulted in the King's Lynn system being more easily adapted to the new technique.

In case it should be concluded from what has been said that water must always be used at the tightening stage, we must say that this is not the case. Very good grain can be produced without water provided a stirrer is available and the correct procedure used. This should be to use full seeding, i.e. with fondant sugar in alcohol, to grain with as small a charge as possible, so that the tightness is as near as possible the optimum from the beginning, and to introduce the grain at a comparatively low supersaturation. The rate of sucrose deposition on the crystals will be very low at this stage, because of the small amount of crystal area available. The rate of water evaporation must therefore be very low, so the steam to the pan must be virtually shut off. This can be done with safety provided a stirrer is available to maintain the circulation. Without a stirrer it is impossible to achieve the same results for, although water may be used to aid circulation, this is all it does, being boiled off again at the same rate as it is added.

In practice it is difficult to convince the sugar boiler that steam should be shut off entirely, especially as he believes that he must get as much sucrose to crystallize in as short a time as possible. This is certainly true, but not irrespective of crystal formation and it does not follow that the best compromise is to push as much steam as possible into the calandria all the time. The evaporation rate has got to be regulated to suit the stage of the boiling, certainly from the point of view of good crystal production. By maintaining the pan at optimum tightness throughout the liquor feed period, the pan can be boiled at the fastest rate, for any given condition of steam pressure and vacuum, and with the production of well shaped, clean crystals.

Pan characteristics

We have now discussed one feature—technique of boiling—which we believe has influenced the success or otherwise of our stirrer installations to date. There is no doubt, however, that other features such as pan design, position of liquor feed, and local factory conditions have had their effect, and in this respect we have made a detailed examination at each installation of the variables which we consider have an influence on the results. Figs. 7, 8 and 9, read in conjunction with Table II, show certain of these measurements.

Table II

Factory	*Type of pan*	A	B	C	D	E	F	*Tube size o.d. (in)*	*Ave. length of blades (in)*	*Heating surface (sq.m.)*	*Final strike volume (cu.ft.)*
King's Lynn	Parallel	12 ft 0 in	12 ft 0 in	4 ft 9 in	4 ft 1 in	15½ in	8½ in	3½	18	205	1100
	Parallel	12 ft 0 in	12 ft 0 in	4 ft 9 in	4 ft 1 in	15 in	8½ in	3½	18	205	1100
	Low Head	14 ft 9 in	12 ft 0 in	4 ft 3 in	4 ft 2 in	14½ in	10¼ in	3½	14½	275	1530
	Low Head	13 ft 9 in	11 ft 0 in	3 ft 11 in	4 ft 6 in	18 in	5½ in	4	13½	220	1250
Cantley	Parallel	12 ft 0 in	12 ft 0 in	4 ft 9 in	3 ft 9 in	18 in	8 in	4	15½	184	1050
	Parallel	12 ft 0 in	12 ft 0 in	4 ft 9 in	3 ft 9 in	15 in	8 in	4	15¾	184	1050
	Parallel	12 ft 0 in	12 ft 0 in	4 ft 5 in	3 ft 9 in	15 in	10 in	4	15¾	184	1050
	Parallel	12 ft 0 in	12 ft 0 in	4 ft 5 in	3 ft 9 in	15 in	10 in	4	15½	184	1050
Ipswich	Low Head	13 ft 9 in	11 ft 0 in	4 ft 6 in	4 ft 3 in	13 in	—	4	14½	145	1250
	Low Head	13 ft 9 in	11 ft 0 in	4 ft 9 in	4 ft 2 in	13 in	9 in	3½	15¾	220	1250
Brigg	Low Head	13 ft 9 in	11 ft 0 in	3 ft 11 in	4 ft 6 in	17 in	6 in	4	13	220	1250
	Low Head	13 ft 9 in	11 ft 0 in	4 ft 9 in	4 ft 2 in	13 in	8½ in	3½	17¾	220	1250

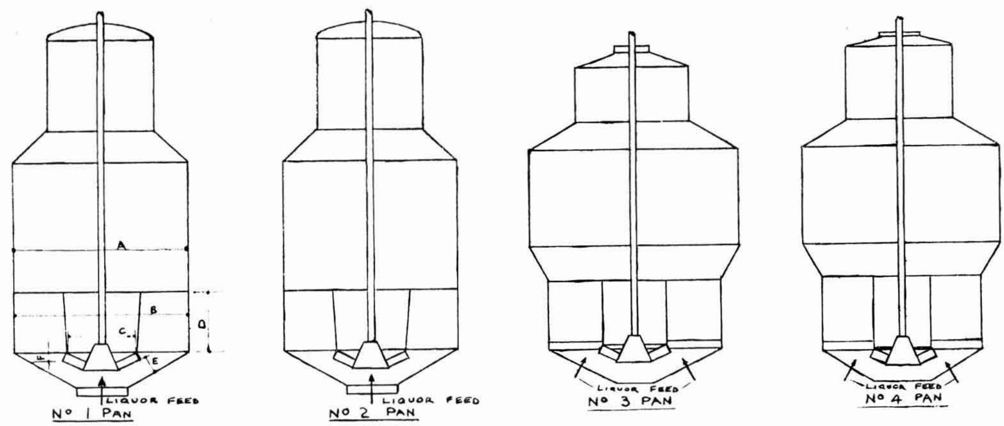

Fig. 7. Pans at King's Lynn.

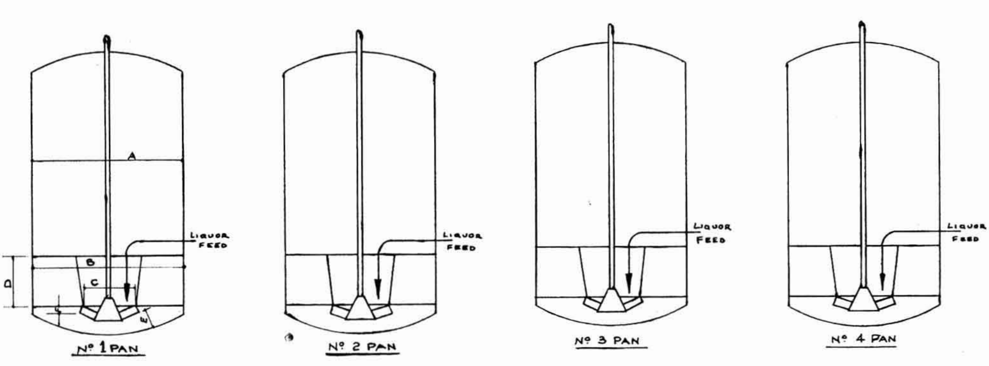

Fig. 8. Pans at Cantley.

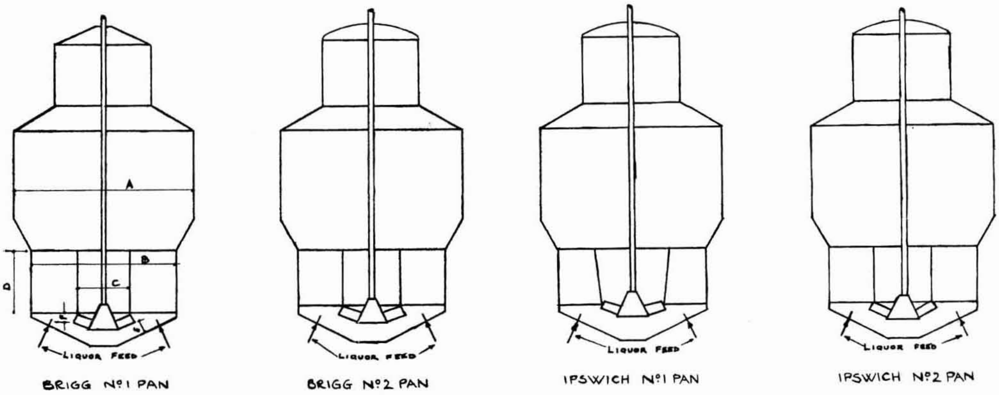

Fig. 9

The question of overall pan shape is still perhaps the most important. A previous report[2] has quoted results from King's Lynn showing that the parallel-sided pans gave consistently better results—lower moisture and ash—than the "low-head" design when using the same liquor, steam, vacuum etc. A further series of tests were carried out again this year on "initial" and "bound" moistures from the four pans. Without going again into too many details, the average of these results from a large number of samples are shown in Tables III and IV.

Column 1 in both Tables refers to the Pans 1–4 of Fig. 7. Column 2, Initial Moisture, is the value found by the standard moisture analysis test involving 3 hr drying at 105°C. Columns 3, 4 and 5 are the loss in weight of similar samples after 24, 48 and 72 hours, respectively, in a humidity oven at the temperature and % R.H. quoted for each Table. Column 6 records results of standard tests performed on the previous samples after their removal from the humidity oven. Column 7 is the sum of Columns 5 and 6, and represents the total moisture removed from the sample. The difference therefore between columns 7 and 2 represents the "bound moisture". As with tests in the previous campaign, initial moisture was consistently lower with the parallel-sided pans, although there was less difference than last year with bound moisture. No. 3 Pan, which is the bigger of the low-head design, was the worst in all respects.

These results are a strictly fair comparison, because as well as all physical conditions being the same, the same boilers handled the pans.

In connexion with pan shape, an interesting investigation into circulation pattern in vacuum pans has been carried out by Sugar Research Limited in Queensland[3]. This was done by using an encapsulated radio isotope, and showed that the circulation pattern considered normal only applied for about one third of the time. It was found that local circulation occurred in spots, and that movements were often sluggish and indefinite with nearly half of the time being spent by massecuite moving in eddy currents.

[3] *Annual Review* (Sugar Research Institute, Queensland), 1962-63, 7–8.

Table III

Pan No.	*Initial Moisture* % (3 *hr at* 105°C)	*Moisture Loss in Humidity Oven at* 22°C and 42% R.H. 24 *hr*	48 *hr*	72 *hr*	*Final Moisture* % (3 *hr at* 105°C)	*Total Moisture* %	*Bound Moisture* % (*Total – Initial*)
1	0·0128	0·0049	0·0080	0·0101	0·0091	0·0192	0·0064
2	0·0146	0·0063	0·0091	0·0119	0·0098	0·0217	0·0071
3	0·0188	0·0087	0·0120	0·0148	0·0129	0·0277	0·0089
4	0·0184	0·0079	0·0114	0·0146	0·0106	0·0252	0·0068

Table IV

Pan No.	*Initial Moisture* % (3 *hr at* 105°C	*Moisture Loss in Humidity Oven at* 22°C and 42% R.H. 24 *hr*	48 *hr*	72 *hr*	*Final Moisture* % (3 *hr at* 105°C)	*Total Moisture* %	*Bound Moisture* % (*Total – Initial*)
1	0·0122	0·0073	0·0097	0·0116	0·0064	0·0180	0·0058
2	0·0086	0·0044	0·0082	0·0103	0·0065	0·0168	0·0082
3	0·0168	0·0111	0·0137	0·0150	0·0145	0·0295	0·0127
4	0·0162	0·0094	0·0120	0·0133	0·0102	0·0235	0·0073

In Fig. 10 is the circulation pattern as determined at the Queensland Institute. This shows the eddy currents at the side of the pan, in a parallel-sided pan. Transcribing these patterns on to a low-head pan shows how these eddies are likely to be increased, and how positive circulation would be worse with the latter design. Mechanical circulation would certainly improve both patterns, but the dead space in the bulged upper section of the low head type presumably remains to some extent.

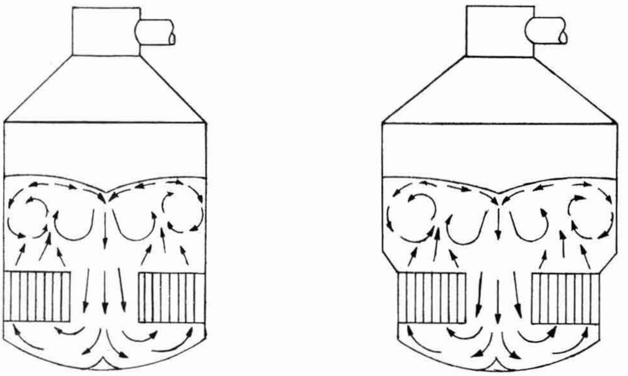

Fig. 10. The circulation pattern in a parallel-sided pan (left) as determined by the Sugar Research Institute, Queensland, has been transcribed to a low-head pan (right), The local circulation at the upper sides is exaggerated in this shape of pan.

Another design feature which is correlated with successful installations is the position of the liquor feed in the pan. So far, the most successful units happen to have had the liquor inlet led down the centre well, i.e. on the suction side of the propeller. This summer, at Brigg a test will be made with a low-head pan at that factory which has the feed inlet altered to this position, so as to compare with a similar pan having the feed on the propeller discharge side.

It had previously been suggested by the authors that the diameter of the downtake was possibly an important feature in pan design, and this was considered a probable explanation for the slightly inferior results on Pans 3 and 4 compared to Pans 1 and 2 at King's Lynn. The results from Cantley, however, make us now believe that this is not so, and that the bulged upper section of the low head design is the principal reason for the less successful results. It is still considered, however, that a diameter of 4 ft 6 in is about the minimum that should be used with the propeller hub diameter which we have at present.

(To be continued)

SINGLE PASS *vs.* RECIRCULATION IN EVAPORATORS

By H. J. SPOELSTRA (Sugar Department, Stork-Werkspoor)

REFERRING to the article by L. A. TROMP entitled "Single pass *vs.* Recirculation in Evaporators" (*I.S.J.*, 1964, **66**, 222–224, 253–254) the following may serve as an additional contribution to comparative examination of the evaporation systems referred to.

We distinguish the following three systems, viz.:

(I) full recirculation, i.e. open downtake,

(II) partial recirculation, i.e. semi-sealed downtake, and (III) single pass, i.e. fully sealed downtake,

which are schematically indicated in Fig. 1.

In these drawings S = incoming juice, b_1 = Brix of incoming juice, A = juice flow through heating tubes, D = vapour (evaporated water), b_2 = Brix of outgoing juice, $x = \frac{A}{S}$ = recirculation ratio, and $y = \frac{b_2}{b_1}$ = Brix ratio (degree of concentration) $\frac{S}{S-D}$.

For system (I) we assume that the circulation juice from the centre well is first fully and homogeneously mixed with the incoming juice before it divides itself into one flow through the tubes and one to the discharge opening. Hence the Brix of the juice mixture in the bottom space is equal to b_2 and the Brix b_3 of the juice leaving the tubes has a value *higher* than b_2.

For system (II) it is also assumed that homogeneous mixing of incoming and recirculating juice takes place in the bottom, but here the Brix $b_3{}^1$ of this mixture has a value lower than b_2.

With system (III) we have no other components than the incoming juice with a Brix of b_1 and the outgoing juice, leaving the heating tubes with a Brix of b_2.

In system I,

$$Sb_1 + (A - D)b_3 = Ab_2 + (S - D)b_2.$$

Since $b_1 = \frac{b_2}{y}$, $A = Sx$ and $D = S\frac{(y-1)}{y}$,

$$\frac{Sb_2}{y} + Sxb_3 - Sb_3\frac{(y-1)}{y} = Sxb_2 + Sb_2 - Sb_2\frac{(y-1)}{y}$$

$$\text{or } \frac{b_2}{y} + xb_3 - \frac{(y-1)}{y}b_3 = xb_2 + b_2 - \frac{(y-1)}{y}b_2$$

$$\text{or } b_3 = \frac{xy}{(xy - y + 1)}b_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

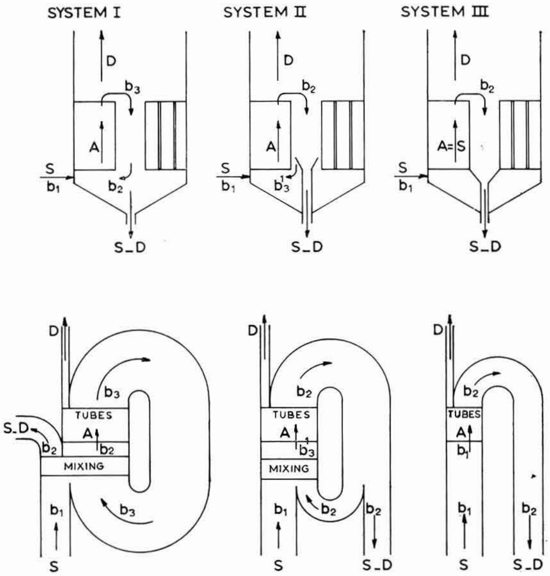

Fig. 1

In system II,

$$Sb_1 + [A - D - (S - D)]b_2 = Ab_3^1$$

Substituting,

$$\frac{Sb_2}{y} + Sxb_2 - Sb_2 = Sxb_3^1$$

$$\text{or } \frac{b_2}{y} + xb_2 - b_2 = xb_3^1$$

$$\text{or } b_3^1 = \frac{(xy - y + 1)}{xy} b_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\text{If we let } F = \frac{xy}{xy - y + 1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

then $b_3 = b_2F$, and $b_3^1 = \frac{b_2}{F}$. The relation between F and x is expressed graphically in Fig. 2 for different values of y.

Comparing the three systems we can say that the heat transfer inside the tubes, as far as the Brix of the juice is concerned, takes place at a Brix level:

for I: between b_2 and b_3 ($> b_2$) = highest.

for II: between b_3^1 ($< b_2$) and b_2 = more favourable than for I.

for III: between b_1 ($< b_3^1$) and b_2 = more favourable than for II.

From Fig. 2 it is seen that a relatively high degree of recirculation x works favourably on the conditions for system I. For system II, however, a relatively lower value of x will be more advantageous. Theoretically it is possible to adjust the juice level in a vessel working according to system II at such a height that $A = S$ or $x = 1$, in which case $F = 1$, and thus the same conditions are created as for system III with fully sealed downtake.

Further it is to be seen that in the case of system I for a certain degree of recirculation the conditions will become more unfavourable with increasing value of $y = \frac{b_2}{b_1}$, which means that working with a sealed downtake will become more advantageous with increasing concentration rate, i.e. for the last vessel. For pure water ($y = 1$) with $F = 1$ the sealed downtake is meaningless for practical purposes.

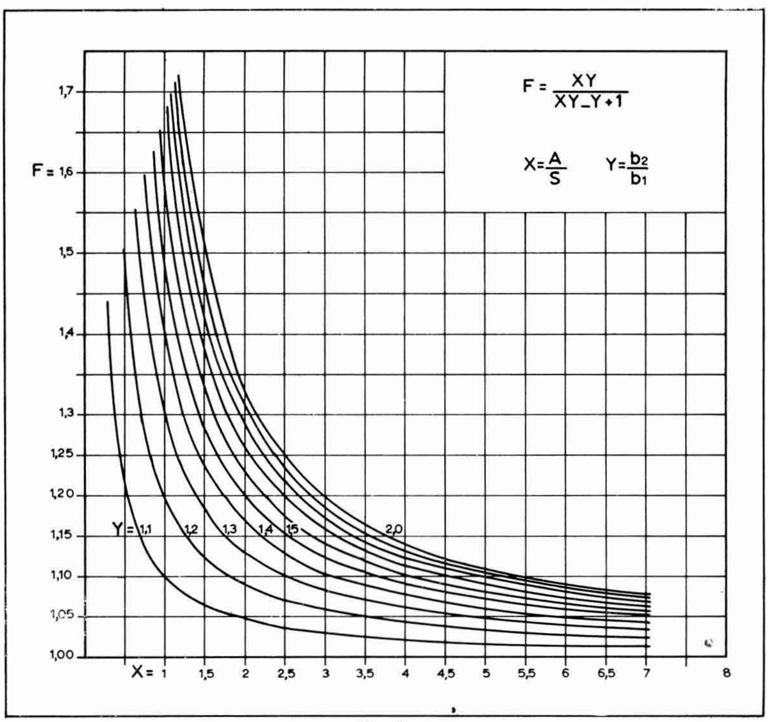

Fig. 2

Finally, it may be observed that a recirculating system needs extra energy for recirculating a certain amount of juice, which energy has to be supplied in the form of extra heat.

From the above we can draw the conclusion that the single-pass system is qualitatively better than any recirculation system because of the more favourable conditions for heat transfer inside the tubes.

However, for the time being, we lack the data necessary for a quantitative comparison. For such a comparison we should know the degree of recirculation x for the conditions prevailing in the respective vessels, or the value of b_3.

As far as we know, such data are not available and hence we do not have any basis for estimation of the Brix level of the juice inside the tubes and its influence on the heat transfer from tube-wall to the boiling juice. The only thing we know is that in the last vessel the Brix b_3 will generally have a value between b_2 and the saturation Brix at the prevailing juice temperature.

Suppose we have a juice temperature of 60°C with a saturation Brix of 76° and $b_2 = 63°$ whilst $b_1 = 37°$. Then $y = 1{\cdot}7$. For $b_3 = 76°$ (as maximum) we get $F = 1{\cdot}21$ and from Fig. 2 we find a circulation $x = 2{\cdot}4$ (as minimum). For $b_3 = 70°$ we would find a degree of recirculation $x = 4{\cdot}2$.

From the above we might *perhaps* estimate the degree of recirculation x in a last vessel at a value ranging from 3 to 5, but that is all we can say for the moment. Making estimations of the degree of circulation (i.e. the b_3 values) of the other vessels would be mere guesswork.

In conclusion we may observe that one should be careful in evaluating the better features of single pass vessels versus those with recirculation by merely comparing the performance results of two independent installations, because different working conditions and other factors such as scale formation, de-aeration of the steam chests, might off-set or flatter the qualitative superiority of the sealed downtake system.

THE APPLICATION OF ON-LINE COMPUTER CONTROL TO CANE SUGAR REFINING

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Process control is complicated by factors of reliability in the measuring circuits. Decision making, based on process information, is only one part of the job. Real difficulties lie in:

(a) getting good samples of heterogeneous materials containing grain in suspension,

(b) reliability, mechanical and electrical, of automatic analysers on high density materials, and

(c) reliability of data transmitters and data loggers.

Factor (a) alone has proven to be a massive problem.

So, with many other aspects of automatic control, the difficulty in the refinery often lies in obtaining the basic accurate information necessary on which to base decision making. Where the information can be obtained it is sometimes possible and desirable to perform the calculations with the aid of a computer.

Such applications are considered in the accompanying article.

MANY industrial processes are becoming applications for control by on-line computers with benefits in increased knowledge as well as increased efficiency. This article seeks to show how computers would operate in a sugar refinery.

A digital computer installed to operate a process automatically is directly connected to many measuring instruments on the plant. It collects data from these instruments, and periodically prepares and prints instrument log-sheets and other information on automatic typewriters. It uses the information to make complex calculations, which give the best value of control set-points to use in the prevailing conditions. The calculations can involve not only technical considerations but also management ones, such as raw material and processing costs, and product values and production requirements. The calculated control settings can be automatically typed or displayed, for use by the operators, or the computer can be directly connected to the appropriate controller cascade inputs, or control valve positioner, to operate the process quite automatically.

The main computer functions fall into two categories. These are the collection, treatment and presentation of data, and calculations for the control and optimization of the plant.

Automatic Collection, Treatment and Presentation of Data

The computer collects information automatically from process instruments, by means of an electromechanical scanning system, operated by the computer. Each instrument is connected directly to the computer if it gives an electrical output. Instruments with pneumatic output are connected to a pneumatic to electric converter, the output of which is connected to the computer. The computer selects each instrument input in turn, converts the signal to digital form, and makes certain calculations before storing the information.

Functions performed automatically by the computer system in the collection, treatment and presentation of data are given below:

(a) regular instrument scanning,

(b) conversion of each input to digital form,

(c) linearization, scale correction, and conversion of each datum to correct engineering units,

(d) checking each converted datum against permissible upper and lower limits of value,

(e) printing of alarm-limit violations on an automatic typewriter controlled by the computer,

(f) averaging a number of sucessive input data from each instrument, and storing the average for each input in the appropriate location in the computer store,

(g) preparation, and printing on an automatic electric typewriter controlled by the computer, of a process log sheet at regular intervals. This log sheet has printed on it the identification of each instrument, together with the value appropriate to it in engineering units, after treatment as described above,

(h) print-out of special trend-logs on demand, and

(i) extensive engineering calculations for the preparation of reports to assist plant management.

Control and Optimization of Plant Operation

The computer can make complex calculations in order to establish continually the optimum settings for plant controls at all times. These calculations and control actions will result in the plant being operated to achieve one, or some, of a number of possible objectives. Some of these are:

(a) maximum possible operating profit, within the physical limits of the plant,

(b) maximum possible white sugar yield, and

(c) maximum possible operating profit, with a specified white sugar production rate.

Control of the plant to meet these objectives entails:

(a) automatic control and scheduling of pan boiling to produce the right kind of crystals without mistakes,

(b) overall control of levels and flow rates to ensure smooth operation and minimize undesired hold-ups,

(c) minimizing residence time at bottlenecks,

(d) monitoring of characteristics of the liquor at various stages (purity, Brix),

(e) control of throughput with due regard to steam economy, and

(f) minimization of sugar loss.

Use of the System by Plant Personnel

The equipment and computer programmes are designed so that the control system operates automatically, as far as is possible. However, in a comprehensive control system such as this, it is most important that plant operators and management personnel should be able to use the equipment to the best advantage. Some analyses may not be obtainable from automatic sensing devices, so that the results may have to be given to the computer by hand; the operators must be able to demand a print-out of instrument readings as required; it can be valuable if the computer prints information which it has derived; the computer must be instructed if the value of any of the products changes; it must be instructed if the objective of operation changes from a fixed production of sugar, in the most economical way, to maximum possible sugar production.

Fig. 1 illustrates an operator's control panel for the purpose of easy communication between the plant operator and computer and vice-versa.

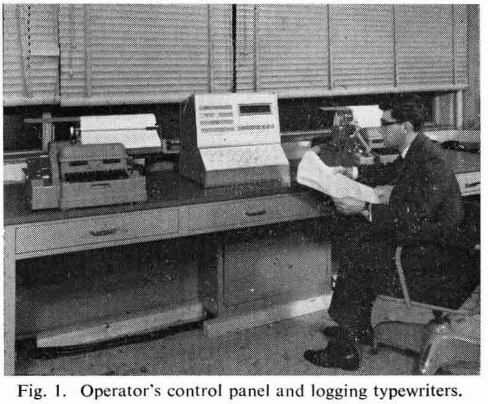


Fig. 1. Operator's control panel and logging typewriters.

TECHNICAL BENEFITS FROM COMPUTER CONTROL

A digital computer control system would provide the following technical benefits:

(1) improved overall operation, resulting from the computer's ability to take into account all relevant instrument readings in deciding a control action and *not* relying on any one measurement, leading to:

(*a*) steadier operating conditions at high throughput rates, and

(*b*) closer matching of individual units to upstream and downstream conditions,

(2) a system of control which takes into account all interactions and time lags,

(3) the flexibility of a computer control system in which control objectives can be readily changed on management directive,

(4) detailed alarm scanning, not only against upper and lower limits but also against rate of change of the parameter,

(5) the ability of the computer to prove instrument readings and check them against others (e.g. by mass or heat balances) to detect instrument errors or failures,

(6) the availability of complete chemical engineering models of pan boiling and other sections as required—these would not only be based on theoretical and design data but would be continually up-dated by the computer to fit the plant data,

(7) the provision of processed data for management, eliminating the necessity for tedious calculations of efficiencies, etc., and

(8) the ease of expansion of a computer system to carry out further functions.

Process Control by Digital Computer

Before discussing some problems of control of sugar manufacture, it is worthwhile comparing computer control with more conventional control methods.

Process control computers can be directly linked to the process and automatically read the relevant data, analyse it with reference to a description of the process under a wide range of conditions, and act upon the decisions made to optimize the plant performance at all times.

To summarize the various types of control:

Under manual control an operator or operators attempt to optimize plant performance subject to human limitations, e.g. lack of information or knowledge, fatigue, inability to cope with a mass of data or perform complex calculations in a short time.

Under automatic control by closed loop instrumentation plant performance may in general be optimized for one fixed set of conditions.

Under computer control, optimization is achieved for a wide range of conditions limited only by such things as maximum plant capacities, hazardous conditions, rate of reaction, etc.

The computer control system is based upon a mathematical description or model of the process. This consists of sets of equations which incorporate the theoretical knowledge of the process with design and operating experience.

It is obvious that initially no such description can be perfect. It is part of the early work after installation of the computer to perfect this model so that it fits the practical data from the particular plant in a particular condition. From time to time the computer will modify the model as equipment alters or plant modifications are made.

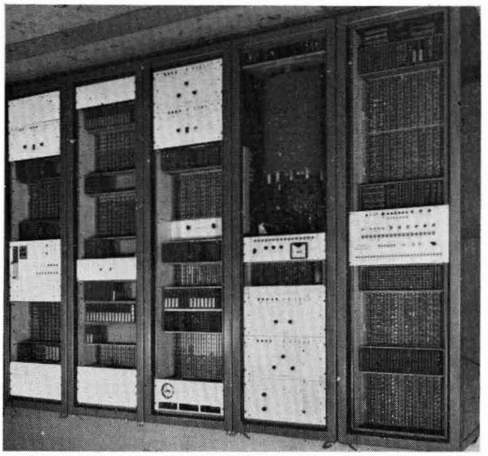


Fig. 2. TRW-330 process control computer

From the early mathematical model, programmes are written so that the computer may take in instrument readings, convert them to a suitable form, carry out the necessary calculations on the data and present results in the required form.

The computer will contain a number of programmes enabling it to optimize plant operation. These programmes will include mathematical descriptions or "models" of various sections, in particular pan boiling, which will be used to predict process performance from a knowledge of input and operating conditions. Also there will be sets of equations giving operating limits of constraints in process operation, a programme to correct the models and keep them up-to-date and a programme to calculate the operating profit for any set of conditions. Finally there will be a programme to calculate the values of plant controls which will result in maximum profit.

Some Control Problems

There are many functions which an on-line computer could advantageously perform in controlling a sugar refinery. Most computer systems are readily expandable and a computer could be installed initially to perform production control to ensure:

(1) smooth operation at all times,

(2) operation of the plant as close as possible to absolute throughput limits at times of high production,

(3) automatic control of pan boiling, which prevents mistakes at a critical stage in production, and provides an essential element in production control, and

(4) control of char washing.

The computer could control the vacuum pans continuously both in the recovery house and white sugar pans and also control rates of throughput throughout the plant, to maintain smooth balanced operation.

It could print out the best settings for length of char starts, Brix required at filtration, length of affination and fine sugar washes and char washing procedures.

We discuss below production control, plant optimization, pan boiling, and char washing.

Production Control

Production control may be considered without interaction with quality control. The system of control needs to start at key points, e.g. initial loading, discharge from the melter, fine liquor flow, concentrated liquor flow, pan capacities and expected boiling times and so on. At these points the rate of throughput or time of discharge are set to obtain the best use of capacity and even flow through the plant under prevailing input conditions; the control equations are chosen by consideration of process times at normal throughput rates. If the process is upset through mechanical breakdown or other mishap the computer would automatically adjust flows, working backwards through the process. This master control can be associated with closed-loop control at individual process stations.

Plant Optimization

The variety in types of raw sugar results in changes in load requirements on different parts of the refinery. Cuban sugars load all parts of the process approximately evenly. Other sugars may require more wash water and thus overload the recovery house, or be difficult to filter, requiring a lower Brix which thus overloads the evaporators or fine sugar pans. There is usually some choice as to what part of the process shall contribute to the achievement of desired quality. Thus if granulated sugar colour is to be improved it is possible to do this by either:

(i) shortening liquor char starts,

(ii) an increase in affination wash,

or (iii) an increase in fine sugar wash.

Each possibility has associated with it at some stage over the process a cost, a time (which may encounter a bottleneck restraint) and a waiting period before it becomes effective.

On the basis of analysis of incoming raw sugar and a given rate, a computer could consider the following possibilities:

(1) Different possible period of affination washes and the associated cost and time of recovery in the recovery house. Each possibility entails a different degree of purification and there is an upper limit set by the time taken in the recovery house.

(2) Different permissible Brix values required for filtration associated with each of the possible conditions in (1). Each again entails a different possible exit condition both in quality and volumetric flow rate.

(3) A range of char starts associated with rates and qualities in (2).

(4) A range of fine sugar washes associated with the values in (3).

The different possibilities to be considered are limited:

(a) by considering only deviations from normal working conditions,

(b) by capacity restraints throughout the process, and

(c) by desired end conditions.

The costs associated with the various combinations can be computed and thus the best combination for changing conditions of input can be ascertained.

The computer would have a stored programme to make this extended optimization calculation. This could be done automatically, or on demand.

It is suggested that the computer should, in the first instance, print out operating guides for process control which take the above considerations into account. Computer output units to control the plant automatically could be added later.

The operators would have printed-out for their guidance the following information:

(i) length of affination wash,

(ii) Brix required at filtration,

(iii) length of char starts, and

(iv) length of fine sugar washes.

Control of pan boiling

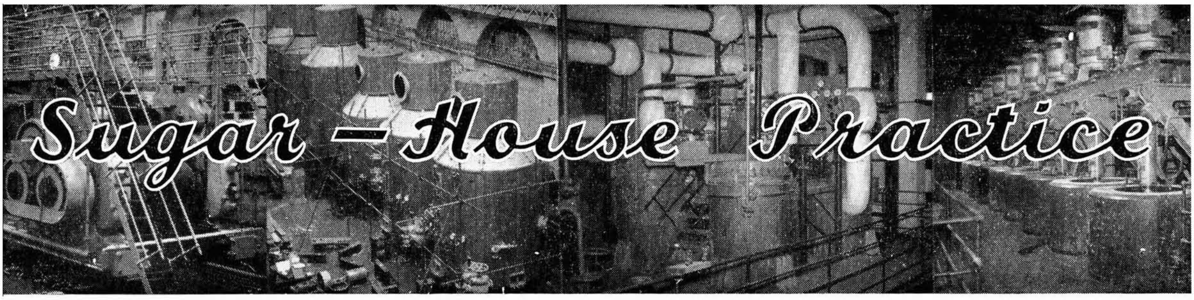
Ideally the rate of feed should be that which, when concentrated to the correct degree of supersaturation, would keep the massecuite just tight. If the feed rate is slow this will loosen the massecuite slightly and reduce supersaturation. If the supersaturation limit is approached before the massecuite tightens boiling is too fast and the vacuum should be lowered. If the massecuite tightens first before the supersaturation limit is reached the feed rate can by increased. If this lowers supersaturation the vacuum can be increased.

Preferably, very close control of both supersaturation and tightness would be done by regulating the rate of feed. The computer would record what it requires the vacuum to do and smooth out its actual response.

The supersaturation limits, which alter as boiling proceeds, can be calculated by the computer from the measurement of impurity levels. Additional information could be gained from the use of both conductivity and boiling point elevation measurements together. These items are both functions of sugar concentration and impurity level and these functions are known in terms of tabulated values. A computer could store these values and determine both supersaturation and impurity levels from the two measurements.

The profile of vacuum control and feed are functions of the rate of crystal growth, which vary for each pan. It is anticipated that for each pan a mathematical model of the crystallization process would be established from the control behaviour of the computer based on feed-back as outlined above.

It is anticipated that control of this nature would avoid mistakes, eliminate the need for "drinks", maximize yield and minimize boiling time.



Exhaustibility of low-grade refinery molasses. Y. Mitsui, K. Mizuya, M. Kamoda and M. Ando. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1964, **14,** 87–93.—Low-grade molasses was evaporated to different non-sugars:water ratios, seeded and kept at various temperatures for 48 hr. When the initial true purity was 45 or 50, the lowest molasses purity was reached with a non-sugars:water ratio of 3·80 and 3·13, respectively, the rate of exhaustion decreasing with higher ratios. The optimum ratio varied with initial true purity. Below 50 purity, the rate of exhaustion increased as the temperature fell; with higher purity the rate rose with higher temperatures. No relationship was found between viscosity and rate of exhaustion at the optimum non-sugars:water ratio, the value of which was also dependent on the origin of the molasses.

* * *

New cooling element for sugar crystallizers. J. Leclézio. *Rev. Agric. Sucr.* (Mauritius), 1964, **43,** 58.—The design and cooling curves are illustrated for a new cooling element, designed by the author and manufactured by Fletcher & Stewart Ltd. A central hollow shaft carries banks of radial pipes connected to header pipes with closed ends. A partition closes the shaft between the end radial pipe and the next, forming a small outlet chamber. The shaft contains a perforated inner shaft into which cooling water is delivered; this passes through the radial pipes, along the headers and into the end pipe and outlet chamber from which it is discharged.

* * *

Technological aspects of the Casa Grande-type cane diffusion tower. J. C. P. Chen. *Sugar J.* (La.), 1964, **26,** (12), 18–19.—A BMA tower diffuser installed at Hacienda Casa Grande in Peru is fed with well-prepared cane which rises against a counter-current of hot water; the wet bagasse (80% moisture) is dewatered by passing through the last mill(s) of one of the tandems (58% moisture after one mill, 49% after two). Overall pol extraction has reached 98% for a rate of 22·8 t.c.h., and diffusion juice is of slightly higher purity than mixed juice from milling (83·58 *vs.* 82·77) although Brix is lower (14·80° *vs.* 17·65°). The bagasse in the tower acts as a filtering medium and tends to remove earth from the juice.

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The "Autocane" system at Cartavio. R. Zubiate and I. Tait. *Sugar J.* (La.), 1964, **26,** (12), 26.—The "Autocane" system of cane carrier control, supplied by Edwards Engineering Corp. to Hacienda Cartavio, Peru, in December 1963, has operated without difficulty, ensuring less fluctuation in cane feed to the crusher, higher carrier speed with a consequently thinner blanket, virtual elimination of knife chokes, less down-time for overloads, and better milling.

* * *

Sugar handling in Peru. F. Proskowetz. *Sugar J.* (La.), 1964, **26,** (12), 27.—Illustrations are provided of new developments under trial in Peruvian sugar plants; they include new low-head pans, bulk shipping of raws, centrifuging of *B*-molasses, and the use of continuous centrifugals.

* * *

Los Mochis makes a comeback. M. Zamora C. and T. B. Fraser. *Sugar y Azúcar*, 1964, **59,** (6), 37–42. An account is given of cane cultivation and sugar production and refining at Los Mochis factory, Mexico, as well as the expansion in progress and planned.

* * *

El Potrero. Anon. *Sugar y Azúcar*, 1964, **59,** (6), 43–44.—A description is given of this Mexican factory-refinery-distillery, its equipment and cane cultivation techniques.

The Application of On-Line Computer Control—*cont.*

Char washing

Washing-off char is sufficiently complicated to benefit from off-line computer control.

The following information would be printed-out in a suitable form as operating guides:

(i) which cisterns are on liquor, syrup, lights or water,

(ii) the rates at which they are receiving throughput, and

(iii) where the liquid coming off should go.

The computer takes into account:

(i) the rate at which the liquor must be processed,

(ii) the Brix of the lights coming off and the profit to be made if they are evaporated, and

(iii) the cost of hot water.

Conclusion

An attempt has been made in the article to show how a digital control computer could overcome some of the difficulties associated with control of the sugar refining process. The applications of digital computers to process control are increasing in number rapidly. Too often, an application is described as too difficult to control, but this difficulty in itself can be a justification for the use of the most powerful tool for process control yet devised.

Tamazula mill maps growth. F. SERNA S. *Sugar y Azúcar*, 1964, **59**, (6), 52–54.—Details are presented of equipment installed at Ingenio Tamazula, Mexico, together with certain milling data for this factory and other Mexican mills.

* * *

Modern design featured at Plan de Ayala mill. ANON. *Sugar y Azúcar*, 1964, **59**, (6), 56–57.—Equipment supplied by Gutehoffnungshütte Sterkrade AG. for this new 5000-ton cane mill, now under construction in Mexico, is described.

* * *

Minimum filtration losses. F. L. BONEM. *Food Processing*, 1962, **23**, (4), 88–90; through *S.I.A.*, 1964, **26**, Abs. 472.—Liquid sugar filtration in Sparkler horizontal-plate pressure filters at the Brookfield terminal[1] of the Great Western Sugar Co. is described. Efficient sweetening-off of the filters is achieved by means of a "scavenger plate" at the bottom of the filter through which the remaining syrup is drained at the end of the cycle. The plates are pre-coated with a syrup slurry of "Fibra-Flo" which is recirculated until a $\frac{1}{8}$-in layer is formed on the filter paper. The scavenger plate is also pre-coated, and its outlet is then closed until the sweetening-off operation. The sweetening-off is completed by circulating hot demineralized water. Total sugar losses are $\sim$0·075%.

* * *

The calorific value of bagasse of a few commercial cane varieties. E. C. VIGNES and M. RANDABEL. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1963, 125–127.—Adequate steam raising had been found difficult in some factories with bagasse from certain varieties but determination of the higher calorific value for eight varieties showed these all to be similar. Thus, for bagasse of the same moisture and pol content, the heat available should be the same. The subject has been studied by other workers, and it has been shown that bagasse with a large proportion of fines or fibre "dust" resulting from thin parenchyma cells and cane with a high proportion of pith cells retained more water and did not burn completely.

* * *

Power consumption of C-massecuite crystallizers. F. LE GUEN and J. DUPONT DE R. DE ST. ANTOINE. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1963, 127–131. A study was made of the main factors affecting the power requirements of Fletcher-Blanchard crystallizers at Riche-en-Eau factory. A recording wattmeter was used to measure power consumption and samples of massecuite and molasses were analysed for Brix, massecuite crystal content and consistency, and molasses viscosity. Massecuite characteristics affected power consumption only slightly, the 7·5 h.p. motor having ample power reserve for rotating the elements (at $\frac{1}{8}$ r.p.m.) in the 1200 cu.ft. crystallizer. Power requirement when empty was as much as 80% of that when the crystallizer was full, there being considerable loss in the motor and gearing. During discharge, power fluctuations arose as the element left and re-entered the massecuite. With viscous massecuites the power increased at times during discharge to 3 times that when the crystallizer was full. The fluctuations arose from the S-shape of the elements and were absent in the case of disc and radial elements. If stirring was discontinued during discharge, a 5 h.p. motor would be sufficient.

* * *

Automatic regulation of magma crystal content. H. F. WIEHE. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1963, 131–134.—The after-worker *C*-sugar centrifugal at Riche-en-Eau factory was equipped with an automatic syrup doser to yield a magma of regular consistency, in order to give a uniform footing for *A* and *B* strikes. Syrup is delivered to a tank fitted with a level control and this tank discharged to a mingler through a valve operated by the centrifugal plough mechanism, with secondary controls to govern the flow as well as provide a delay to allow proper mixing of sugar and syrup. When the centrifugal reaches high speed again, the syrup tank is refilled. The automatic equipment reduced the variation in magma crystal content to a maximum of 3·7% on Brix compared with 17·3%.

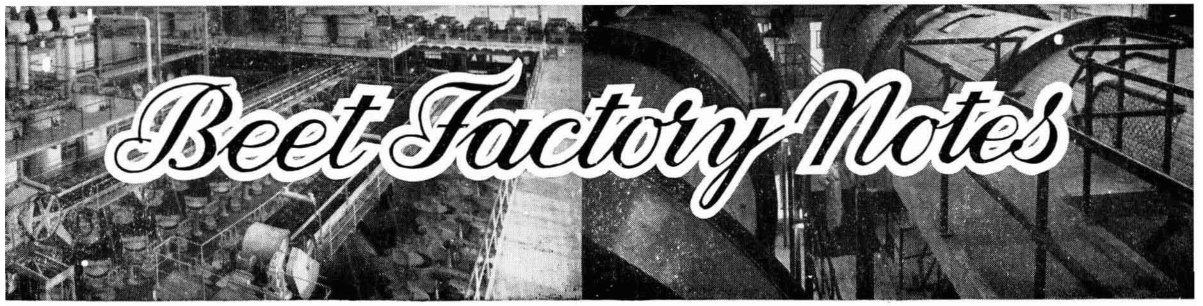
* * *

Brief survey of the work of (USSR) refineries and refining sections in 1963. A. E. GUSEV and I. F. ZELIKMAN. *Sakhar. Prom.*, 1964, **38**, 487–491.—Tabulated data for beet raws intended for refining show that generally the colour was lower and the moisture and reducing sugars contents higher than the permissible levels. In some cases, the refinery liquor had a higher colour content than the original beet sugar, while the reducing sugars contents were particularly high; this was due to the poor quality of recycled products. The use of adsorbents, and particularly AGS-3 granular carbon, is discussed. The low decolorizing power of bone char in Soviet refineries is attributed to inefficient regeneration. The moisture content of raffinade and granulated sugar are tabulated and information given on granulated sugar yields and sugar losses at some refineries.

* * *

Storage and affination of cane raw sugar. S. V. DYKHNE and A. YU. ZUBOV. *Sakhar. Prom.*, 1964, **38**, 498–503.—An automatic bulk raw sugar storage scheme, based on experience outside the USSR, is described, which makes provision for the handling of bagged sugar. Sugar unloaded from rail trucks is screened, crushed and weighed before transference by belt conveyor either to the warehouse or directly to the affination section. Reclaimed sugar passes over a screen beneath which is a special vibratory feeder (which is described in detail) delivering via a belt conveyor beneath the warehouse and an elevator to affination. Information is given on the automatically controlled affination scheme, and water and steam consumption are briefly discussed. The scheme is based on a storage capacity of 10,000 tons and an affination throughput of 250–400 tons of sugar per day.

[1] *I.S.J.*, 1960, **62**, 351.



Beet sugar wastes and their treatment: the Findlay (flume and condenser water) system. S. L. FORCE. *Eng. Bull. Purdue Univ.*, 1963, **47**, (2), 116–125; through *S.I.A.*, 1964, **26**, Abs. 307.—Condenser waters and flume-wash waters operate in a closed cycle in which the former supply the flumes and the latter are purified in a de-gritting hydrocyclone, vibrating screens and two Dorr clarifiers. The clarified water is pumped to a spray pond from which the cooled water returns via an excess water pond (for buffer capacity) to the main tanks supplying the condensers. Carbonatation muds and sludge from the clarifiers are stored in separate ponds. Water from the ponds is discharged in early summer (when the B.O.D. is relatively low) to the municipal sewage plant. A plan and a detailed flow diagram of the system at Findlay, Ohio, are reproduced.

* * *

Beet juice purification at reduced temperature. V. TIBENSKÝ. *Listy Cukr.*, 1964, **80**, 110–113.—A test plant has operated successfully for 3 campaigns in continuous carbonatation of beet juice at 50°C. In the scheme, raw juice is mixed with a large excess of re-circulated 1st carbonatation juice and is pre-limed to 0·1–0·2% CaO. It is then gassed with CO_2 to an alkalinity of 0·01–0·05% CaO and a large portion of the juice re-cycled. The remaining portion is limed to optimum alkalinity before filtering. The total amount of milk-of-lime added is 1·5% CaO. Average time for the process is 10–15 min. Filtration and settling data are tabulated showing improvement on the existing conventional carbonatation process at 80°C without recirculation. The filtered juice was clear and light in colour; the resultant thin juice had an average colour content of 5·0°St/100°Bx. Replacement of existing pre-defecation with the new method is recommended.

* * *

Drying of beet pulp in Škoda dryers. M. ŠKRÁBAL. *Listy Cukr.*, 1964, **80**, 113–120.—A detailed description is given of Škoda equipment for beet pulp drying and briquetting and mixing with 10% molasses where required for animal fodder. The efficiency and economics of the processes are discussed.

* * *

Are there still some unexplored ways of improving juice purification? G. QUENTIN. *Zucker*, 1964, **17**, 336–339.—The economic effects of some measures in juice purification are compared and possible ways in which to improve efficiency are discussed. Details are given of a scheme tested at Novi Sad (Yugoslavia) which has given satisfactory results and in which decanting and filtering of the mud presents no difficulties even when poor quality beet are processed. The mud from the final saturation, containing about two-thirds of the total calcium, is added to raw juice and the pH raised to 8·5. The juice-mud mixture is heated and treated by so-called "precipitation saturation" (defeco-saturation) in a vessel which is separated into two chambers by a suspended inner chamber. In the outer chamber the normal 1st carbonatation pH is maintained, while the juice in the inner chamber is over-saturated. Fresh juice is fed together with re-circulated juice into the bottom of the inner chamber, while juice is withdrawn from the bottom of the vessel. Lime (about one-third of the total) is added at the top of the inner chamber in the form of limed clear juice. The juice is then settled, the thick mud going to rotary filters, while the clear juice and filtrate are mixed and limed. About one-third of this juice is then returned to defeco-saturation. The remainder is heated and treated by so-called "adsorption saturation" where a pH of 11 is maintained. This juice is then treated by final saturation where it is adjusted to the usual 2nd carbonatation pH. It is then settled, the mud being returned to raw juice and the clear juice filtered. The advantages of the scheme, which is to be used in an Austrian sugar factory, are discussed.

* * *

Nomogram for determining the reduced length of a beet cossette and its F factor. A. K. BURYMA. *Sakhar. Prom.*, 1964, **38**, 420–424.—By "reduced" is meant that length of a cossette of uniform thickness and profile, 100 g of which has the same diffusion surface and cossette factor as a factory cossette. A technique and a nomogram are described for calculating the reduced length and F factor and hence the diffusion losses.

* * *

Operation of an ERV automatic regulator for water supply to a diffuser. I. I. LAZAREVICH. *Sakhar. Prom.*, 1964, **38**, 428–431.—The scheme described consists of flowmeters for condenser and press water, a reference input element (adjusted manually according to cossette feed) and an ERV automatic regulator. All the available press water is used and the level of total diffusion water is regulated by varying the condenser water feed. This is brought about automatically by a signal equivalent to the difference between actual and required water levels.

* * *

Pre-cleaning beet en route from piles to process. V. A. NOVIKOV, N. M. KICHIGIN, V. S. YATSENKO and V. I. VASIL'EV. *Sakhar. Prom.*, 1964, **38**, 431–434. A special system for removing soil, etc. from stored beet en route to processing is described. It comprises a hopper into which the beet are fed from the pile by grabs or dumper trucks. The beet fall from the hopper onto an endless chain conveyor, pass over a vibratory screen and then via an adjustable conveyor to a road truck or into the flume; the impurities are thrown clear of the device by another conveyor.

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Determining molasses (quantity) in storage tanks. A. A. DULOV. *Sakhar. Prom.*, 1964, **38**, 435–436. A gauge stick graduated in cm and consisting of three sections screwed together is housed in a 150-mm dia. pipe fixed to the wall of a molasses tank and running from the top to near the bottom. The quantity is then determined from the indicated level. Other modifications to tanks and molasses feed lines, e.g. to facilitate s.g. measurements and prevent foaming, are described.

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Recent information on sugar beet storage. P. A. GUMENCHUK and D. S. KOBLAI. *Sakhar. Prom.*, 1964, **38**, 442–446.—Beet stored for up to 66 days in uncovered piles sprayed with lime solution (10–12 g of lime per litre of water) generally showed lower sugar losses than did beet stored in piles, the sides and top of which were protected with earth and mats of rushes or straw. The number of withered and mouldy beet was also lower in the uncovered piles.

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Determining the thickness of insulating covers of (beet) piles. A. M. KHELEMSKII. *Sakhar. Prom.*, 1964, **38**, 446–451.—The thermal characteristics of stored beet are discussed, whereby it is shown that three zones exist in the cross-section of a trapezoidal pile; the temperature increases with height in the central zone (the rectangle formed by dropping perpendiculars from the ends of the top surface) while in the other two zones (the end triangles) the temperature remains unaltered with height. A nomogram is presented for calculating the thickness of insulating layers where the height:width ratio is 1:3 or 1:5 and for different heights and temperatures. A worked example is also given.

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The carbonatation vessel at Kamenskii sugar factory. A. D. BAGLYUK. *Sakhar. Prom.*, 1964, **38**, 452–453. Above the top of three screens placed at regular intervals in the lower section of the carbonatation vessel two grids with longitudinal bars are located at right angles to each other with a gap between, so that the plan view is of a chequered screen. This prevents blockage of the usual top screen with juice muds.

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The application of methods of mathematical statistics in the sugar industry. K. VUKOV. *Cukoripar*, 1964, **17**, 129–133.—A review is presented of the basic concepts of statistical mathematics with descriptions of some methods and their use in the sugar industry. Also considered are the correct choice of samples, the most effective experimental techniques and the avoidance of erroneous conclusions.

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Pulp pressing with a Stord press. M. CZIRFUSZ. *Cukoripar*, 1964, **17**, 134–137.—A description is given of the five types of Stord beet pulp press with information on their operation and including performance data showing the pulp moisture content after pressing with or without preliminary pressing and/or without heating.

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Water economies in East German sugar factories. F. KASTNER. *Listy Cukr.*, 1964, **80**, 150–156.—Details are given of the water schemes in four East German beet sugar factories (Salzwedel, Goldbeck, Wöferlingen and Walschleben) and suggestions are offered whereby the experience of these factories can best be utilized.

* * *

Flow and friction during sugar manufacture. B. BRUKNER. *Zucker*, 1964, **17**, 360–365.—The shape and dimensions of beet flumes and their gradients and water flow velocities are discussed. To minimize friction, and hence increase beet flow, the flume walls should be vertical and the bottom flat. The depth should equal half the width. With smooth walls and optimal dimensions, the optimal velocity of 1 m/sec (sufficient to carry stones and sand with the beet) is attainable at a gradient of 1:50, although it is recommended that the first section of the flume should be of steeper gradient to provide initial acceleration. Large stones should be extracted from the flume as quickly as possible and one side of the flume should be deepened for this purpose. Baffle plates to steer the stones to a discharge port are not recommended. Water added to stone catchers raises the water level in the flume after the catchers and reduces the flow rate so that either the flume should be widened after the catchers or the excess water pumped away. Conventional trash catchers also reduce the flow rate and remove only part of the trash, which should be separated on the basis of the differences in the settling rate of beet and trash (this is preferable to a method based on differences in the density of beet and impurities, particularly in the case of coke). Means of raising the beet from the bottom of the pit in such a trash catcher are discussed. Beet washing with jet sprays is recommended. Preliming muds should be separated from the juice in centrifuges and Raschig rings are recommended for entrainment separation in evaporators. Vapour flow should be directed to these by baffle plates. Highly efficient continuous pulp presses using hydraulic pressure are considered feasible. Comparison of presses on the basis of the absolute water content of pressed pulp should be replaced by comparison on the basis of the relative water content. The flow in vacuum pans should be measured by determining the Reynolds number, thus giving fair comparison when determining the effects of mechanical stirrers.

NEW BOOKS AND BULLETINS

Bibliography (1912-1963). 102 pp; 8 × 10 in. (Sugar Cane Breeding Institute, Coimbatore-7, South India.) 1964.

This bibliography, in mimeograph form, of published work from Coimbatore for the fifty years after its inception in 1912, was prepared in connexion with the Golden Jubilee of the Institute in 1962. For various reasons its appearance was delayed and it has now been issued, brought up to date as far as the end of 1963. The hope is expressed that it may be a useful compilation for those interested in sugar cane breeding, as doubtless it will be. It is divided into seven sections: breeding, botany, cytogenetics, physiology, chemistry, plant pathology, and entomology, altogether 348 papers being covered. Brief descriptions or summaries of each paper are given, usually of half-a-dozen to a dozen lines in length.

F.N.H.

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F. A. O. Commodity Review, 1964. 141 pp; 8½ × 11 in. (Food & Agriculture Organization of the United Nations, Rome, Italy.) 1964. Price: 15s 0d.

This publication is one of a regular series of annual commodity reviews prepared in the Commodities Division of F.A.O's Department of Economic and Social Affairs. Part I is a general review containing a summary of developments in international commodity markets during 1963 and early 1964 and of international agreements and commodity consultations. Part II is a brief account of the outcome of the U.N. Conference of Trade and Development which took place in Geneva from 23rd March to 16th June 1964. Part III consists of a series of chapters analysing the current situation and outlook for all of the major agricultural commodities.

The section on sugar contains data on the supply and distribution of centrifugal sugar from 1960/61 to 1963/64 with the averages for the period 1955/56–1959/60. The situation with respect to cane and beet sugar production in 1963/64 and world sugar prices are surveyed as well as the decline in world sugar trade in 1963. The halt in the annual expansion of world sugar consumption in 1963 is recorded and the prospects of increased world sugar production in 1964/65 are briefly discussed.

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How to Improve your Cane Production—A Guide for the Sugar Cane Grower. 14 pp.; 8 × 12½ in. (South African Sugar Association Experiment Station, Mount Edgecombe, Natal, South Africa.) 1964.

This publication (in mimeographed form except for the title page) should fulfil its function of assisting the South African cane grower for it contains a wealth of information. Most of this has been acquired as a result of experimentation and covers the varied climatic and soil conditions that prevail. There are sections on planting, fertilization, weeding, irrigation and harvesting.

In the foreword it is stated that a comprehensive guide to sugar cane farming in Natal is at present being compiled by staff at the Experiment Station. In this, current practices in various parts of the South African sugar belt are to be reviewed in relation to recent research findings and to advances in other forms of agriculture.

F.N.H.

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Weed Control. Ed. E. K. Woodford and S. A. Evans. 356 pp.; 5½ × 8½ in. (British Weed Control Council; Blackwell Scientific Publications, Oxford.) 1963. Price: 21s 0d.

The third edition of this very useful book[1] has now appeared. Chemical weed control is a rapidly developing science with hew herbicides constantly appearing. It is not surprising therefore that the book should contain a great deal of new matter which is not in the earlier editions and that it should have increased in size by 92 pages. Nevertheless the price remains very reasonable under presentday conditions. It might well be described as an essential handbook or reference work for all those concerned in any way with weeds and chemical weed control, being well written and authoritative. One of the useful features of the book is the appendix consisting of an alphabetical list of the common names and chemical abbreviations of modern herbicides.

The book deals primarily with conditions as they are in the United Kingdom, separate crops or groups of cultivated plants being dealt with separately in the earlier chapters. Sugar beet is one of them (pp. 51–54). Sugar cane, being a tropical crop, is not dealt with specifically, but much of the general information in the handbook is likely to be of value to those concerned with weed control in sugar cane.

F. N. H.

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Mechanized Sugar Cane Production. Conference Report. 76 pp.; 8½ × 11 in. (Massey-Ferguson (Export) Ltd., Banner Lane, Coventry, Warwicks.) 1964. Price: 25s 0d.

This is the printed record of the Conference held in August 1964 and concerned with mechanized cane agriculture with particular reference to harvesting[2]. Some of the papers have been reproduced in full in our pages and others summarized. Here they are all presented, together with the discussions arising from them, and a series of illustrations featuring the Massey-Ferguson cane cultivation equipment in action. The Report is available as a Spanish translation.

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[1] *I.S.J.*, 1961, **63**, 153.

[2] *I.S.J.*, 1964, **66**, 291–293.

LABORATORY METHODS AND CHEMICAL REPORTS

The press method of cane analysis. T. TANIMOTO. *Hawaiian Planters' Record*, 1964, **57**, 133–150.—A method of analysis applicable to small samples has been developed and applied in the Physiology and Biochemistry Department of the Experiment Station, H.S.P.A. About 4 lb of cane as a sample (minimum 600 g) is chopped in a Buffalo chopper, mixed and, if necessary, frozen in 800 g aliquots for keeping without deterioration. After defrosting, 600 g is weighed and pressed at 10,000 p.s.i. in a Carver screw press. The pressure is maintained at this level until no more juice is expressed and the residue weighed, dried and reweighed, while the juice is analysed. Examples are given showing comparative values by the press method and analysing for sugars, a technique for which is described.

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Sugar micro-determination by direct colorimetry of ferricyanide. T. TANIMOTO and G. O. BURR. *Hawaiian Planters' Record*, 1964, **57**, 151–158.—A rapid, accurate method, sensitive to less than 1μg of reducing sugars, is described; it is useful for e.g. analysis of leaf extracts, blood sugars, etc. The extract from about 1 g of leaf is clarified with lead acetate or Somogyi reagent, treated with 200 mg active carbon, diluted to 100 ml, shaken at intervals during 15 min and filtered. The filtrate is adjusted to contain less than 80 μg reducing sugar per ml by dilution. To 2 ml of filtrate is added 5 ml of 0·001 N alkaline ferricyanide (made by diluting 2 ml of 0·05N potassium ferricyanide to 100 ml with 1·0N Na_2CO_3 solution) and the mixture heated at 100°C for 15 min or 80°C for 25 min in glass marble-closed tubes to reduce evaporation. After cooling in a running tap water bath for 4 min, the excess unreduced ferricyanide is determined with a spectrophotometer or photoelectric colorimeter at 420 mμ.

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Browning of refined soft sugar. II. S. SHINADA and M. MIZUSHIMA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1964, **14**, 1–11.—Nine brands of refined soft sugar were stored at various temperatures and relative humidities. Some turned brown in 1–2 weeks at 45°C and 80% R.H. and in 3 weeks at 10°C and 60% R.H. At 20°C they turned brown most easily at 60–70% R.H. (especially when exposed to the atmosphere), but were harder to brown at higher R.H. values. Over 20°C browning was more rapid when sealed tight from the atmosphere. Under 20°C soft sugar turned brown where the surface was in contact with air; over 20°C browning took place throughout the sample; thus two processes are presumed to exist, one oxidative and the other non-oxidative. Matter separated from strongly basic anion exchange resin was found to accelerate browning of heated sugar solutions and of refined soft sugar in storage. The browned sugars were extracted with methanol and butanol. Paper chromatography of the methanol extract separated four sugars which were not identified; the butanol yielded, besides sucrose, glucose and fructose, three other spots of R_g 4·60, 3·59 and 2·29. The first of these unknowns was identified as 5-hydroxy-methylfurfural, present to the extent of 0·3–5·4 p.p.m.

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Floc and saponin of beet sugars. T. SHIGA, H. OKUYAMA and N. NOSAKA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1964, **14**, 12–24.—A floc test was developed in which 2·5% v/v of a 0·1% solution of "Amidol" (2,4-diaminophenol hydrochloride) is added to a sucrose solution of $\not>$ 20% concentration, and of pH approximately 3. The solution is heated for 30 min at 80–90°C and allowed to stand 48 hr, when floc formation is investigated. Saponin was determined in beet peelings (0·057%) and crown core (0·012%). The lower section of the peeled roots contained twice as much saponin as the upper and middle sections. Saponin was extracted from peelings with alkaline hot water and a yield of 0·34–0·65% was obtained having a haemolytic potency of 40–65γ/ml (+). The best yield of saponin from 1st carbonatation lime cake was obtained by dissolving the $CaCO_3$ with HCl, when a 0·45% yield of 5 γ/ml (+) material was obtained. Saponin in beet molasses is about 10% of that in root peelings. It could best be purified by chromatography on a "Sephadex" column and had a maximum potency of 5 γ/ml (+), m.p. 203–210°C and pol $[\alpha]_D^{24}$ of +36·9. Characteristic wave numbers of infra-red absorption spectra of saponin and oleanolic acid were the same, and hydrolysis of beet saponin yielded glucuronic acid, glucose and arabinose. Complete removal of floc materials from beet sugar could be achieved using anion exchange resins.

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One intermediate in the browning reaction of sugar solution. F. ONDA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1964, **14**, 25–31.—To samples of sugar and process liquor was added 2,4-dinitrophenylhydrazine reagent and, after 24 hr, the resulting precipitate was filtered, washed with 2N HCl and with 50% ethanol. It was dissolved in 70 ml ethyl acetate, dehydrated with Na_2SO_4, and chromatographed on an alumina column. The column was washed with ethyl acetate and 19:1 ethyl acetate: ethanol, and eluted with 7:3 ethyl acetate:ethanol. The eluate was concentrated under vacuum below 40°C, crystallized and the product [the bis-2,4-dinitriphenylhydrazone of 3-deoxy-D-glucosone (3-D-G)] dried and weighed. The concentration of 3-D-G varied from 7·16 mg % solids in beet raw sugar and 8·82 mg % in cane raws to 17·03 mg % in beet molasses, 36·73 mg % in cane molasses and 43·14 mg % in refinery molasses. Heating of glucose with glycine produced parallel rises in colour and 3-D-G formation, this also occurring with an affined sugar solution. The material is therefore considered to play an important rôle in browning.

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Sucrose stability and the characteristic of viscosity of low-grade refinery molasses. R. KIUCHI, M. KAMODA and M. ANDO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1964, **14**, 76–86.—Solubility of sucrose in refinery low-grade molasses resulting from raws of different origins was determined and shown to vary one from the other (Australian highest and Cuban lowest), all differing from the values of THIEME, LINDEN *et al.* and GILLETT. No clear relationship was found between solubility and the invert:ash ratio. Viscosity measurements on refinery molasses gave values similar to those of cane molasses in the literature; however, Natal molasses was 2½ times as viscous as that from Taiwan, while Australian molasses was 1½ times as viscous. It is concluded that Australian and Natal molasses is more difficult to exhaust than Cuban or Taiwan molasses.

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Malformation of the sucrose crystal in the presence of sucrose stearate. M. TESHIROGI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1964, **14**, 95–101.—An illustrated account is given of the phenomenon whereby "flower"-like crystals, with readily detached "petals" or flakes, were formed when 1, 3 and 5% of sucrose stearate was added to sucrose solutions of unstated supersaturation.

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Determination of free or combined hydrogen sulphide in sugar factory waste waters. A. LEMAITRE and M. F. BARDOUX. *Sucr. Franç.*, 1964, **105**, 159–161.—Techniques are described in detail for determination of free and combined H_2S by entrainment in a CO_2 stream and adsorption in a Zn or Cd solution to give an insoluble sulphide. The sulphur in the precipitate is determined by iodometry or by colorimetry, the latter using ferric chloride and *p*-aminodimethyl aniline to give methylene blue. Two alternative methods to determine the Cd in a CdS precipitate by complexometric techniques are also described in detail.

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Determination of sucrose in cane juice by the Jackson & Gillis No. 4 and invertase methods. L. P. LECLÉZIO and V. OLIVIER. *Rev. Agric. Sucr.* (Mauritius),1964, **43**, 59–60.—Comparative analyses were made of mixed juice samples using the Jackson & Gillis No. 4 method, the "rapid" invertase method (at 57–58°C) and "overnight" invertase method. The laboratory ambient temperature was 25–29°C, and direct and Clerget polarization were measured at this temperature. The average difference between the Jackson & Gillis and "rapid" invertase methods was 0·03 and 0·06% sucrose for different periods, while the difference between the "rapid" and "overnight" invertase methods averaged 0·03%. It is thought that the Jackson & Gillis method is preferable for industrial purposes since it is less subject to error than the invertase method. The need to control laboratory temperatures at about 20°C is also emphasized.

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Study of white sugar as an example of quality control. A. EMMERICH. *Starke*, 1963, **15**, 387–393; through *J. Sci. Food Agric. Abs.*, 1964, **15**, i–324.—Because the purity of the white sugar of commerce usually exceeds 99·9% and because the proportion of each impurity (water, organic and inorganic matter) is ~0·1%, conventional methods of quality control are not by themselves adequate. Special methods (examination of appearance, colour, turbidity of aqueous solutions and their capability to yield foam, size of crystals, etc.) used in West Germany, where statutory price is related to quality, and in England are discussed.

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Oxidation of carbohydrates. II. Synthesis of glucosaccharic acid from sucrose. K. S. CHIA and C. C. LIN. *Chemistry* (Taiwan), 1962, 98–104; through *S.I.A.*, 1964, **26**, Abs. 526.—The oxidation of sucrose, glucose or starch to glucosaccharic acid by HNO_3 was investigated. A maximum yield of 28·6% of potassium hydrogen glucosaccharate from sucrose was obtained with sodium vanadate as catalyst after 5 hr at 60°C. The corresponding yield of oxalic acid was ~31%. In the absence of vanadate the maximum yield of glucosaccharate was 24·3% from sucrose (after 15 hr at 85°C) compared with 46·8% from glucose and 44·0% from starch. The corresponding yield of oxalic acid from sucrose was ~12%, but could be increased by increasing the amount of HNO_3 above 30% on sucrose, at which glucosaccharate formation was a maximum. Oxalic acid formation from glucose or starch was ~12%. An improved procedure for converting glucose into glucosaccharate at 56·3% yield is described.

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Examination of raw sugar quality with respect to the affination process. M. ATHENSTEDT. *Zeitsch. Zuckerind.*, 1964, **89**, 320–321.—A method for predicting the quality of affined sugar obtainable from a given raw sugar is described. Based on that of SPENGLER & BRENDEL[1], the method consists in making up an artificial massecuite from 45 g of raw sugar and 25 ml of refined sugar solution (the latter previously heated to 60°C, cooled and saturated at 20°C) and spinning in a 4500-r.p.m. laboratory centrifuge. After 1½ minutes' spinning, 10 ml of wash water is added to the centre of the basket. The resultant sugar is then tested for ash (conventional conductivity measurement after dissolving 5 g of sugar in 100 ml of water) and the reading adjusted to 20°C by correcting by 2·3% per °C. The colour of a 10% solution adjusted to pH 7·0 is measured with a Lange colorimeter at 546 mμ, the extinction coefficient as obtained being converted to °St. Reproducibility of the method is ± 2–3%.

[1] *Zeitsch. Ver. Deutsch. Zuckerind.*, 1927, **77**, Techn. T. 229.

BY-PRODUCTS

A review on the industrial utilization of sugar and sugar by-products. R. R. COVAR and Y. V. IMPOROGO. *Sugar News* (Philippines), 1964, **40,** 73–75.—A brief survey is presented of the by-products obtainable from sucrose, molasses, filter-cake, bagasse and cane.

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Condensation products of polyhydric alcohols with carboxylic acids: esters from sucrose and long-chain fatty acids. B. F. WONG and C. YANG. *Chemistry* (Taiwan), 1962, 105–110; through *S.I.A.*, 1964, **26,** Abs. 525.—The optimum conditions for the Osipow reaction were investigated. A high conversion (>80%) of methyl ester to sucrose monoester is obtained with three moles of sucrose per mole of methyl ester and 0·3 mole of alkaline catalyst (K_2CO_3 is superior to KOH or NaOH). The reaction rate and monoester content decrease with increasing chain length of the fatty acid.

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Isolating potassium from vinasse and Steffen alkali in the form of K_2SO_4,$CaSO_4$. V. I. CHOPIK. *Sakhar. Prom.*, 1964, **38,** 425–428.—Tests are reported on the isolation of the double salt from vinasse and Steffen waste, in which sulphuric acid and gypsum are added and the resultant precipitate treated with water to separate the gypsum from the K_2SO_4 which is then concentrated and used as fertilizer, while the residual solids may be used in animal fodder.

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Dextran biosynthesis for the production of blood plasma substitute. I. Isolation of the micro-organism from sugar beet. A. VAVRA and I. VAVRA. *Zeitsch. Zuckerind.*, 1964, **89,** 315–319.—Tests are described in which bacteria of the *Leuconostoc* genus were isolated from beet press juice and allowed to ferment to form a type of dextran which is suitable for elaboration to clinical dextran. Yields varied from 14 to 26% on sucrose used and the dextran contained from 89 to 96% α-1,6-bonds. Solubility of the dextran ranged from good to excellent.

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The use of protein in cane juice as an animal feed. D. H. PARISH. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1963, 147–150.—Trials with feeding rations containing dried muds to sheep and cattle showed that their digestibility was low and their protein content was not an accurate guide to their feeding value. Possible causes are suggested.

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The amino-acid composition of the hot water-insoluble nitrogen fraction of cane leaves, cane juice and factory filter muds. D. H. PARISH. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1963, 151–153.—Amino acids produced by hydrolysis of the three types of material were analysed by the method of MOORE & STEIN[1] and shown to be virtually identical.

Wet process for extracting crude sugarcane wax. C. S. CHANG. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (34), 135–146.—Optimum conditions for extraction of crude wax from fresh Oliver filter-cake with benzene were determined. The wet cake containing 55–60% of water and about 38% bagacillo on dry matter can be extracted with a reliable recovery of 96–97%; the study has provided data for establishing a pilot plant process.

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Production of α-cellulose from bagasse by a nitric acid method. Some aspects of the problem of acid recovery. I. General quantitative relations between the variables affecting the acid recovery. J. GUERRA. *Nuestra Ind. Rev. Tecnol.*, 1963, **1,** 3–12; through *S.I.A.*, 1964, **26,** Abs. 376.—Mass balance calculations are carried out on the initial phase of acid treatment and recovery, for the design of a pilot plant. Typically, 111 parts of dried sieved bagasse (containing 11 parts of water) are mingled with nitrating acid containing 184 parts of water and 105 parts of HNO_3, the excess acid being expressed in two twin-roll mills with 33 parts of imbibition water before the second mill and re-used. A general formula and graph are given relating the bagasse initial moisture, mill extraction coefficient and HNO_3 losses in the pressed product: a consumption of 30% of HNO_3 (35% solution) on dry α-cellulose should be possible, assuming a 37% yield of α-cellulose on dry bagasse.

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Submerged citric acid fermentation of beet molasses in tank-type fermenters. D. S. CLARK and C. P. LENTZ. *Biotechnol. Bioeng.*, 1963, **5,** 193–199; through *J. Agric. Food Sci. Abs.*, 1964, **15,** ii–39.—Citric acid was obtained from ferrocyanide-treated molasses in fully baffled, mechanically agitated 2·5-litre glass tank fermenters, with a pellet-type inoculum prepared by incubation of *Aspergillus niger* in mash in shake flasks. 70% conversion of available sugar was achieved in 140 hr with a stirrer speed of 400–700 r.p.m. and sparging using medium porosity sintered disc. Aeration conditions, as judged by sulphite oxidation and mash viscosity, have less effect on citric acid yield than was previously thought.

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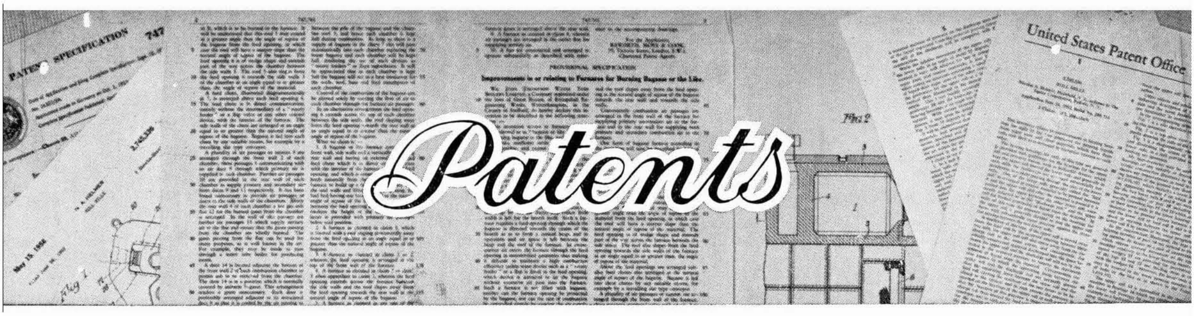
Brief review of the progress of industrialization of sugar cane by-products. J. ACOSTA C. *Bol. Azuc. Mex.*, 1964, (179), 8–16.—Based on a study of by-products utlization in a number of cane-growing countries, the importance to Mexico of utilizing bagasse for paper products, etc., and of molasses for yeast production (as a cheap source of protein), for animal fodder and for alcohol production, is emphasized.

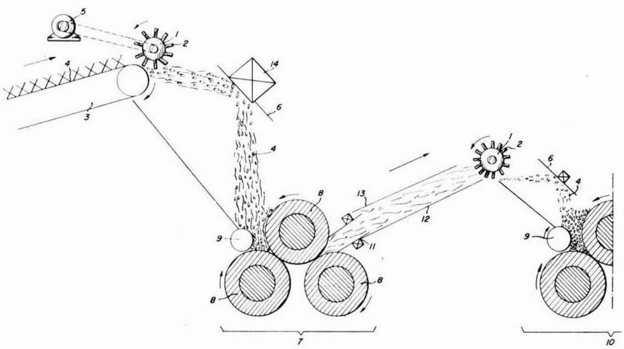
[1] *J. Biol. Chem.*, 1951, **192,** 663–681.



UNITED STATES

Conveyor device for feeding sugar cane in a mill train. P. R. PAYET, of Combuston, Réunion. **3,120,173.** 3rd May 1960; 4th February 1964.

Prepared cane 4 rises along conveyor 3 and is projected by the blades 2 of rotor 1, driven by motor



5, along an aerial trajectory to deflector 6 which directs it to the intake of the mill 7, this intake having a feed roller 9. A similar unit may be provided so that cane leaving the first mill is directed by rotor and deflector into the feed opening of the subsequent mill 10. The device imparts a velocity to the cane feed independent of that of the mill rollers and aids in ramming cane into the mill. Further, by incorporating a magnet 14 behind the deflector 6, tramp iron may be separated from the feed to the mills.

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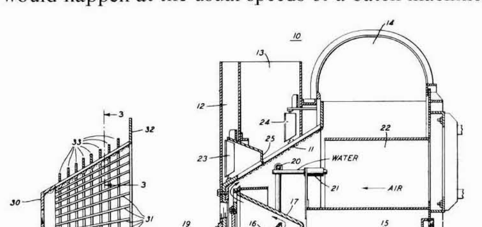
Centrifugal machine basket. A. H. MCPHEE and T. H. REID, *assrs.* HEPWORTH MACHINE COMPANY INC., of Long Island City, N.Y., U.S.A. **3,123,557.** 8th September 1959; 3rd March 1964.

The continuous centrifugal 10 has three stationary housings 12, 13 and 14, and a frustro-conical basket 11. Massecuite is supplied by screw 15, which has a water jacket 18 to maintain a suitable temperature, and is delivered into the acceleration cone 16. It follows the directions of the arrows, being distributed evenly by cone 17 to the base of basket 11 up which it travels, sugar being discharged into housing 14. Suitable driving means are provided for rotating the screw 15, cones 16 and 17 and basket 11. Syrup separates from the crystals in the first part of the basket and is discharged into housing 12, while wash water is supplied through nozzles 20 and passes over the sugar layer and into housing 13. In order to aid the separation, air is supplied to the interior of the basket from chamber 22, while vanes 23, 24 attached to the outside of the basket create an additional pressure difference.

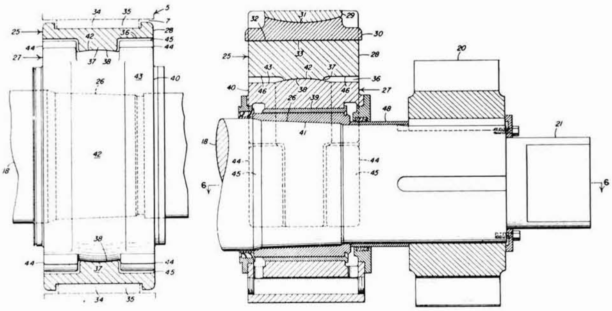
The relatively low speed of the basket (600 r.p.m.) compared with that of batch machines permits its construction to be simpler while having adequate strength. It comprises a metal end or hub member 30 to which are attached spaced ribs 31 extending to the end member 32 corresponding to the maximum diameter of the basket. Circumferential stresses on the ribs are absorbed by a series of hoops or tension rings 33 which with the ribs form a frustro-conical shell inside which is placed the single mesh sieve or screen, in the form of a perforated stainless steel sheet, which retains the crystals. The centrifugal force on the basket is not sufficient to distort it, pushing the plate into the spaces of the shell, as would happen at the usual speeds of a batch machine.



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

Roll mounting for sugar (cane) mill. T. M. HAMILL, of Kailua, Hawaii, *assr.* HONOLULU IRON WORKS CO. **3,127,831.** 20th June 1962; 7th April 1964.

The shaft of a mill roll 18 is located in bearing 27 fitted with a brass liner 39, filler or wear plate 41 rotating with the shaft. The bearing may alternatively be a roller bearing or other form of bearing.



It is held in a chair or saddle 28 interposed between it and the shaft housing, the contact interface 38/42 being spherical to allow relative movement of the shaft. The top of the chair 28 is subject to the pressure of a hydraulic ram, the bottom of which acts through a bearing pad 30, this also having a spherical interface 31. The chair is guided in its vertical movement by parallel tongues 34 in the housing 6 which locate in guideways 35 in the sides of the chair. Two pairs of opposed wings 44 on the casing 40 of the bearing 27 fit in corresponding sockets 45 in the chair so limiting the universal angling and relative rotation of the bearing and chair. When the shaft is misaligned (to maintain even pressure on the cane) the spherical surfaces permit vertical application of pressure by the rams, while the effective variation in length of the shaft is provided for in the sideplay between the tongues 34 and grooves 35 and consequent lateral play between the chair and housing.

* * *

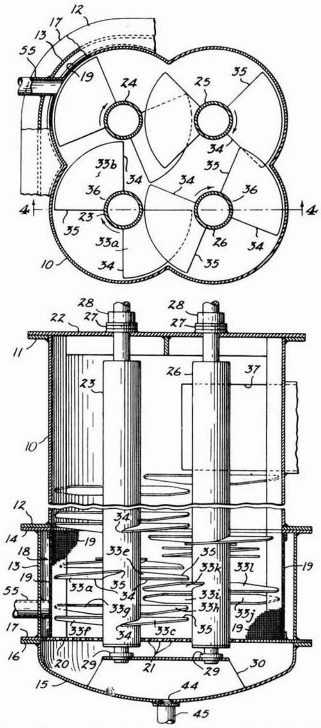
Sugar (cane) mill. R. E. BEITER and F. K. ELLIS, of Honolulu, Hawaii, U.S.A., *assrs.* HONOLULU IRON WORKS COMPANY. **3,131,624.** 5th December 1961, 5th May 1964.—See U.K.P. 954,004[1].

* * *

Vertical (cane) diffuser. F. C. SCHAFFER and R. W. MCKENZIE, of Baton Rouge, La., U.S.A. **3,142,589.** 16th May 1962; 28th July 1964.

Cane cut into discs or shredded is extracted in counter current by water in the diffuser which comprises a vertical tank 10 in which rotate shafts 23, 24, 25 and 26 carrying intermeshing flight sectors 33 and driven from above the top plate 22 by motors and gearing which are not shown. The shafts are supported by bearings 27 and 29, the latter held in a spider 30 mounted on the dished bottom 15 of the tank 10. The bottom of tank 10 comprises a section 13 of greater horizontal dimensions, an inner screen section 19 continuing the line of tank wall 10 to the bottom plate 20. The prepared cane is mixed with recycled and heated juice and pumped into the tank through pipe 55 and is raised by the flight sectors 33 on the vertical shafts, and is removed by sweep arms on a rotating shaft and so out through opening 37. Water enters the top of the tank through a pipe (not shown) and descends against the upflow of cane, extracting the sugar to produce a juice which passes through screen 19 and the perforations 21 in the plate 20 to enter the bottom 15 from which it is withdrawn through pipe 45. Part is sent to process and part is recycled to the cane feed.

The illustrations show four shafts in the tank; the tank may be suitably shaped and provided with varying numbers of shafts—two in a row, three having their axes in a row or at the apexes of an equilateral triangle, or even more than four. The flight sectors may cover larger or smaller arcs as desired, to provide adequate upflow of the cane.



[1] *I.S.J.*, 1964, **66**, 400.

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.

Continuous sugar centrifugal. Western States Machine Co., Hamilton, Ohio, U.S.A.

The Western States continuous centrifugal is of the high-speed (up to 2200 r.p.m.) conical type with massecuite rising from the acceleration bowl over a perforated screen through which molasses and wash liquid is separated while the sugar passes over the top. It requires supervision rather than operating labour, has low maintenance cost potential, is simple, with nominal mounting problems, has a uniform power demand and provides a constant flow of product.

Important features of the machine include a heat-treated ductile cast stainless steel basket accurately machined and balanced, grooved and drilled to provide efficient mother liquor elimination and uniform support for the variety of filter linings available. An automatic control system maintains the flow of feed at a constant pre-set adjustable value, compensating for variations in static head and material fluidity. The sturdy monitor case provides supports for all machine elements and is split and flanged to provide access for cleaning and maintanance. Washing and steaming equipment is adjustable and the multi-groove single belt drive is arranged to dampen vibration and enhance stability.

The Western States continuous centrifugal has a forced feed lubrication system, and a three-point mounting to ensure equal distribution of the load.

* * *

Cercospora **beet leaf spot treatment.** Rohm & Haas Co., Washington Square, Philadelphia, Pa., 19105 U.S.A.

Dependable control of *Cercospora* leaf spot can be achieved through the use of "Dithane" fungicides produced by Rohm & Haas. Sugar beet producers are well familiar with these products, since they have used "Dithane M-22" ("Maneb") for a number of years as a standard means of keeping leaf spot in check. More recently growers have begun applying "Dithane M-45", the latest addition to the "Dithane" line. A new and different reaction product, "Dithane M-45" contains three important ionic components: zinc, manganese and ethylene bis-dithiocarbamate. Its distinct chemical structure enables it to provide superior leaf spot protection, even when conditions are especially conducive to development of the disease.

In the application of "Dithane" fungicides, the most important consideration is getting the material on the foliage before leaf spot appears. Experience has shown that one treatment made before the onset of the fungus provides greater protection than two applications after infestation appears. After the initial preventive application, spraying every 8–12 days will usually keep the beet tops free of leaf spot. During rainy or extremely humid and hot weather, more frequent treatment may be needed.

* * *

"Nylaflow" pressure tubing. Polypenco Ltd., Gate House, Welwyn Garden City, Herts.

This flexible tubing is suitable for use in hydraulic supply lines as well as pneumatic lines, caustic lines, syrup lines, etc., and is available in a range of burst pressures and sizes. The tubes are easily coloured for identification, using surface dyes, and needs no templates or elaborate bending jigs.

* * *

New irrigation standpipe. Wright Rain Ltd., Ringwood, Hampshire.

For use in conjunction with the "Lancer" sprinkler, recently produced for overseas use, a new weld-on riser stand incorporates a ball-valve to seal the sprinkler line, allowing the standpipe to be moved while watering is taking place.

Experience has shown that night time moving of sprinkler lines is not entirely eliminated under certain soil and crop conditions when 24-hour operation of equipment is required.

Use of the new riser stand allows standpipes to be sited at alternate positions along the pipeline, so that during the night, by merely moving each one to the next position to cover an unwatered section, pipeline moving can be delayed until the next day.

* * *

"Magnafloc". Allied Colloids (Manufacturing) Co Ltd., Bradford, Yorkshire.

"Magnafloc" reagents are synthetic water-soluble polymers of high molecular weight. Their molecules have great length and a very high affinity for solid surfaces, so that the molecules form bridges between solid particles on which parts of the molecule are adsorbed. This induces or aids flocculation which increases settling rates, sedimentation, filtration rates, supernatant clarity, etc. and requires only small amounts of the order of a few p.p.m. of "Magnafloc".

* * *

New level instruments. Fielden Electronics Limited, Wythenshawe, Manchester.

The "Tektor TT6" is a solid state capacity sensitive controller designed to give high stability with excellent discrimination, in a compact, robust and inexpensive form. The transistorized "switch", moulded in silicone rubber, is designed to fit in the head of the extensive range of Fielden Type 40 electrodes. The TT6 has exceptional stability against mains voltage and temperature variations. It is relatively insensitive to any resistive changes in the electrode system, and once set at the works will require no adjustment on installation or in use.

The "Aquatrol" Type NF2 has been developed to provide an inexpensive and simple, yet versatile and reliable, automatic level alarm and/or control (both high and low level) of electrically conducting liquids. It operates on the principle of electrical conductivity, employing robust electrodes in the container at the points of control. Installation is a simple matter, a multiple electrode system being available which requires only one entry into the container. No special wiring is required between "Aquatrol" and electrode(s) and these is no limitation on the length of wiring used.

The "Telstor 62" is the most recent addition to the Fielden range of continuous level measuring instruments. A very high order of accuracy and linearity is achieved using a new method. The condenser which is represented by the probe, with material being measured as dielectric, is in turn charged from a low impedance stabilized source, and then rapidly switched to discharge into a low impedance, and the mean discharge current which is directly proportional to capacity is measured.

* * *

New "Low-Line" feeder units. Industrial Vibrators Ltd., 80A Stratford Road, Shirley, Solihull, Warwickshire.

The new range of "Low-Line" electromagnetic vibrating feeder units has been specially designed to meet applications where little head room is available for the installation of vibrating feeders while at the same time being capable of giving high tonnages. The range of sizes available is from 3 ft to 6 ft long in widths of 12, 14 and 18 inches with corresponding capacities of 8 c.f.m., 12 c.f.m. and 16 c.f.m., respectively. The feeders will handle an extremely wide variety of fluent, powdered and granular material, as well as solid lump materials, ranging in size from 4 inches down. The feed rates are completely variable, since the feeder always operates in association with the controller provided with each unit, giving facilities for increasing or decreasing the rate of flow. The electrical circuitry of these units renders them ideal for semi- or fully-automatic processing for operation in association with weighers, bagging machines, etc. While the feeder units are generally applied to operate horizontally, they can operate with declination of down to 10° and will successfully handle materials when inclined at up to 20°. Naturally, capacities vary under such conditions.

* * *

Wormgear speed reducers. John Holroyd & Co. Ltd., Milnrow, Rochdale, Lancs.

The "Verso" reducers are small sturdily built units suitable for heavy duty work under arduous industrial conditions. A new leaflet shows the many mounting positions in which the gearbox can be located, this versatility being achieved by having feet at both top and bottom of the box. It can be supplied as a self-contained gearbox or with flange-mounted driving motor from ¼ to 1 h.p., making a very compact speed reducer. Ratios available range from 5:1 to 70:1. Data Sheet No. 42 gives full technical data about this new gear unit, including horsepower and torque tables.

* * *

PUBLICATIONS RECEIVED

SPRAG CLUTCH DATA SHEETS. Renold Chains Ltd., Wythenshawe, Manchester.

Renold Chains Ltd. have published a set of data sheets covering in a compact form their entire range of sprag clutches. These are robust, backlash-free mechanisms occupying minimum space and designed for applications involving over-running, indexing and backstopping. Torque capacities range from 4·5 lb.ft. for light mechanisms up to 136,500 lb.ft. for use as a safety device against run-back on heavy elevator installations. Continuous over-running speeds as high as 3450 r.p.m. are listed and the special indexing series of clutches is capable of rates up to 1200 strokes per minute in approved cases.

* * *

STAINLESS STEEL BUYERS' GUIDE, 1964. Stainless Steel Fabricators' Association of Great Britain, P.O. Box 360, 75 Harborne Rd., Edgbaston, Birmingham.

This new booklet comprises a list of members and classified list of products. These cover a wide range and include alcohol plant, centrifugals, crystallizers, evaporators, vacuum pans, etc. It is available free of charge to interested readers.

* * *

WELCOME TO NORDISKAFILT. Nordiska Maskinfilt AB., Helmstad 1, Sweden.

This attractive booklet gives a discription of the Nordiska Maskinfilt factory at Halmstad where papermakers' felts are made as well as filter cloths, conveyor belts and other industrial textiles. Each department is described and illustrated, and an account given of product control, research and development, and technical service.

* * *

GEAR TYPE FLEXIBLE COUPLINGS. David Brown Corporation (Sales) Ltd., Park Works, Huddersfield, Yorkshire.

Four types of couplings—flanged sleeve and continuous sleeve, double- and single-engagement—are illustrated and specified, with information necessary for selection, ordering and basic installation as well as data on keyways and lubrication.

Brevities

Pittsburgh-IMACTI agreement.—Industrieele Mij. Activit N.V. (IMACTI) of Amsterdam, a leading producer of ion exchange resins and resin systems, has signed an agreement with Pittsburgh Activated Carbon Company to distribute Pittsburgh activated carbons in Western Europe. Pittsburgh Activated Carbon Company is the largest producer of granular activated carbons in the U.S.A.

* * *

Iraq cane sugar project.—Hawaiian Agronomics Co. (International) has been awarded a six-year management contract by the Government of Iraq to establish and manage the $30,000,000 Amarah cane sugar project on 16,000 acres at Mujar El Kabir on the Tigris River. Company personnel, primarily from Hawaii, will initially direct all major parts of the operation, training Iraqi personnel who will ultimately take over management. A refinery is to be constructed which will have an annual production capacity of 100,000 tons of refined sugar, approximately 32,500 tons to come from cane grown on the project site and the balance from imported raw sugar.

U.S. Sugar Supply Quotas, 1965[1]

	(Short tons, raw value)
Domestic beet	2,650,000
Mainland cane	895,000
Hawaii	1,115,479
Puerto Rico	1,140,000
Virgin Islands	15,232
Total Domestic Areas	5,815,711
Philippines	1,050,000
Argentina	59,244
Australia	171,913
Belgium	1,744
Brazil	204,057
British Honduras	3,845
British West Indies	112,690
Colombia	27,038
Costa Rica	32,143
Dominican Republic	357,566
Ecuador	45,652
Fiji	41,954
France	5,315
French West Indies	39,706
Guatemala	36,828
Haiti	20,168
India	89,224
Ireland	7,983
Madagascar	6,723
Mauritius	13,866
Mexico	358,617
Nicaragua	37,395
Panama	13,298
Peru	222,691
Réunion	2,038
El Salvador	15,820
South Africa	98,047
Southern Rhodesia	8,403
Taiwan	63,026
Turkey	1,408
Venezuela	2,458
Held in reserve*	233,429
	9,200,000

*This quantity, amounting to 10% of the tonnage to be allocated among foreign suppliers, will be prorated when total charges for 1964 are known.

Brevities

Dorr-Oliver equipment for new Louisiana plant.—Two Dorr-Oliver "RapiFloc" systems and two "RapiDorr" clarifiers are included in the equipment for the new 4000-tons per day factory under construction for the Cajun Sugar Cooperative in New Iberia, Louisiana.

* * *

U.K. licence for French gears.—E.T.S. (Lonertia) Ltd. have recently been appointed U.K. selling agents for the gear products of Engrenages et Réducteurs S.A., a company formed by the amalgamation of Citröen and Robert Messian, two well-known and long-established French gear manufacturers. A very wide range of gears and gearboxes is to be offered, including a standard range of single and double helical boxes, spur and helical gears up to 26 ft dia. and bevels, including spiral bevels, up to 13 ft dia.

* * *

Cane diffuser for South Africa[2].—Entumeni Sugar Milling Co. (Pty.) Ltd. have placed an order with Patrick Murray (Pty.) Ltd. for a De Smet continuous diffuser to be built under licence from the Belgian manufacturers. The plant will process 1500 tons of cane per day and will be operated completely automatically from a control panel which will also operate the preceding three-roller mill and subsequent two dewatering mills.

Brevities

Hawaii sugar production, 1964[3].—The last of the 26 plantations in Hawaii completed operations for the 1964 season on the 9th December and production has been set at 1,178,500 short tons, a record. In the previous year output amounted to 1,100,768 tons while the previous record crop was established in 1955 with an output of 1,145,112 tons.

* * *

Cuban sugar industry rationalization[4].—The Cuban Minister for the Sugar Industry recently gave details of the Sugar Perspective Plan for 1965–70. It is planned to invest 150 million pesos for the sugar industry, 190 million for sugar transport and 27 million for bulk handling installations. The plan envisages the concentration of production in only 60 sugar centrals, the remaining 101 centrals being cannibalized. It is thought that more than a dozen will not be able to operate in the current season. Installation of new factories is contemplated after completion of the first phase of the plan. Between 40 and 60% of the sugar is intended to be shipped in bulk, requiring costly installations in Cienfuegos and Nuevitas.

* * *

Caroni Ltd. 1963/64 report.—Sugar production in 1964 was 205,121 tons, compared with 203,580 tons in the previous season. The crop was taken off much more smoothly and there was less froghopper damage and fewer labour troubles. Since the world price affected one third of export sugar sales and had fallen considerably through 1964, the net profit was reduced by more than half. The high sugar price and profits of 1962/63 had resulted in pressure for higher wages and consequently labour costs in 1964 were greater than in 1963. The full effect will be felt in the 1965 crop so that, unless there is a recovery in the world price, profits for 1965 are likely to be substantially reduced.

* * *

Greek beet campaign, 1964[5].—The 1964 campaign came to an end at the end of October when the three sugar factories ceased operations. The targets set for all three (Larissa, Platy and Serres) in June were surpassed in respect of sugar. The prices at which the sugar beets were bought by the Hellenic Sugar Industry Company were 20% higher than those of 1963 and about 5–10% higher than prices paid to farmers in Western Europe. In spite of the higher beet prices the cost of the sugar, estimated at Drs. 6·90 per kilo, is some 10% lower than last campaign and only 10–15% higher than that for European sugar factories. If the higher price paid for beets is taken into consideration the cost of production is practically the same as in Europe. All three factories operated for a total of 255 days, processing 522,413 tons of beets to produce 61,820 tons of sugar, 24,930 tons of molasses and 11,530 tons of pulp. The question of setting up a new factory or the extension of the capacity of existing factories is being examined by the Ministry of Coordination.

* * *

Sugar factory for Paraguay[6].—A West German firm has applied for permission to install a sugar mill at Horqueta, Department of Concepción, where it has purchased some 100,000 hectares of land. The new mill, to be installed at an estimated cost of about U.S. $7,000,000, would begin production in early 1966 with an initial output of 35,000 tons a year.

* * *

New sugar factories licensed in India[7].—The licensing Committee of the Indian Ministry of Industry has recently approved the licensing of nine new cooperative sugar factories. The expansion of 22 existing cooperative sugar factories has also been licensed, representing in all an additional capacity of more than 300,000 tons.

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1 Through C. Czarnikow Ltd., *Sugar Review*, 1964, (693), 226.
2 *S. African Sugar J.*, 1964, **48**, 931.
3 C. Czarnikow Ltd., *Sugar Review*, 1964, (692), 222.
4 *Economia* (Florida, U.S.A.), 1964, **2**, (9), 4.
5 F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (31), 13.
6 *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **29**, 951.
7 F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (31), 18.

BREVITIES

Philippines sugar production, 1964/65[1].—The 1964/65 sugar production of the Philippines is estimated at 2,139,867 short tons (1,941,275 metric tons), according to the Philippine Sugar Association. Last year's production amounted to 1,830,000 short tons (1,660,000 metric tons). The increase is 16·9% on the 1963/64 figure.

* * *

Danish beet price[2].—The Danish Government has raised the beet price paid to farmers by 1·90 kroner to 92·90 kroner (2s 0d to 96s 4d) per metric ton, basis 16·3–16·7% sugar content. This compares with 93 kroner (96s 4½d) per ton and 98·30 kroner (101s 10½d) per ton in 1963/64 and 1962/63, respectively. As has been the practice in past years a late delivery premium which ranges from 2·40 to 5·00 kroner (2s 6d to 5s 2d) per ton is to be paid to the growers in addition to the basic price. No estimates have been published for 1964/65 production but with acreage increased by 15% to 69,000 ha, the crop must reach at least the national average of 1½ million tons.

* * *

Cuba–Finland trade agreement[3].—A trade agreement between Finland and Cuba was signed in Helsinki recently under which Finland will import sugar, among other goods, and will export to Cuba machinery and forest industry products, reports Reuter. The agreement includes the "most-favoured-nation" clause to promote a general increase in trade between the two countries.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 18th January* 1965)	s d
Anglo-Ceylon (5s)	7/1½
Antigua Sugar Factory (£1)	11/3
Booker Bros. (10s)	18/1½
British Sugar Corp. Ltd. (£1)	19/6
Caroni Ord. (2s)	2/1½
Caroni 6% Cum. Pref. (£1)	15/9
Demerara Co. (Holdings) Ltd.	3/9
Distillers Co. Ltd. (10s units)	23/3
Gledhow Chaka's Kraal (R1)	22/6
Hulett & Sons (R1)	37/6
Jamaica Sugar Estates Ltd. (5s units)	3/10½
Leach's Argentine (10s units)	20/6
Manbré & Garton Ltd. (10s)	38/6
Reynolds Bros. (R1)	23/6
St. Kitts (London) Ltd. (£1)	17/6
Sena Sugar Estates Ltd. (5s)	6/9
Tate & Lyle Ltd. (£1)	32/4½
Trinidad Sugar (5s stock units)	3/3
United Molasses (10s stock units)	26/6
West Indies Sugar Co. Ltd. (£1)	10/–

CLOSING MIDDLE

New York Stocks (*at 16th January* 1965)	$
American Crystal ($5)	18
Amer. Sugar Ref. Co. ($12.50)	20⅞
Central Aguirre ($5)	25¼
Great Western Sugar Co.	37⅛
North American Ind. ($10)	14⅝
South P.R. Sugar Co.	30½
United Fruit Co.	17½

Malayan cane industry prospects[4].—The Malayan Minister for Commerce and Industry, Dr. LIM SWEE AUN, said in Kuala Lumpur recently that his Government has set up a committee to work with the sugar refinery at Prai, Western Malaya, to establish a cane growing industry in the North Malayan states of Kedah and Perlis. The Minister was reported to have added: "With the development of sugar cane plantations we can not only diversify our agriculture but also ensure a more stable economy for this country by providing more employment and saving foreign exchange."

* * *

Egypt sugar expansion.[5]—Two new cane mills are to be supplied to Egypt by Czechoslovakia. A plant capable of dealing with 8000 tons of cane per day will be built at Beshma and will commence operations in January 1968, whilst a factory planned to come into service two years later, with a capacity of 12,000 tons of cane per day, is to be constructed at Baliana.

* * *

Mainland China sugar expansion[6].—According to a report of the news agency "New China", the sugar cane and beet acreages in China were expanded in 1964, several new refineries are under construction and existing refineries are to be expanded. Most of the factories will be completed before the start of the new crop.

* * *

Brazil sugar expansion[7].—According to information released by the Instituto do Açucar e do Alcool, nine new sugar factories, with a total annual capacity of 3,300,000 bags of sugar (198,000 metric tons), are to be installed in the State of Sao Paulo. In the State of Paraná, annual production is to be raised to 6 million bags (360,000 metric tons) within three years by increasing existing capacity and building ten new factories. As a result of these and other developments, output should increase from about 57 million bags (3,420,000 tons) in the current season to 70 million bags (4,200,000 tons) in 1965/66, of which about 20 million bags (1,200,000 tons) would be available for export. The expected rise is attributable partly to the introduction of a realistic minimum price policy for producers, and partly to the fact that farmers are substituting the cultivation of sugar cane for that of coffee under the scheme for eliminating uneconomical coffee plantations.

* * *

Bagasse paper project for Argentina[8].—A Japanese mission visited Tucumán in September to study the possibility of installing a paper factory to use bagasse as raw material.

* * *

Somalia sugar expansion[9].—A project for the expansion of the S.N.A.I. plant at Giohar has been inaugurated. Annual refined sugar output is to be raised from the present 12,000 tons to 35–45,000 tons by the end of 1965.

* * *

Indian sugar exports[10].—A quantity of 232,000 tons of sugar was sold for export during the season 1963/64 as against 431,000 tons in 1962/63 and 424,000 tons in 1961/62. However, the estimated f.o.b. value of the exports was higher at Rs. 842 per ton, compared with Rs. 676 and Rs. 397 per ton, respectively, in the previous two seasons.

1 F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (31), 18.
2 *Agra-Europe*, 18th November 1964.
3 C. Czarnikow Ltd., *Sugar Review*, 1964, (685), 192.
4 *Financial Times*, 4th November 1964.
5 C. Czarnikow Ltd., *Sugar Review*, 1964, (689), 211.
6 F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (32), 16.
7 *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **29**, 1012.
8 *La Ind. Azuc.*, 1964, **70**, 323.
9 *Sugar y Azúcar*, 1964, **59**, (11), 90.
10 F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (30), 19.