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On décrit un dispositif pour la défeuillaison de la canne à la main, qui permet d'accroître le nombre de cannes défeuillées par 100–200% en comparaison avec des moyens conventionnels, et un mécanisme, tiré par tracteur, pour le nivellement du terrain. On mentionne brièvement des autres dispositifs mécaniques pour application aux champs de cannes.

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Les effets du surchauffage sur la cristallisation du saccharose sous les conditions d'ébullition. 2-éme partie. M. C. BENNETT et Y. L. FENTIMAN. p. 36–39

Les auteurs définissent les paramètres principaux concernant le mesurage des effets du surchauffage, et ils décrivent des essais pour déterminer l'effet du surchauffage sur la sursaturation. Ils ont déterminé des vitesses de cristallisation sous les conditions d'ébullition et ont trouvé que la constante à 73,0°C s'accord avec la valeur obtenue par SMYTHE.

* * *

Les constituants à surface active dans la cristallisation du sucre de betteraves. 2-ème partie. J. F. T. OLDFIELD et J. V. DUTTON. p. 40–43

On a trouvé que les peptides de poids moléculaire élevé dans un extrait d'un sucre écumant amènent à la formation d'écume. On n'a pas constaté l'identité d'un composant écumant de poids moléculaire bas dans l'extrait. Les auteurs ont mesuré les concentrations des peptides dans des extraits de sucre blanc de betteraves et ont trouvé que, généralement, les concentrations plus élévées de peptides étaient accompagnées des indices de formation d'écume plus élévés, bien qu'à des concentrations plus basses il n'y ait pas de rapport direct entre la concentration de peptide et l'indice de formation d'écume.

* * *

L'économique de l'irrigation supplémentaire de la canne à sucre. D. B. CAMPBELL p. 43–45

L'auteur considère les avantages économiques de l'application de l'irrigation supplémentaire à la canne à sucre dans cettes parties du monde ou on peut cultiver la canne sans l'irrigation, et discute le calcul des quantités d'eau nécessaires.

Der mechanischer Rohranbau in Australien. S. 35–36

Man beschreibt eine Handvorrichtung für die Entblätterung von Zuckerrohr, mit welcher man 100–200% mehr Rohr als durch übliche Methoden entblättern kann. Eine von Traktor gezogene Vorrichtung für die Nievellierung des Bodens wird auch beschrieben Andere auf Rohrfeldern anzuwendende, mechanische Vorrichtungen werden auch in kurzem erwähnt.

* * *

Die Einwirkungen der Uberhitzung auf die Kristallisation der Saccharose unter siedenden Verhältnissen. Teil 2. M. C. BENNETT und Y. L. FENTIMAN. S. 36–39

Die Verfasser definieren die Hauptparameter in der Messung des Uberhitzungseffekts und beschreiben Versuche, um die Einwirkung der Uberhitzung auf die Übersättigung zu bestimmen. Man hat Kristallisationsgeschwindigkeiten unter siedenden Verhältnissen bestimmt, wobei sie eine Übereinstimmung zwischen der Konstante bei 73,0°C und dem von SMYTHE erhaltenen Wert gefunden haben.

* * *

Oberflächenaktive Bestandteile in der Rübenzuckerkristallisation. Teil 2. J. F. T. OLDFIELD und J. V. DUTTON. S. 40–43

Die Verfasser haben gefunden, dass hochmolekulare Peptide in einem, aus einem schäumenden Zucker stammenden, Extrakt das Schäumen verursachen. Es war nicht möglich, einen niedermolekularen, schäumenden Komponent im Extrakt zu identifizieren. Die Peptidkonzentrationen in aus Rübenweisszuckern stammenden Extrakten wurden gemessen, wobei man fand, dass im allgemeinen die höheren Peptidkonzentrationen von höheren Schaumindexen begleitet wurden, obgleich bei niedrigern Konzentrationen gibt es keine Beziehung zwischen der Peptidkonzentration und dem Schaumindex.

* * *

Die Okonomie von nachträglicher Bewässerung des Zuckerrohrs. D. B. CAMPBELL. S. 43–45

Der Verfasser betrachtet die ökonomische Vorteile der Anwendung von "nachträglicher" Bewässerung des Zuckerrohrs in jenen Ländern, wo man das Rohr nicht ohne die Bewässerung anbauen kann, und bespricht die Berechnung des Wasserbedarfs.

Cultivo mecanizado de caña en Australia. Pág. 35–36

Se presenta una descripción de un deshojador a mano que permite la deshojación de 100–200% más caña que por medios convencionales. También se describe un equipo, tirado por tractor, para allenar el terreno. Se mencionan brevemente otros equipos mecánicos para uso en campos cañeros.

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Efectos de supercalefacción sobre cristalización de sacarosa en condiciones de ebulición. Parte II. M. C. BENNETT y Y. L. FENTIMAN. Pág. 36–39

Se definen los parametros principales que se conciernen en la medida de los efectos de supercalefacción, y experimentos para determinar el efecto de supercalefacción, y experimentos para determinar el efecto de supercalefacción sobre la supersaturación se describen. Las velocidades de cristalización se han determinado en condiciones de ebulición, y los autores han demostrado que el constante medido a 73,0°C concorda con el valor obtenido por SMYTHE.

* * *

Constituentes activos superficialmente en cristalización de azúcar de remolacha. Parte II. J. F. T. OLDFIELD y J. V. DUTTON. Pág. 40–43

Peptidos de alto peso molecular en un extracto desde un azúcar espumoso se han demostrado capaz de causar formación de espuma. Un componente de bajo peso molecular del extracto, también capaz de causar espuma, no se ha identificado. Los autores han medido las concentraciones de peptidos en extractos desde azucares blancos remolacheros y han descubrido que, generalmente, altos niveles de peptidos se acompañan de altos indices de formación de espuma. No obstante, a niveles más bajos, no hay ningún relación directa entre concentración de peptido y indice de formación de espuma.

* * *

Los económicos de regadío suplemental en caña de azúcar. D. B. CAMPBELL. Pág. 43–45

Se discutieren las ventajas económicas del uso de regadío suplemental para caña en las partes del mundo donde se puede cultivar sin regadío, asi como la calculación de exigencias de agua.

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Notes & Comments

The Commonwealth Sugar Agreement and UK membership of the EEC[1].

Of the many obstacles to be crossed before the United Kingdom can be accepted into the Common Market, the one of particular interest to our commodity is the integration of the Commonwealth Sugar Agreement into an enlarged Community. Well before, and on many occasions since, applying for membership the British Government has made it quite clear that certain safeguards would need to be agreed upon before the UK could join the Common Market. Indeed, when addressing the Council of Western European Union, the UK Secretary of State for Foreign Affairs pointed out that the Agreement which exists between the British Government and Commonwealth sugar producers is a commitment which must be fulfilled.

The Commission of the European Communities in its report dealing with the request for accession on the part of the UK, Ireland, Denmark and Norway has now stated that it is anticipated that by 1970 a surplus to domestic consumption requirements of 800,000 tons will exist in the Community as it is at present constituted and of this quantity only half can be used for purposes other than human consumption. Furthermore, they point out that within a few years a further 100,000 tons of exportable sugar will become available from the OCAM countries and from the Overseas Territories. Nevertheless, they mention that the current validity period of the Commonwealth Sugar Agreement, which at present runs to the end of 1974, roughly coincides with the period during which the Common Market for sugar has laid down guaranteed quotas for each member state, which indicates their acceptance of the fact that no adjustment to existing arrangements could be contemplated by the British Government before that date. No hard and fast recommendations are made by the Commission, apart from stating that the actual difficulties regarding Commonwealth sugar will have to be solved during the negotiations.

The physical problem of absorbing the surplus from the present members of the EEC—which the Commission in its above statistics has estimated at a net figure of 500,000 tons—plus the Negotiated Price quota of the CSA, together with domestic production in the UK, Ireland and Denmark, is by no means large when the size of the total market is taken into consideration. Consumption in the enlarged market is likely to be in the region of ten million tons by 1970 and production from all the various sources will be well within a 5% margin of this figure. It would appear, therefore, that there can be no statistical justification for the UK's current imports of Negotiated Price Quota sugar not to continue in full after 1974.

* * *

EEC sugar market regulations.

The Chairman of the West German Wirtschaftliche Vereinigung Zucker e.V., Herr E. G. VON LANGEN, addressed the Dutch Sugar Industry Association at their annual meeting on the above subject[2]. He said that the purpose of the quota system should be to adapt production to consumption in order to avoid surpluses. However, this aim had unfortunately not been completely fulfilled. There was to be no relation between the national production and national consumption, and politically fixed quotas would exceed consumption.

The addition to the basic quota, up to 135%, with production payment, would involve the danger of an excessive over-production which, on the other hand, would lead to disposal at a loss for export or in cattle feed. The value of the production payment would be justified if it were used for utilization of record crops, but it would miss its aim of steering production if additional beets were grown. This danger was above all to be feared in France where, even at a mixed price of DM 6.80 for the 100% quota and DM 4.00 for the 35% addition, the beet price would be higher than hitherto.

Herr VON LANGEN pointed out that an adequate beet price was necessary to guarantee the maintenance of sufficient sugar beet cultivation. He dealt with the intervention, target and threshold prices and price adjustments and said that beet and sugar prices seem to be secured by the decrees issued in this

[1] C. Czarnikow Ltd., *Sugar Review*, 1967, (837), 191.
[2] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (34), 1-2.

respect. However, prices would be jeopardized by excessive use of the intervention fund.

He dealt with avoiding over-production and dangerous use of the intervention fund, mentioning the following possibilities: (i) reduction of the minimum beet price by increasing export duties, which would result in losses for the factories and beet growers, (ii) reduction of the additional quota of 35%, and (iii) reduction of the intervention price and the sugar beet price.

* * *

World sugar production estimates, 1967/68.

Late in November, F. O. Licht KG published their first estimates of world sugar production for the year 1967/68[3]. Detailed figures are reproduced elsewhere in this issue but they may be summarized as follows: Total production is expected to reach 66,224,300 metric tons, raw value, almost a million tons more than the 1966/67 figure of 65,233,153 metric tons, raw value, or an increase of 1·52%. Cane sugar production is expected to be some 240,000 tons down at 36,887,100 tons, while beet sugar production is expected to be 1,232,000 tons higher at 29,337,200 tons. The latter increase is largely due to an expected increase of 600,000 tons in the production of the European Common Market countries as well as more than 400,000 tons increase expected in sugar production by the USSR, and 100,000 tons extra by Poland.

The most important reduction in cane sugar production is expected in Cuba, where the drought has caused severe damage and stunting of the cane so that Licht's estimate of production is only 5,200,000 tons, compared with over 6,000,000 tons produced in 1966/67. This reduction is partly offset by increases in other cane-growing countries such as India (300,000 tons more than in 1966/67), USA (124,000 tons more) South Africa (100,000 tons) and the Philippines (80,000 tons more).

Great weight is attached to Licht's estimates which are prepared with care, and it is significant that they set total production at a level considerably exceeded by most trade estimates of consumption during the period, confirming the expectation of a significant reduction in world stocks to be expected during the 1967/68 crop year.

* * *

World raw sugar prices.

During 1967 there was a steady climb in raw sugar prices, interrupted by the sudden spurt and rapid fall to the previous level at the time of the 6-days' war in the Middle East. The trend toward higher prices has been the result of the improving statistical position while there has been plenty of sugar immediately available to hold prices down or induce setbacks as at the time of writing when the London Terminal Market prices has recently declined from £25 to £23 per ton.

Discussing the future, E. D. & F. Man, the London brokers write[4]: "The outlook is still continuing to show prospects of higher prices in 1968 particularly in the latter half. We adhere to the view that statistics warrant a firm market as the year progresses, but that at the start of the year it looks as though there will be a surplus of available raw sugar over buying demand . . . Again it looks reasonable to anticipate that the market will move in a trading range for the next month or so and we hazard a guess that the range may be £24-£28. It seems to us very likely that a £30 L.D.P. will be reached by the second quarter."

* * *

US sugar quota, 1968.

The US Secretary of Agriculture has announced that the initial Overall Supply Quota for 1968 has been fixed at the level he had proposed[5], namely 10,400,000 short tons, raw value. Several adjustments have been made to individual quotas, however: the 10,000 tons for the Bahamas has been cancelled, as has the 6656 tons quota reserved for Rhodesia. The Hawaiian quota has been reduced by 65,375 tons to 1,200,000 tons, and these amounts have been reallocated to foreign suppliers.

Shipment of 825,000 tons by foreign suppliers in the first quarter of 1968 is to be permitted instead of the 700,000 tons originally proposed, while the permitted shipment for the second quarter is reduced from 1,400,000 to 1,275,000 tons[6].

Changed quotas are:

	1968 *quotas* (*short tons, raw value*)	*Original proposals*
Hawaii	1,200,000	1,265,375
Argentina	53,273	51,539
Australia	187,945	184,317
Bahamas	0	10,000
Bolivia	5,156	4,988
Brazil	433,061	418,965
British Honduras	11,250	11,264
British West Indies	158,132	154,621
Colombia	45,827	44,335
Costa Rica	50,981	49,322
Dominican Republic	433,061	418,965
Ecuador	63,011	60,961
Fiji	41,243	40,447
French West Indies	49,744	48,639
Guatemala	42,963	41,565
Haiti	24,059	23,276
Honduras	5,156	4,988
India	75,178	73,727
Malagasy	8,875	8,703
Mauritius	17,229	16,896
Mexico	442,799	428,388
Nicaragua	50,981	49,322
Panama	32,079	31,034
Peru	345,417	334,175
Salvador	31,506	30,481
South Africa	55,339	54,270
Swaziland	6,787	6,656
Taiwan	78,310	76,799
Thailand	17,229	16,896
Venezuela	21,768	21,059
Reserve for possible allocation to Rhodesia	0	6,656

[3] *International Sugar Rpt.*, 1967, **99**, (33), 1–5.
[4] *General Remarks on the Sugar Situation*, 1967, (199).
[5] *I.S.J.*, 1968, **70**, 2.
[6] C. Czarnikow Ltd., *Sugar Review*, 1968, (848), 18.

Mechanical Cane Cultivation in Australia

DURING the last two decades serious efforts have been made by Australian cane farmers to cut costs and increase production through mechanization, particularly in view of falling world sugar prices.

One grower has so mechanized cane planting that three men can plant 7–8 acres per day, using a high-performance planter with a capacity of 1 acre/hr and a simple hand stripper or small machine for removing leaves and trash from the cane before planting. The stripper is a double-bladed shear which forms a circle around the cane stalk and which is fitted with a wooden handle so that the blades can be pushed down the stalk (Fig. 1). The cleaned stalk is then cut into sections for planting.

Fig. 1

Diagram—Courtesy of Australian News and Information Bureau

This device enables 100–200% more cane to be cleaned than by conventional means and does not cause injury to the hands. Normally stripping is a tedious task, and bad chafing and cutting of hands results in a reduction in output. The stripper can also be fitted in a vertical position on a stand made from an old plough disc and a length of piping, and operated by two men, one of whom picks up the cane stalk and places it in the jaws of the stripper, while the second man draws the cane through to remove the trash.

Another stripper used in Queensland consists of two steel drums fitted with flails. The flails are made from sections of fabric transmission belting and are driven by a small petrol engine. Cane stems are fed into the flails against the direction of rotation to remove the trash. Cane eyes are not damaged and germination has been entirely satisfactory.

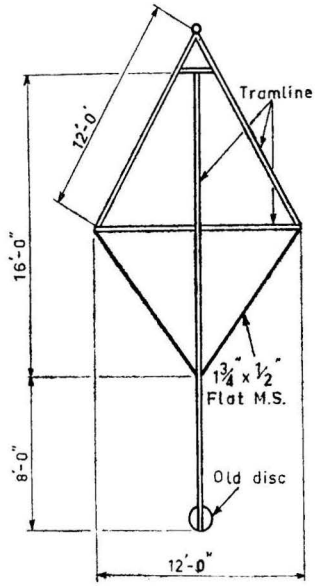

Diagram of land leveller.

Fig. 2

Diagram—Courtesy of Australian News and Information Bureau

Cane chopper-harvesters have been used to cut cane setts for planting. The only modifications required are the removal of some conveyor chain cushions to reduce chain tensions and prevent cane eye damage, and pivoting of the stalk carrier bin to permit easier dumping of the much bulkier cane and trash.

A tractor-drawn land levelling device (Fig. 2) has been made by joining tramlines together in the form of a triangle supported at one end by an old plough

disc. The long base of the leveller, measuring 24 ft × 12 ft wide, prevents it following minor depressions. The disc hollows out a smooth track in the loose soil which disappears after the final cultivation. Levelling of land for irrigated cane by heavy earth-moving machines is an expensive operation costing up to Aus.$400 per acre. Bulldozers push top soil into rows, and self-loading scoops grade the sub-soil to a very gentle slope to allow for drainage. Tile drains are not required if the levelling is accurate. The top soil is then pushed back over the sub-soil and levelled in the normal way.

Break-pushers, which are large frames made from welded pipe and fitted to the front of a tractor, are pushed through lodged cane like a snow plough after high winds or flooding have caused the cane to fall or become tangled. The break-pushers can then be followed by the cane cutters.

Superheating Effects on Sucrose Crystallization under Ebullition Conditions

By M. C. BENNETT and Y. L. FENTIMAN
(Tate & Lyle Limited, Research Centre, Westerham Road, Keston, Kent, England)

Paper presented to the 13th General Assembly of the Commission Internationale Technique de Sucrerie (C.I.T.S.), 1967

PART II

The magnitude of the superheating effect

In order to avoid any confusion which might arise through the terminology the following definitions are made:

Boiling point.—This is the temperature at which the sucrose solution is in equilibrium with pure water vapour at a defined pressure. In the experimental system described here, the vacuum crystallizer operates with an air leak, so that the total pressure of the crystallizer atmosphere is the sum of the unknown partial pressures of water vapour and air. The Boiling Point of the solution is therefore unknown and it is necessary to define other significant temperatures.

Ebullition temperature, T_m°C.—This is the measured temperature of the massecuite in the crystallizer under conditions of ebullition, where the rate of formation of vapour is greatly in excess of the rate of introduction of air. The temperature at which ebullition commences is not precisely defined. In the experimental system described, the Ebullition Temperature was predetermined by the mercury contact thermometer M.

Superheating.—The superheating of the solution can be removed by allowing solution and vapour to come to equilibrium. This can be achieved by allowing the solution to discharge through a Cottrell pump on to the bulb of a thermometer T_2, which will then record the "vapour-equilibrium" solution temperature, T_2°C. The observed superheating for the particular set of ebullition conditions chosen is therefore described by $(T_m - T_2)$°C.

Boiling point elevation (B.P.E.)—Another thermometer, T_1, is placed in the neck of the flask and a spiral of wire arranged to collect pure solvent from the condenser. The thin film of pure solvent on the thermometer bulb will also be in equilibrium with the vapour phase in the crystallizer and the thermometer therefore records the "vapour-equilibrium" solvent temperature, T_1°C. The B.P.E., given by $(T_2 - T_1)$°C, can be considered as a characteristic of the solution and to a very close approximation, independent of experimental conditions.

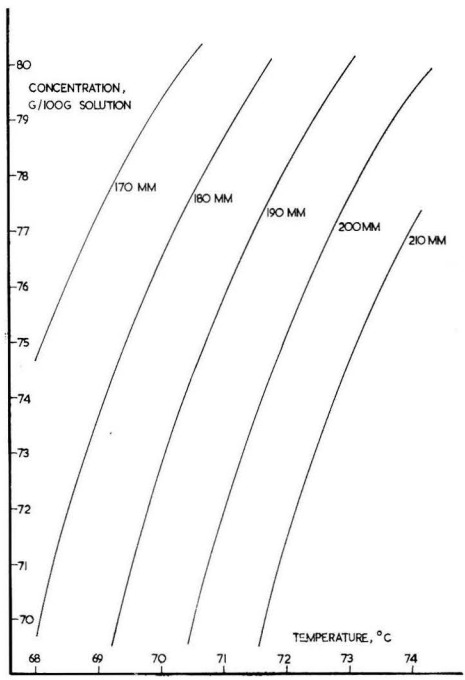

Fig. 5

The magnitude of the superheating temperature rise under ebullition conditions at constant pressure can be deduced from the equilibrium vapour pressure data of DUNNING, EVANS and TAYLOR[5]. In Fig. 5 these data have been plotted as the change in concentration with temperature for each of a number of constant vapour pressures. It can be seen that, around 190 mm, an increase in concentration of 1·5 g sucrose/100 g solution, like that found in Table I, can be accounted for by a rise in temperature of about 0·7°C. Since the curves are parallel, the effect is not very sensitive to vapour pressure and hence does not depend greatly on the composition of the vapour phase.

In order to measure the superheating temperature rise directly [as $(T_m - T_2)$°C], a Cottrell pump W and a thermometer T_2 were installed as discussed above, and as shown in Fig. 1. Another thermometer T_1 was installed in the vapour space so that the "vapour-equilibrium" solvent temperature (T_1°C) could be obtained during the same experiment and the B.P.E. determined. Reproducible superheating effects were obtained when the electric heating mantle was replaced by a constant level boiling water bath. As already indicated in Fig. 4, the superheating effects were slightly reduced by this change.

Typical results are given in Table II where the data are presented in four groups.

GROUP A.—The B.P.E., $(T_2 - T_1)$°C, has been used to determine the concentration of sucrose in the solution: we have used the B.P.E. data of JACKSON[6], which are considered to be the best available. The solubility data of VAVRINECZ[3] for non-boiling equilibrium conditions at T_m°C have been used to calculate the supersaturation ratio S_v^{BPE}.

GROUP B.—Using our own values for the concentration of the sucrose solution determined by refractometry and the solubility data of VAVRINECZ[3] at T_m°C the supersaturation ratio S_v was calculated.

GROUP C.—Using our own experimentally determined values for both the concentration and the solubility under ebullition conditions using a boiling water bath (Fig. 4), the supersaturation ratio S has been determined. It is seen that the values for S in Group C are considerably lower than the calculated ratios S_v^{BPE} and S_v in Groups A and B; in two cases the solution is, in fact, undersaturated while the calculated values would show it to be supersaturated.

GROUP D.—The difference between the solubility under ebullition conditions and the solubility under non-boiling equilibrium conditions has been used to determine the superheating temperature rise from the data in Fig. 5. This is compared with the experimentally observed value $(T_m - T_2)$°C and the two values are seen to be in good agreement.

From the data presented in Table II it must be concluded that in a controlled pressure boiling system the superheating, which is necessary for a satisfactory rate of evaporation, causes a marked reduction in supersaturation. The magnitude of the effect depends upon the extent of superheating, which in turn depends upon the source of heat and method of heat transfer. The effect is likely to have an important bearing on the specification of conditions under which commercial vacuum pans operate and offers a satisfactory explanation for the anomalously high supersaturations encountered in factory practice[7,8].

Following the discovery of the large effect of superheating on supersaturation the following changes were made in the experimental procedure for crystallization velocity determinations.

(*a*) The crystallizer was heated by a boiling water bath.

(*b*) All rate determinations were made at a boiling massecuite temperature of 73·0°C.

(*c*) Changes in supersaturation were made by changing the total pressure.

Table II. Superheating effects on supersaturation

		1	2	3	4	5	6
A	T_m°C	72·8	72·3	74·5	74·6	74·0	74·3
	B.P.E. $(T_2 - T_1)$°C	6·2	6·6	7·1	7·4	7·8	8·2
	Concentration (JACKSON[6]), g/100 g solution	76·6	77·6	78·5	79·1	79·9	80·6
	Non-boiling solubility at T_m°C[3], g/100 g solution	77·1	77·0	77·5	77·5	77·4	77·4
	S_v BPE	0·97	1·04	1·06	1·10	1·16	1·21
B	Refractometric concentration, g/100 g solution	76·7	7·77	78·4	79·1	79·8	80·5
	S_v	0·98	1·04	1·05	1·10	1·16	1·21
C	Ebullition solubility at T_m°C, g/100 g solution	78·3	78·1	78·6	78·6	78·5	78·6
	S	0·92	0·98	0·99	1·03	1·09	1·13
D	Superheating $(T_m - T_2)$°C	0·5	0·5	0·4	0·5	0·5	0·5
	Temperature rise °C from solubility difference (Fig. 5 at 190 mm)[5]	0·5	0·5	0·5	0·5	0·5	0·5

(*d*) The seed was 40 g of the sieve fraction 18–22 B.S.S. from Tate & Lyle pure sucrose. The total number of crystals present (n) was determined by

[5] *J. Chem. Soc.*, 1959, 2363.
[6] Ph.D. Thesis, University of Bristol, 1950; unpublished Tate & Lyle Research Report, 1952, (R/187).
[7] LYLE: "Technology for Sugar Refinery Workers" (Chapman & Hall, London) 1957, p. 252.
[8] VANHOOK: "Principles of Sugar Technology". Vol. II. Ed. P. HONIG. (Elsevier, Amsterdam) 1959, p. 137.

direct counting of known masses before and after each run.

(*e*) The liquor was seeded at 72·0°C. This allowed an initial pretreatment of the seed producing a new clean surface, and condensate was subsequently withdrawn until the supersaturation increased for the liquor to boil at 73°C.

(*f*) Supersaturation was determined from the measured saturation concentration under boiling conditions at 73·0°C (mean of six determinations, 78·30 g/100 g solution).

Results are given in Fig. 6 (unwashed seed) which shows a plot of specific crystallization velocity V against supersaturation under the ebullition conditions of the experiment; the straight line was drawn from a least squares analysis. The supersaturation is indicated as both the Supersaturation Ratio S and the excess concentration $C - C_o$, where the concentration in the flask (C) and at saturation (C_o) are expressed in g/100 g H_2O. The results fit the first order rate equation $V = k(C - C_o)$ and give a value for the rate constant $k = 0{\cdot}620 \times 10^{-4}$ g sq. cm/min per unit excess concentration (g/100 g H_2O).

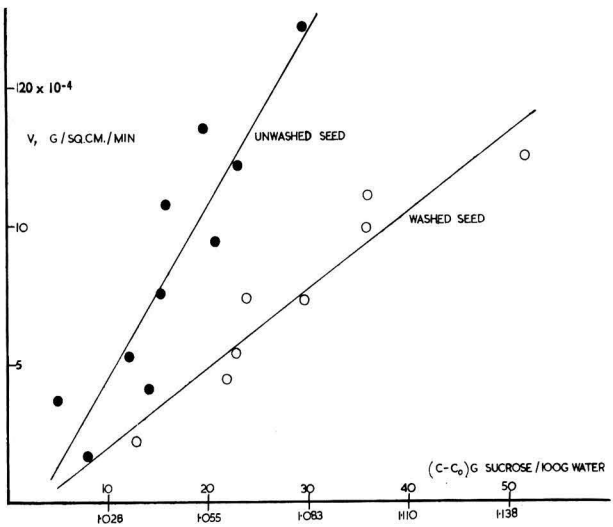

Fig. 6.

It is interesting to compare this result with those of other workers. SMYTHE[9], using perfect single crystals under non-boiling conditions, determined the rate of growth as a function of supersaturation at a number of temperatures. If rate constants are determined from the linear part of his results, and these extrapolated to 73°C, a value for k of $0{\cdot}340 \times 10^{-4}$ g/sq.cm./min per unit excess concentration (g/100 g H_2O) is obtained.

The reason for the large difference in rate constants almost certainly concerns the value taken for the shape factor α. Examination of the seed crystals used for the determinations shown in Fig. 6 (unwashed seed) revealed that the crystal surface was quite rough while examination of the product showed that the crystals were irregular. It would appear that the use here of the shape factor for a cube, $\alpha = 4{\cdot}41$, was incorrect and that in order to determine the correct shape factor it is necessary to measure the specific surface area of the crystals.

Some indication of the effect of the roughness of the seed crystals can be gained from experiments in which the seed was washed with methanol containing 5% water. After drying in the vacuum oven the crystals appeared bright, and under the microscope they were seen to have smooth surfaces. Using this material, the specific crystallization velocity V was again determined at a number of supersaturations and the results are shown in Fig. 6 (washed seed). The slope of the least squares line gives a rate constant $k = 0{\cdot}281 \times 10^{-4}$ g/sq.cm./min. which is in fair agreement with that of SMYTHE. It appears that the shape factor for a cube is much more appropriate for the washed than for the unwashed seed, but the precise shape factor is not known. Attempts to measure the specific surface area of sucrose crystals by permeametry methods failed to distinguish between unwashed and washed seed ; further attempts are being made using the adsorption of krypton at liquid nitrogen temperature.

ACKNOWLEDGMENT

We wish to acknowledge the valuable contribution of Dr. R. J. BISHOP in designing the apparatus in its early stages and the technical assistance of Miss S. J. PRICE. We also wish to thank Dr. W. J. DUNNING of Bristol University and Dr. W. M. NICOL of the Physics Department for helpful criticism and advice.

[1] *Proc. 10th Congr. I.S.S.C.T.*, 1959, 323; *Austral. J. Chem.*, 1967, **20**, 1087.

SUMMARY

An apparatus has been developed to study the crystallization of sucrose under ebullition conditions. The new apparatus operates at constant temperature, pressure and hence supersaturation in the range of factory vacuum pan conditions.

This crystallizer (Fig. 1) is essentially a flask with a reflux condenser, which can operate at any required constant pressure. By means of a magnetic valve, pure water as condensate can be diverted from the flask into a calibrated receiver. With the valve closed, a supersaturated solution is boiled under reflux at constant pressure, temperature (T_m°C) and concentration. When seed crystals are added, sucrose crystallizes from solution and the concentration, and hence the boiling temperature, decreases. When the temperature has decreased by 0·1°C a mercury contact thermometer actuates a relay and the valve opens, allowing condensate to leave the hitherto closed system. The concentration of sucrose in the flask therefore rises, and the boiling point rises: when the rise is 0·1°C, the mercury contact thermometer causes the valve to close and the cycle is repeated. The rate of collection of condensate in the calibrated vessel gives precisely the rate of crystallization of sucrose, from which the specific crystallization velocity can be calculated for the particular temperature and concentration of that experiment.

Supersaturation ratios were calculated using the published solubility data of VAVRINECZ[3]. A plot of specific crystallization velocity against supersaturation was roughly linear, but did not pass through the origin. In two experiments with the calculated supersaturation in excess of 1, the seed crystals were seen to dissolve. This clearly indicated that the solubility under the ebullition conditions of the crystallizer was greater than as published. By careful adjustment of the pressure, sucrose solutions were boiled under reflux at a number of temperatures, and equilibrium in the presence of excess solid phase was approached from both over- and under-saturation. The saturation concentrations determined for these ebullition conditions were about 1·5 g sucrose/100 g solution greater than the published values for non-boiling equilibrium.

The discrepancy was traced to the superheating necessary for a satisfactory evaporation rate. When the boiling rate was reduced, by changing the electric heating mantle for a water bath, the measured saturation concentrations approached the published non-boiling values.

The magnitude of the temperature rise due to superheating can be deduced from the vapour pressure curves for sucrose solutions; it is seen to be about 0·5°C. The superheating temperature rise was measured by installing a thermometer (T_2) in the jet of a Cottrell pump in the crystallizer; the superheating, given by $(T_m - T_2)$°C, was about 0·5°C. A second thermometer (T_1) placed in the same vapour, but bathed in pure condensate, allowed the B.P.E. of the sucrose solution to be measured without reference to the experimental conditions of the determination. Hence the concentration could be deduced from known B.P.E. data; this was found to agree with the concentration determined refractometrically on the sucrose solution. Six complete sets of data are shown in Table II.

It is concluded that in a controlled pressure boiling crystallizer the superheating which is necessary for a high rate of evaporation causes a marked reduction in supersaturation. The effect is likely to be found in all commercial vacuum pans and offers a satisfactory explanation for the anomalously high supersaturations which have been reported.

Specific crystallization velocity determinations have been made under ebullition conditions using pure sucrose solution with both washed and unwashed seed. In each experiment the supersaturation was determined using our own measurement of solubility under the experimental ebullition conditions employed. The crystallization rate constant was determined for ebullition at 73·0°C and the value for washed seed crystals found to be in agreement with that of SMYTHE[9].

Brevities

East German sugar factory for Uruguay[1].—Under the terms of an agreement between the East German export organisation Chemieanlagen-Export-Import GmbH and Azucarera del Río Negro SA, a beet sugar factory having a daily slicing capacity of 2000 tons is to be erected at Mercedes, in Uruguay.

* * *

French sugar as German animal fodder[2].—It is reported from Paris that a group of French firms has sold 30,000 tons of white sugar to one German firm and 28,850 tons to another, which is intended to be used for animal feeding purposes in Germany.

* * *

Argentina sugar production target for 1968[3].—The Government of Argentina has fixed a production target of 750,000 metric tons for the campaign year 1968. This quantity is one-third lower than the production capacity of the sugar industry of Argentina and 70,000 tons below the probable home sugar requirements. By means of this limitation of sugar production, surplus stocks which still exist and cannot be exported should be reduced. They are estimated at about 180,000 tons as at the beginning of the 1968 sugar campaign year (May 1968).

* * *

BASICO.—The joint capital of this consultancy firm, founded in 1964 as a joint venture by Kleinwanzlebener Saatzucht AG and Süddeutsche Zucker AG, has been raised to DM 1 million. The increase has been made necessary by the constantly expanding activities of BASICO, which specializes in consulting and planning in agriculture and agricultural industry, mainly in the developing countries, but also in Europe and the USA.

* * *

New Rumanian sugar factory.—Buzau sugar factory, which has a daily slice of 3000 tons of beet, has recently started operations. This is the first of three BMA sugar factories being built in Rumania.

[1] *Die Lebensmittel-Industrie*, 1967, **14**, 402.
[2] *Public Ledger*, 18th November 1967.
[3] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (32), 18.

Surface Active Constituents in Beet Sugar Crystallization

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Paper presented to the 13th General Assembly, Commission Internationale Technique de Sucrerie (C.I.T.S.), 1967

PART II

To obtain an indication of the molecular size of the peptide, the "Sephadex" fractionation was repeated on "Sephadex G75" (exclusion limit 70,000). The results are recorded in Table VI; in this experiment 2 ml of each fraction were used in the assessment of foaming capacity.

Table VI

Sephadex G75 fractionation of foaming extract Effect on the foaming index obtained by adding 2 ml of each fraction to a low foaming sugar

	Foaming index			*Volume of fraction*
Fraction	*B.P.*	*118°C*	*Sugars present*	*ml*
1	—	—	Nil	10
2	—	—	,,	13
3	84	60	,,	12
4	97	63	Trace of levan	13
5	103	71	Nil	12
6	96	65	,,	12
7	104	72	,,	12
8	102	70	,,	12
9	107	78	Trace of sucrose	12
10	200	110	Raffinose, sucrose and invert	12
11	97	72	,,	12
12	98	61	Trace of sucrose	13
4+5+6+7+8	132	90	—	—

The electrogram showing the amino acids produced by acid hydrolysis of the fractions is reproduced in Fig. 2. The material from G75 was no longer concentrated into two fractions but was dispersed over fractions 4 to 8 tailing into fractions 9 and 10. Fractions 10 and 11 contained the sugars and pyrrolidone carboxylic acid which yielded the strong glutamic acid spot in these fractions.

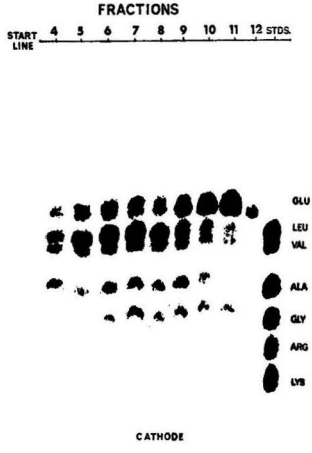

Fig. 2. Electrogram of hydrolysed G-75 fractions

The sugar-free fractions 4 to 8 containing peptide all induced foaming to some extent though, as is to be expected with the disperse fractionation, the effect of the individual fractions was less apparent than with the concentrated fraction 7 from G25. In combination, when 2 ml of each fraction was added to 50 g of sugar, these fractions had a very noticeable effect on the foaming index. It is considered that the peptide material is heterogeneous with respect to molecular size, the bulk of the material having a molecular weight exceeding 5000 but less than 70,000. Material in this size range would be excluded on "Sephadex G25" but would not be completely excluded on "Sephadex G75".

Although fraction 10 contained very little peptide, this fraction had a very marked effect on the foaming index. It is concluded that the foaming potential of this fraction is due to a surface-active component other than peptide.

Fraction 10 was initially a clear yellow solution but, after standing at room temperature for 24 hours, a small amount of brown precipitate was produced and the foaming capacity of a 2 ml addition to 50 g of sugar had been reduced from an initial index of 200:110 to 156:102. Further investigations on this fraction are continuing.

Of the peptide-containing fractions, fraction 4 was opalescent yellow in colour and fractions 5 to 8 were virtually colourless. It is concluded that the foaming capacity of these fractions is due to peptide and not to coloured compounds.

The peptide hydrolysis products from the "Sephadex G25" fractions 7 and 8 were bulked and examined by two-dimensional paper chromatography and the paper chromatogram is reproduced in Fig. 3. The chromatogram was run successively for 12 hours in 77:10:13 *n*-butanol:formic acid:water, dried and run for 12 hours in the second dimension in 100:100:28 phenol:*m*-cresol: 0·1M sodium borate of pH 9·3[9]. Amino acids which could be identified from the known positions of standards were, in decreasing order of concentration: leucine, α-alanine, glycine, serine,

[9] LEVY and CHUNG: *Anal. Chem.*, 1953, **25**, 396.

glutamic acid, threonine, proline, aspartic acid, valine and lysine. Small amounts of other ninhydrin-positive compounds were also present. There was, however, a strongly-reacting unknown "X" and the intensity of this spot was almost as strong as that of leucine. The unknown runs close to the position of γ-amino butyric acid but when this latter compound was added to the hydrolysate the two amino acids were clearly separated by two-dimensional chromatography.

The hydrolysates from the more disperse "Sephadex G75" peptide fractions were analysed individually by two-dimensional chromatography. Each of the hydrolysed fractions was found to contain the unknown but its concentration relative to the other amino acids differed detectably between the fractions.

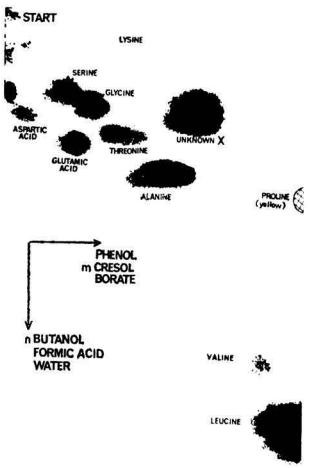

Fig. 3. Paper chromatogram of hydrolysed peptide fractions

Further investigations of this component are continuing.

It is considered significant that γ-amino butyric acid was not present in the hydrolysates since this amino acid is present in beet juices and readily reacts with invert sugar to form coloured compounds. The peptides in the foaming fraction are therefore not associated with Maillard reaction products but probably originate as part of the beet protein.

Peptide concentration in white sugar

The chemical composition of the non-peptide surface-active constituent is at present unknown but the possibilities of estimating the peptide constituents by hydrolysis to amino acids was investigated.

The method employed was based on the extraction of foaming components from carbon. Fractionation of the extract on "Sephadex G25" to separate the peptides is very time-consuming and direct measurement of total amino nitrogen in hydrolysed carbon extract would be inaccurate because of interference by the glutamic acid from pyrrolidone carboxylic acid. The method adopted was visual estimation of the amino acids, excluding glutamic acid, after electrophoresis of the hydrolysed extract from carbon

A 500-g quantity of sugar was dissolved in 750 ml of water; 1 g of powdered activated carbon was added, the mixture stirred at 80°C for 30 minutes and it was then filtered on a 12-cm Buchner funnel using a Whatman No. 2 paper. The carbon was washed with 250 ml of water and the filtrate and washings discarded. The washed carbon was eluted with 5 × 50 ml of boiling glacial acetic acid, the eluates bulked, vacuum-distilled to dryness and the residue taken up in 10 ml of water. To 5 ml of the aqueous extract was added 5 ml of concentrated hydrochloric acid and the mixture heated in a sealed tube at 110° for 16 hours. The remaining 5 ml of extract was concentrated to 1 ml. The hydrolysate was vacuum-distilled and made up to 1 ml with water. Eight samples of sugar were examined and considerable variation in peptide level is apparent from the comparative electrogram shown in Fig. 4. Amino acid levels in the concentrates were estimated by visual comparison with standards after separation by high voltage electrophoresis. No amino acids were detected in the aqueous concentrates before hydrolysis.

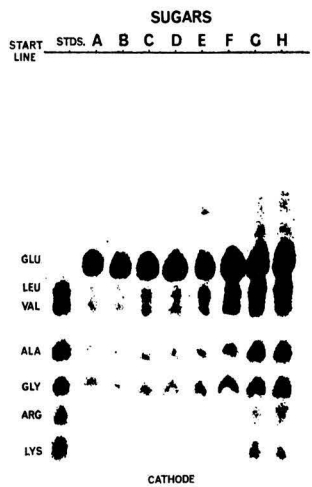

Fig. 4. Electrogram of hydrolysed extracts from white sugars

Glutamic acid, which was the principal amino acid in each hydrolysate and which largely came from pyrrolidone carboxylic acid, not peptide, was not estimated. The estimate of the remaining amino acids was totalled to give an approximate peptide concentration in the acetic acid eluate. The results, together with the foaming indices and polarographic oxygen maxima of the eight beet white sugars, are recorded in Table VII.

Table VII

Comparison of peptide content of carbon extracts with the foaming indices and polarographic peak heights of white sugars

Sugar	*Peptide (p.p.m. on sugar)*	*Foaming index* B.P.	118°C	*Polarographic peak height* (μA)
A	0·1	86	61	10·4
B	0·1	83	60	9·8
C	0·2	91	67	8·8
D	0·2	89	66	7·8
E	0·3	97	77	6·4
F	0·3	90	77	5·8
G	1·0	107	103	1·8
H	1·2	112	89	0·0

Table VII shows that with the exception of samples G and H there appears to be a relationship between the peptide content of the carbon extracts and the foaming indices or the polarographic peak heights of the sugars. It will however be seen from the next section that peptide content is not the only criterion affecting the foaming indices of sugars.

Effect of re-crystallization on foaming

In order to obtain a true indication of the effect of recrystallization on foaming it was necessary to produce sugar of a similar grain size to that of the initial sugar. A small-scale vacuum pan was developed for this purpose. It consisted essentially of a 5-litre "Quickfit" wide-necked reaction vessel fitted with a mechanical stirrer as illustrated in Fig. 5. The vapour could either be retained by reflux or removed by distillation. The vessel was heated by a 500-watt hemispherical "Isomantle" and the vacuum was automatically controlled to ±0·1 inches Hg.

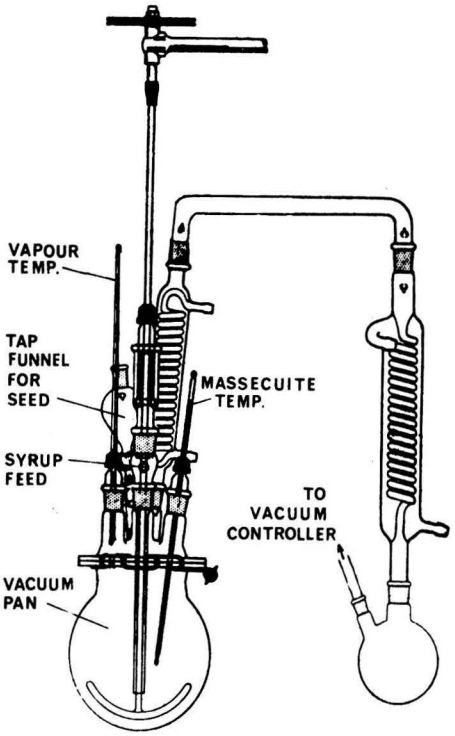

Fig. 5.

The system of boiling which was developed was as follows: 700 ml of 67°Bx syrup was run into the reaction vessel, and the stirrer and the heater switched on. The reflux condenser was turned off and the distillate condenser turned on. The vacuum was adjusted to 21·5 in, giving a vapour temperature of 68°C when boiling commenced. The liquor was boiled down until its temperature reached 77°C, corresponding to a supersaturation of 1·25, and was then seeded with 0·1 g of icing sugar suspended in 2–3 ml of *iso*-propanol. The reflux condenser was turned on and the stirring rate increased while the grain grew and came together. After 10 minutes under these conditions the reflux condenser was turned off, the footing further tightened and then a feed of hot 67°Bx liquor run slowly into the flask. The rate of flow was increased as the boiling proceeded so that the supersaturation, calculated from the boiling-point elevation, was about 1·2 during the remainder of the operation. The feed was shut off when the massecuite volume reached 3·5 litres and a final concentration to 90°–92° Bx was carried out.

The massecuite was spun in a 12-inch diameter basket at 1000 r.p.m. and the sugar was washed with 450 ml of cold water using a fine spray. The total spinning time was usually about 5 minutes.

The damp sugar was granulated in a 30-inch long, 6-inch diameter stainless steel granulator, using a hair dryer as a hot-air source.

The yield of sugar was approximately 30%.

The results of three typical recrystallization experiments are described. The sugars were dissolved, adjusted to pH 7·5 with sodium carbonate solution and then to 67° Bx with water and each syrup was crystallized in the laboratory vacuum pan. The foaming indices, and the peptide concentrations in carbon extracts, from both initial and recrystallized sugars are recorded in Table VIII.

Table VIII

Effect of recrystallization on foaming index and peptide in carbon extracts

Experiment	*Sugar*	*Foaming index* B.P.	118°C	*Peptide (p.p.m. on sugar)*
1	Initial	335*	225*	10·6
	Recrystallized	91	80	0·5
2	Initial	90	93	0·8
	Recrystallized	92	72	0·1
3	Initial	97	77	0·3
	Recrystallized	94	68	0·03

* This foam test was carried out in a 400-ml tall beaker.

In experiment 1, the initial sugar was the middle-product sugar from a white sugar factory operating a three-boiling system. The improvement in foaming index was very considerable and was accompanied by a marked reduction in measured peptide.

With the higher quality sugars in experiments 2 and 3, recrystallization improved the foaming index slightly but the 118° index was not as low as recorded for sugars A and B in Table VII even though the peptide contents of the latter were no lower than was achieved in these two recrystallized sugars.

It is concluded that the peptide material is not the sole source of foaming in white sugars and that recrystallization alone is not sufficient to produce non-foaming sugars.

Acknowledgments

The authors wish to thank R. M. BOOCOCK, R. E. ATKIN and R. W. MURDEN for the invaluable assistance they have rendered in carrying out much of the work reported in this paper.

Summary

An attempt has been made to identify the components mainly responsible for the foaming observed in some beet white sugars.

Beet saponins are known to have surface-active properties, but, at the low level which they occur in white sugar, their contribution to foaming is considered to be small.

A foaming sugar can be made non-foaming by treatment with powdered carbon, and a crude foaming extract can be obtained by eluting the spent carbon with hot acetic acid.

This extract contained no saponin, but did contain high molecular weight peptides which were found to induce foaming. The extract also contained a low molecular weight foaming component, which is at present unidentified.

The peptide concentrations in acetic acid extracts from eight beet white sugars were measured by estimating the total amino acid concentration after hydrolysis by visual comparison with standards on electrograms. Glutamic acid was not included in the estimate since this was formed mainly by hydrolysis of pyrrolidone carboxylic acid and not from peptide.

It was found that, in general, higher levels of peptide were accompanied by higher foaming indices, but at the lower peptide levels a direct relationship between peptide and foaming index did not hold.

The Economics of Supplementary Irrigation in Sugar Cane

By D. B. CAMPBELL (Tate & Lyle Technical Services Ltd.)

THIS article is directed towards those newly developed areas of the world where yield and cost records may be incomplete and where management may be considering the merits of supplementary irrigation as a means of increasing financial returns. In some ways it may have a dampening effect on the initial enthusiasm for installing supplementary irrigation systems; this is not its particular intention but if this is so it might also have served its purpose. By its title it is also not intended for those territories which grow sugar cane under extreme conditions of aridity where economical yields are impossible without the application of water; rather is it directed to those areas of the world which can grow a crop without irrigation but for varied reasons may wish to install a supplementary irrigation system which they hope will be of benefit to their operation. The attitude of management to irrigation in this context is invariably a favourable one. The idea of irrigation has been well sold even under conditions where its effects may to some degree be difficult to quantify. Certainly during drought, rare though it may be, financial controllers of companies are invariably under some pressure to provide capital for the installation of irrigation supplies. No responsible financial director can fail to be sympathetic to such demands and will undoubtedly want to do everything in his power to help under such conditions. The safeguarding of production in times of sporadic drought may be high on the list of reasons why irrigation is often installed in regions where rainfall in normal years is adequate for the production of economical yields. Thus irrigation under these conditions acts as an insurance service and the economics of its presence will be greatly affected by the intensity of its use.

The first consideration in this exercise is the cane plant itself. Though cane is not a zerophyte, it nevertheless does display great tolerance to high soil moisture tensions. Though bud initiation and root development of the seed piece will not take place in dry soil, once the cutting has established its own root system, very severe and prolonged soil

moisture deficits have to develop before the plant will actually die. Ratoon stubble, using the roots of the previous crop, can invariably extract sufficient moisture to enable it, if not to put on economical growth, at least to survive critical times of very low soil moisture levels. Invariably after the soil moisture reservoir has been replenished, the recovery of the crop to normal growth increments is quite quickly assured and, indeed, because of the stimulus of a prolonged drying and a sudden wetting to the process of nitrification, rate of growth after a drought may often be enhanced. It has been shown that photosynthesis can continue in sugar cane plants growing in soil with moisture levels below permanent wilting percentage, though at a much lower rate than when moisture was readily available. After such a condition the plant can develop 80–90% of the original rate of photosynthesis two days after irrigation. HUMBERT reports that studies in Hawaii showed an exaggerated rate of growth following periods of reduced growth when the cane plants approached permanent wilting point. These facts suggest that sugar cane, though perhaps subject to severe moisture stresses, during which quite serious yield reductions may result, will, on receiving water, revive and indeed if the period of stress has not been prolonged, may accelerate its growth rate and eventually recoup its previous losses. It is fairly clearly established, then, that it would be rare indeed for the total investment in the establishment of a ratoon crop to be lost, though the return on the investment might be severely reduced because of drought. Sugar cane, being vegetatively propagated and having the ability to regenerate after cutting, has the valuable property of being able to withstand longish periods of low soil moisture contents and to recover relatively quickly after the factor of limiting moisture has been removed.

If we are assured that the investment will not be lost because of periods of drought, then before examining means of alleviating sporadic drought we must be further assured that there are no other factors limiting yield other than a possible periodic shortage of moisture. It is highly likely that the expenditure involved in any scheme for the artificial application of water will be high. There is little advantage in providing expensive water if there is severe competition from weeds, nutrient limitations or low stalk populations. The latter condition involves the important question of intensity of replanting, the level of which must be thoroughly investigated. The introduction of irrigation may well be a valuable tool in increasing the length of economical ratooning by reducing stool mortality or by stimulating the germination of "suppljes" and thereby substantially reducing production costs. On the other hand if the level of replanting is such that poor soil conditions and low populations persist, then the returns from the expensive application of water will be severely reduced.

There are many authorities who value short periods of severe low soil moisture as a method of "natural cultivation", especially in very heavy clay soils. Such soils are being increasingly subjected to the detrimental effect of heavy in-field transport, mechanical loaders and harvesters. The growth of subsequent ratoons suffers and the swelling and shrinkage of the clays under a severe drying and wetting régime may be a valuable means of maintaining soil structure. Supplementary irrigation by maintaining soil moisture at constant levels will of course negate such effects.

The final and possibly most important cultural factor to consider is the provision of adequate drainage conditions. The effect of any supplementary irrigation régime will be to dampen the acuteness of the peaks of a monomodal or bimodal rainfall pattern. Such patterns invariably give high precipitation over short periods. The facilities for removing excess water both in the field and regionally must be adequate at such times. The quick build-up of high water tables followed by a relatively slow release of excess water to the drains will restrict the volume of soil available to the plant. If such a condition is followed by drought, the situation will obviously be severely aggravated and the plant will rapidly wilt and the growth curve bend. It is normal in the tropics for rainfall and high temperature conditions to coincide. This is the time when the plants want to grow. If high water tables restrict the growth during this boom time, then the effect of a drought during previous or subsequent periods will be even more severe on the final yields obtained.

Total irrigation régimes, be they flood or overhead, are expensive both in capital and operational spending. Supplementary irrigation is even more so because of its indefinite and seasonal nature. It is difficult to justify highly skilled field management, backed by competent maintenance services to an operation which in some years may be barely required. The result is naturally a lowering of operational efficiency and resultant high application and maintenance costs. It is therefore essential that managements assure themselves that the sugar cane plant is making the best use of the natural rainfall it already receives and that no other capital injection is required to make the conventional cultivation operations more efficient, before embarking on further spending for the provision of supplementary water.

It has become fairly well accepted that where supplementary irrigation is required it will be applied by an overhead system. There are three main reasons for this. Firstly, the terrain in relatively high rainfall conditions can often be steeply rolling. Control of surface applied water is difficult under these conditions and precision contouring of cane rows and distribution canals imposes problems on other field operations. Secondly, where flat terrain exists under a monomodal rainfall pattern, drainage during the wet season is of extreme importance. It is difficult to compromise between an intensive drainage system and the efficient application of surface irrigation water. Any cultural method designed to remove water quickly will naturally tend to diminish the effectiveness of artificially applied water. The final reason is that the very presence of field canals for the

distribution of surface water imposes further difficulties on an industry, which in many parts of the world is looking to mechanization to solve its economic problems.

Irrigation requirements

The method of calculating supplementary irrigation requirements is often to extract the dryest period within a series of annual rainfall recordings, compute the effective rainfall in any one month by discounting the effect of very high and very low precipitations, and balance against this the estimated consumptive use of the cane, the latter being based on the evaporation of an open water surface during the period under consideration. Thus irrigation capacities are often calculated on maximum requirements. It is unlikely, especially in supplementary régimes, that this is the most economical method and it seems that designs should conform more closely to the requirements of average conditions and thus maximize the use of expensive installations.

Under a supplementary system the highest returns may be obtained from irrigating a particular stage of plant growth. For example, the return from applying water to established plant cane may be greater than from the application of water to ratoons. Under such conditions water resources should be concentrated in plant cane areas. If a central pumping station serves a network of underground pipes for distribution of water, then this immediately imposes an inflexible high cost per unit area system and the full irrigation potential cannot be brought to bear on the priority areas. Under supplementary irrigation conditions, therefore, it is highly advantageous to have pumping and distribution systems as portable as possible. The relationship between open water evaporation and consumptive use, inexact as it may be, still provides a valuable practical guide to crop water requirements. It is the relationship between water requirements at various stages of the plant's life and final yields of sugar that continues to claim the attention of investigations. The responses likely to be obtained to supplementary irrigation at different physiological stages in a plant's life are open to much conjecture. The field experimentation is quite involved and the application of experimental irrigation practice to commercial cane growing can be quite difficult. This latter problem is of course only a question of management, but maintaining correct nozzle pressures, optimum distribution patterns and irrigation cycles in remote parts of the world can be difficult in the extreme and any attempt to duplicate experimental irrigation results in the field is often unsuccessful. Irrigation requirements, we have said, are often calculated to provide the maximum water requirement for the plant. It has been shown by SHAW in Jamaica (see Table) that the relationship between yield response and number of irrigations is not linear and as might be expected follows the law of diminishing returns. Where other cultural effects might be limiting, it is reasonable to suggest that supplementary irrigation will only contribute yield increments of the order shown towards the latter end of the scale. Especially might this be so as the application of supplementary irrigation often coincides with periods of low temperatures. These periods are characterized principally by a lowering of night temperatures.

No. of Irrigations	4	5	6	7	8	9	10	11	12	13
Tons cane per acre	30·1	32·9	35·2	37·2	38·9	40·3	41·3	42·2	42·9	43·4
TC/A increment	—	2·8	2·3	2·0	1·7	1·4	1·0	0·9	0·7	0·5

Evaporation from a free water surface may not reflect the consumptive requirements for a crop accurately during such times. The application of water will depress soil temperatures and unless actual lysimeter studies have been carried out to determine yield increments under such conditions the response to irrigation during periods of low temperatures will be disappointing. The response to irrigation will at the same time depend on the stage of crop growth. SHAW working in the quite equitable climates on the plains in Jamaica reports that yield increments to irrigation are much larger in the first third of an annual crop's life than in the last third. This is an important finding especially where supplementary irrigation is concerned and where there is a limitation of equipment or water, it is obviously important to decide what stage of growth will give the highest return to irrigation. This curve indicates that the productivity in the latter third of the crop's life may only be 50% of the production in the first third. Thus irrigation should be used to ensure that the crop in the young stages of growth suffers no moisture stress. Under less equable conditions however and where cropping periods coincide with time of low soil temperatures this curve is unlikely to hold true and climatic conditions rather than physiological factors are likely to dominate growth increments.

Change of Emphasis

It may be heretical to suggest that the striving towards maximum yields per acre may well be of less importance as a method of reducing costs than heretofore considered. Because of the ever increasing proportion of total production expenditure being devoted to cane harvesting, high sugar yields in association with high cane yields may in some places have to be sacrified in the interests of efficient mechanical cane handling. The importance of high outputs from extremely expensive mechanical harvesters and the importance of the delivery of a clean product to the factory may entail drastic reappraisal of acceptable cane yields in the field and lower cane tonnages achieved from upright varieties may be the only answer to economical mechanization. Thus supplementary irrigation and indeed the whole economics of water application, fertilizing and all other cultivation practices may have to be reappraised under the ever changing conditions of cane handling.

Sugar cane agriculture

Spring recommendations for the control of Johnson grass and other weeds and grasses in Louisiana sugar cane, 1967. ANON. *Sugar Bull.*, 1967, **45**, 147–150. Recommendations are given regarding the use of various herbicides, including "Fenac" and "Terbacil" ("Sinbar"). It is pointed out that so far there is no economically feasible chemical that can take the place of the fallow ploughing programme in which land is ploughed six or more times in late spring and summer after the temperature is high enough for seed germination and good grass growth.

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The use and efficiency of different forms of nitrogen in sugar cane. J. L. DU TOIT. *S. African Sugar J.*, 1967, **51**, 213–227.—The relative amounts of different nitrogenous fertilizers used in South Africa during the period 1957–1965, notably ammonium sulphate, urea and limestone ammonium nitrate, are clearly shown by means of a chart. This illustrates the fluctuations in popularity of different forms of nitrogen by South African cane growers. The sudden rise in popularity of urea is explained by the establishment of a urea factory in South Africa (at Modderfontein) in 1959. In 1957 urea accounted for only 6% of the nitrogen used. By 1960 the figure had risen to 60%. The advantages and disadvantages of the different forms of nitrogen fertilizer are discussed and experiences in other cane growing countries cited.

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Army worms on the march in Natal. ANON. *S. African Sugar J.*, 1967, **51**, 241.—Several recent outbreaks of this pest in Natal and damage done to young cane, pasture or fodder crops are discussed Remedial measures, i.e. spraying with "Malathion", "Dipterex", "Sevin" and DDT, are given.

* * *

Mosaic-infected Johnson grass found in Louisiana. T. P. PISONE, R. W. TOLER and W. P. BOND. *Plant Disease Reporter*, 1967, **51**, 108.—Johnson grass (*Sorghum halepense*) with mosaic symptoms was found in Louisiana in the summer of 1966, symptoms being on young plants and the young leaves of old plants. It is considered that the Johnson grass strain of sugar cane mosaic virus has become established and is a potential threat to maize as well as to sugar cane. Mosaic-infected Johnson grass is also widespread in Arkansas and Texas.

Notes on insect pests of crops in Malagasy. I. *Lepidoptera.* J. APPERT. *Agronomie Tropicale*, 1967, **22**, 153–230.—Five cane pests are included. A description of the insect is given with information on common names, distribution, biology, hosts, control measures, etc.

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Soil fumigants and nematodes in sugar cane. T. K. TSAI and H. T. CHU. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (42), 1–8.—This paper reports the results of experiments conducted with "Fumazone" and "Nemagon", which gave better results than some fumigants tried earlier. The favourable effect was shown not only in plant cane but also in ratoon cane.

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Studies in ratoon stunting disease of sugar cane. III. Effect of thermal treatments on germination of sugar cane. H. P. LIU, S. M. LEE, W. S. TENG and P. T. HSIEH. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (42), 9–21.—Hot water treatment (HWT) and hot air treatment (HAT) of setts from several varieties, taken from different parts of the stalk, were compared to ascertain effect on germination. Heat tolerance was found to vary with different varieties; in general the higher the temperature the lower was the germination rate with both HWT and HAT. Setts from the upper part of the stalk gave lower germination with HWT than setts from lower levels, but with HAT the reverse applied. HWT caused more damage than HAT when the temperature was raised 1—2°C higher than the standard heat treatment. Results of using setts after varying periods of storage are discussed.

* * *

Studies on root-knot nematodes of sugar cane. I. Effect of soil temperature on the activity of *Meloidogyne* spp. C. H. HU. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (42), 23–40.—Four species of root-knot nematodes have been found in sugar cane fields in Taiwan, *Meloidogyne incognita* and *M. javanica* being the most important. They are widely distributed in the island. Experiments showed that temperature was an important limiting factor in the development of root-knot nematodes in Taiwan.

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Comparison of species of Pythium causing sugar cane root rot. S. C. HSU and Y. C. LIU. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (42), 41–46.—Severe damping-off of seedlings, sometimes more than 80%, was found to be due to four species of root rot fungi (*Pythium*).

The present paper is concerned mainly with *Pythium mamillatum*. Experiments showed that combined inoculations of the pathogens caused more damage than individual inoculations of the four fungi.

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A further study on chemical control of the sugar cane long horn beetle, *Dorysthenes hydropicus*. H. T. TSENG. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (42), 47–50. Severe damage (over 1000 ha) by the beetle in several districts is reported, mainly in unirrigated cane. Two applications of "Heptachlor", at the rate of 2·5 lb/ha before planting and as a side dressing later, were found to be just as effective as "Aldrin".

* * *

Studies on methods of improving sandy soil. D. S. CHENG, S. S. WAN and Y. J. HSIA. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (42), 71–78.—The improvement in yields of cane resulting from applications of filter press cake and clay in varying amounts (250, 500 and 1000 tons/ha), are given. Filter press cake was more effective than equal quantities of clay. With both, the greater the application the greater was the increase in yield in both plant and ratoon cane. Soil texture was markedly improved.

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Planting methods with sugar cane on tidal lands. I. The influence of row spacing on yield. W. T. CHEN. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (42), 87–96. Results are given of tidal land cane spacing experiments at Yung-Lin in Taiwan on light sandy soil; this is an area subject to flooding in autumn and strong winds in winter. Varieties grown must show resistance to drought and salty soil conditions. The variety N:Co 310 proved superior to F 148. A spacing of 1 m representing 40,000 setts/ha was regarded as the most suitable.

* * *

Studies on the cultivation of the newly released cane variety F 151. R. S. CHEN and C. C. TSE. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (42), 97–109.—Field trials on planting time and spacing with this new variety are recorded. They were carried out during 1962-65 on two plant and two ratoon crops.

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Release of new cane varieties in Taiwan. I. SHEN. *Taiwan Sugar*, 1967, **14**, (1), 7.—Although the variety N:Co 310 is widely cultivated, especially in marginal lands, it has given way to some extent to the varieties F 146 and F 148. It is expected that other new varieties may supplant it further, viz. F 153, F 154, F 155 and F 156. Descriptions of these varieties are given.

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Soils and fertilizer usage on Taiwan sugar cane farms. K. LI. *Taiwan Sugar*, 1967, **14**, (1), 20–22.—Throughout south-east Asia only Japan uses more fertilizers than Taiwan per unit of cropped land. From 20 to 30% of the fertilizer used in Taiwan is for sugar cane. The proposed increase in soil surveys and improved soil testing facilities combined with field experiments should lead to greater efficiency in fertilizer use and a sound system of soil management for various cane varieties.

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Effects of methyl bromide fumigation on young seedlings of sugar cane. C. C. LO. *Taiwan Sugar*, 1967, **14**, (1), 23–26.—Experiments are reported in which sterilization of the soil used for raising sugar cane seedlings by means of methyl bromide was compared with the currently practiced steam sterilization. Germination in the case of methyl bromide was slightly inferior to that with steam sterilization but mortality of seedlings was less. The best dosage rate was found to be one pound methyl bromide per 120 flats or seedling containers, and the optimum fumigation period 24 hours, with sowing taking place a fortnight after fumigation.

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The circulatory system of the pink sugar cane mealy bug, *Saccharicoccus sacchari*. R. L. YADAVA. *Indian Sugar*, 1967, **16**, 821–826.—Results are given of a detailed anatomical study of the circulatory system of this insect.

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Response to nitrogenous and phosphatic manuring of sugar cane on alluvial soils of the Tulsipur Zone of the Gonda District, Uttar Pradesh. N. CHATTERJEE and K. S. MATHUR. *Indian Sugar*, 1967, **16**, 839–844. Results are given of 19 manurial trials with the variety CoS 510, in three soil types, under irrigated and non-irrigated conditions. Nitrogen requirements under irrigation were markedly higher on all three soil types.

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Louisiana's newest commercial variety of sugar cane—L 60-25. L. ANZALONE, E. PALIATSEAS and S. J. P. CHILTON. *Sugar J.*, 1967, **29**, (11), 9–10.—Details are given regarding this new variety, the two most outstanding characteristics of which are early maturity and high sucrose. It is resistant to red rot disease and tolerant to ratoon stunting disease. Although it is susceptible to mosaic, the virus spreads less rapidly than in the commercial variety CP 52-68.

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Helicopters spread dry chemical and fertilizer on cane fields. ANON. *Sugar J.*, 1967, **29**, (11), 18–19.—An aerial dispensing system for dry agricultural chemicals and fertilizers, which has been developed by Evergreen Helicopters Inc., is described. The spreader, the first of its kind, will permit fast, uniform and economical application of granular materials by air. It was used to apply a phenomenal fertilizer dressing of 1000 lb/acre over thousands of acres of cane in Puerto Rico. It may be modified or adapted for seed broadcasting, distributing as little as one pound of seed per acre.

Root rots the cause of poor stands of ratoon cane. H. T. CHU, S. C. HSU and Y. T. LIU. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (43), 1–9.—In some parts of Taiwan ratoon crops, amounting to several hundred hectares, have been so poor as to be not worth harvesting. Investigations are described which indicate that root rots, i.e. species of *Pythium* and *Leucoporus*, are the cause.

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***Leucoporus* root rot of sugar cane in Taiwan.** S. C. HSU and H. T. CHU. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (43), 11–20.—A description is given of a new or previously unrecorded root rot found in Taiwan on the sugar cane variety N:Co 310. It is due to a species of *Leucoporus* and causes plants to be weak and stunted.

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Studies on nursery-raised sugar cane setts. P. TSAI. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (43), 21–54.—This consists of three separate papers. Experiments are described which were undertaken to ascertain whether setts or cuttings from different parts of the stalk, raised and grown-on in nurseries and then field planted, could reduce the time taken to produce millable stalks. Different varieties of cane were used. Under certain conditions the period of growth in the field was reduced from 12 to 10 months.

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Photosynthesis by sugar cane leaves. New carboxylation reaction and pathway of sugar formation. M. D. HATCH and C. R. SLACK. *Biochem. J.*, 1966, **101**, 103–111; through *J. Sci. Food Agric. Abs.*, 1967, **18**, i–86.—After exposure to $^{14}CO_2$ for approx. 1 sec, more than 93% of the ^{14}C fixed in detached leaves is present in malate, aspartate, and oxaloacetate. After exposure for longer periods, large proportions of the ^{14}C are present in 3-phosphoglycerate, hexose monophosphates, and sucrose. Similar results are obtained when the leaves are attached to the plant. ^{14}C appears first in C-4 of the dicarboxylic acids and C-1 of 3-phosphoglycerate; the labelling pattern of the hexoses is consistent with their formation from 3-phosphoglycerate. The reaction that gives C_4 dicarboxylic acids is the only quantitatively significant carboxylation reaction. ^{14}C incorporated into the C_4 dicarboxylic acid pool is transferred via 3-phosphoglycerate to sugars. A pathway is suggested for photosynthetic fixation of CO_2 in sugar cane leaves.

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Physico-chemical changes in major soil types of the Nira canals under the prevailing system of sugar cane cultivation. II. K. S. PHARANDE. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (2), 51–75. This paper[1] deals with exchangeable calcium, magnesium, sodium, total nitrogen, available phosphate, available potash, organic carbon and C:N ratio. Soil samples from 66 profiles on the five major soil types in the unirrigated cane areas were analysed. There was an overall increase in the total nitrogen status in the upper layers of all soil types but not in the lower layers. Available potash showed considerable decrease throughout. Exchangeable calcium and magnesium showed increases in some soils and reductions in others. Organic carbon increased in surface layers of all soils.

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Sugar cane breeding work in Western Pakistan. ANON. *Ann. Rpt. Ayub Agric. Research Inst.*, 1963–64, 119–134.—A detailed account is given of the breeding and varietal selection work on sugar cane carried out at the agricultural research institute at Lyallpur. Reference is also made to the activities of the four outstations at higher altitudes where sugar cane flowers more readily, these being at Saligran (2500 ft), Pail (2500 ft), Tret (3000 ft) and Charapani (4000 ft).

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Brazil—a pioneer with new sugar cane varieties. G. TINOCO. *Brasil Açuc.*, 1967, **69**, (3), 43–46.—Among South American countries Brazil has been a pioneer with sugar cane. The history of sugar cane and sugar cane varieties over the years in the country is discussed.

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The precautionary measures necessary in the introduction of new varieties of cane. G. MILLER A. *Brasil Açuc.*, 1967, **69**, (3), 55–57.—The quarantine measures considered necessary in the introduction of new varieties of sugar cane to a cane producing area are outlined. It is pointed out that a quarantine station should be some 100 km from the nearest cane growing area if possible.

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The history of sugar in Paraguay. ANON. *La Ind. Azuc.*, 1967, **72**, 40.—A brief reference is made to the work on the history of sugar and sugar cane in Paraguay by E. FRIEDMANN. The industry was started in a small way at Villarrica by JACOB FRIEDMANN, a Hungarian, who came to Paraguay in 1908.

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"Paraquat"—a useful herbicide in young plant cane. O. W. D. MYATT. *Cane Growers' Quarterly Bull.*, 1967, **30**, 114–115.—The use of "Paraquat" for controlling weeds in young plant cane when continuous wet conditions have impeded normal weeding is explained. The leaves of the young cane plants are affected but the growing points remain uninjured and new leaves are quickly produced.

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Some causes of germination failure. C. D. JONES. *Cane Growers' Quarterly Bull.*, 1967, **30**, 118–119.—It is pointed out that pineapple disease (*Ceratocystis paradoxa*), caused through failure to treat setts with mercurial solution at planting time, and fertilizer burn are common causes of germination failure in Queensland. Recently lack of soil moisture and poor soil tilth have been important factors.

[1] *See also I.S.J.*, 1966, **68**, 238.

Sugar beet agriculture

Control of *Cercospora* leaf spot by aerial and ground applications of fungicide. L. CALPOUZOS, G. F. STALLKNECHT and H. G. JOHNSON. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **14**, 160–163.—Experiments are reported comparing disease control and yield of sugar beets sprayed by helicopter (low volume) and by tractor-drawn equipment (high volume). Both methods were economically justified when compared with the unsprayed control. Spraying with ground equipment was better than spraying by helicopter under the prevailing conditions.

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Calcium nutrition of sugar beet. W. L. BERRY. *Diss. Abstr.*, 1966, **26**, 6985–6986; through *J. Sci. Food Agric. Abs.*, 1967, **18**, i–92.—Sugar beet were solution-cultured with nutrients in which the Ca content was varied (0·6–28 meq/litre); in a duplicate series high K (8·0 meq/litre) was included, the basal media containing 0·5 meq/litre. The plants in the low-K series showed a higher incidence of Ca deficiency than did those in media having the supplementary K. Symptoms of Ca deficiency appeared in the low-K plants even when the nutrient contained 28 meq of Ca per litre. Under these conditions the plants were unable completely to utilize the Ca present. The first appearance of a K-Ca interaction in the low-K series of plants occurred simultaneously with the first signs of K stress (reduced growth rate, symptoms in the older blades, depletion of K in the nutrient). The Ca-K interaction was unaffected by the concentration of Na present. The critical level of Ca in the beet was indicated, in the blades, by Ca 0·5% (dry basis). Under otherwise favourable conditions the plants were unable to obtain Ca effectively from nutrient media of relatively high Ca. The concentration of Ca in plants grown in the low-K media was higher than those grown in the high-K media; translocation from root to young leaves was restricted and Ca distribution in the plants was irregular. A possible function of K is that of facilitating the translocation of Ca within the plants.

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A method of obtaining different degrees of field emergence from a given (beet) seed sample. O. NEEB. *Zucker*, 1967, **20**, 269–272.—The method described and intended for experimental purposes consists basically of mixing proportions of killed seed with the normal seed before sowing. The seed is killed by brief treatment with boiling water and then dried at room temperature until its original water content is regained. It is recommended that the killed and the untreated seed be pelleted before preparing the mixtures.

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The sowing of sugar beet to final plant spacing. K. H. BAROCKA, H. GEIDEL and W. HAUFE. *Zeitsch. Zuckerind.*, 1967, **92**, 241–246.—An account is given of field experiments carried out in Germany with a view to ascertaining the limits within which the sowing of sugar beet may be carried out to a final spacing. It was concluded that the practice may be adopted where field germination or emergence exceeds 50% and that it is of little importance what spacing is adopted within the range of 12 to 15 cm, although a spacing of 12 cm was considered preferable. It gave satisfactory populations with field emergence of 40%. Seed spacings wider than 15 cm are considered to involve too much risk.

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A new method of harvesting sugar beet seed. K. DE KONIG. *Landbouwmechanisatie* (Wageningen), 1966, **17**, 389–394; through *Field Crop Abs.*, 1967, **20**, 144.—Desiccation of beet grown for seed with 4% "Diquat" in 800 l water/ha enabled combine harvesting to be carried out earlier. Early thinning of the crop was possible but there was risk of blockage of the combine in threshing. This was avoided by threshing in two stages. Seed yield and quality were higher than that obtained with traditional drying on frames. Artificial drying immediately after harvest was essential.

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Variety trials with irrigated sugar beet. V. IONESCU-SISESTI *et al. Probleme Agric.*, 1966, (5), 51–61; through *Field Crop Abs.*, 1967, **20**, 145.—In these trials 25 European varieties of sugar beet were grown over a 3-year period. Hungarian diploid varieties were outstanding in one trial and Romanian polyploid varieties in another, as far as yield was concerned.

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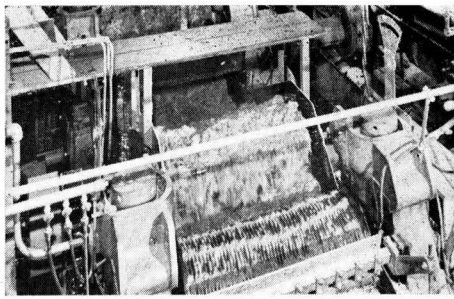
Contributions to the study of the irrigation régime for sugar beet in the western plain of Romania. I. BORA. *Probleme Agric.*, 1966, (6), 14–25; through *Field Crop Abs.*, 1967, **20**, 145.—An account is given of the trials carried out for 3 years in Dohangia State, in the Crisana region, with different levels of irrigation. Irrigation increased yields. Recommendations are given in regard to the amount of irrigation in normal and in dry growing seasons.

Cane sugar manufacture



The effect of cooling rate on the rate of exhaustion of low-grade massecuites. E. T. RELF. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 43–48. Pilot-scale experiments at the Sugar Research Institute, in which *C*-massecuite discharged from a pan was crystallized at varying rates covering the range of temperature falls between 1°F and 7·5°F/hr (giving an overall temperature drop of 45–48°F from the pan temperature), showed that although the faster cooling rates gave a significantly higher rate of molasses purity drop in the earlier stages, the final exhaustion was practically the same for all cooling rates. Hence, provided the crystallizer capacity of a given factory is sufficient to allow a cooling cycle of 30 hr, there is little to be gained by cooling at a faster rate, which will involve increased power requirements and greater strain on the crystallizer drive mechanisms. In all cases it was found that the supersaturation of *C*-massecuite exceeded 1·0, the lowest (1·06–1·08) being obtained after 6–8 hours' retention of the massecuite at approx. 150°F, while after 30 hours' curing at 105°F the supersaturation was 1·14. The massecuite viscosities were similar after curing, with a scatter of $\pm 10\%$, although more variation was found in the molasses viscosities, which ranged from 260 to 520 poises. The average limiting purity at a given temperature was 41·0, i.e. only 0·3 units above the target purity. A true purity of 41·6 was attainable after 16 hr at a cooling rate of 7°F/hr and after 24 hr at 2°F/hr, although 4 hr should be added to these times to allow for filling and discharge.

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Boiling in massecuites. A. SKYRING and R. F. BEALE. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 49–53.—To the outside of a factory low-grade pan was fixed a single-tube pan, comprising six separate steam-jacketed steel tube sections connected by very short sight glass tubes to give an overall height corresponding to the normal strike level in the factory pan, from which the massecuite and vacuum were tapped. Tests were conducted at varying steam pressures and with varying numbers of jackets connected to the steam, a constant vacuum of 26 in Hg being applied. When the lower four tubes were heated with steam at 12–15 p.s.i.g. a spasmodic variation in colour of the massecuite at the boundary layer was detected as low as the third sight glass (below the 3rd tube from the bottom), indicating the presence of bubbles just inside the boundary layer, a phenomenon which was still apparent at a steam pressure of 6 p.s.i.g. Higher up the column, the boundary layer was thinner and quite distinct bubble formation was observed. Seen from above, a $\frac{1}{2}$-inch layer of massecuite was found adhering to the column walls, the vapour passing through the "pipe" formed in the centre. Individual bubbles were separated by a membrane of massecuite which periodically broke and adhered to the wall layer. All bubbles appeared to be inside the boundary layer and not immediately adjacent to the wall; with lower steam pressure and heavy massecuite, bubble formation and massecuite movement appeared to cease. The observations are considered sufficient to refute the argument that vapour bubbles do not occur in calandria pan tubes under conditions obtaining at the end of a strike. The presence of considerable volumes of vapour made clear observations of the effect of heating all six tubes impossible.

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Pan stage procedure affects filtrability. R. J. B. MCLEAN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 55–59.—Tests were carried out at Tully sugar factory to see why an improvement in clarification efficiency from 1965 to 1966 was not accompanied by any rise in filtrability of Brand I sugar. Because of a discrepancy between the capacity of the milling tandem and that of the sugar end, throughput at the pan station was extremely high, and during the test period two pans were handling 68% of the total *A*-massecuite going to the centrifugals. Each of these pans had a boiling rate of 78 gal of massecuite/100 gal of footing/hr, compared with values of 56, 59 and 34 in the other three *A*-massecuite pans. It was found that filtrability fell with higher rate of boiling, which should therefore be limited when sugars of high filtrability are required. In the two high-throughput pans mentioned the filtrability of the sugar produced from the *A*-massecuite was 50, compared with 55, 53 and 61 in the other pans.

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True seeding—let's be critical! E. D. JENSEN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 61–67.—Having defined "true seeding", the author considers it doubtful whether any operators in Queensland sugar factories are actually using true seeding, although most believe that they are. In experiments with a laboratory pan[1] at Fairymead sugar factory to determine the cause of irregularities in *C*-massecuite grain, it was found that the slurry used for seeding contained grain varying in size from <1 to $>50\mu$. The ball mill used for its preparation was found to have an insufficient number of steel

[1] PENKLIS & WRIGHT: *I.S.J.*, 1964, **66**, 19.

balls, and a rod mill was used. After 20 hours the slurry grain obtained from this measures less than 20μ, with an average size of 5μ, but there was still quite wide variation in the size of grain produced in the seeded *C*-massecuite. A more consistent crystal content in the massecuite was produced by using heat and/or water to check graining, although the quantity of slurry required was considerably greater than the theoretical quantity calculated from the data presented by GILLETT[1]. In factory operations, more even grain was produced by using slurry of 75–80 purity, which also accelerated grain development. It was found preferable to use more slurry to obtain a more even grain than to allow a longer time for development of the smallest grains. Photomicrographs are presented showing peculiarities in the shape of *C*-massecuite grain which are due, it is suggested, to impurities in *B*-molasses associated with stale cane or a high salt content. The type of mills used at various Australian sugar factories for slurry preparation are discussed, and brief mention is made of shock seeding. Control of the quantity and purity of the ingredients used for slurry is also discussed.

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An introduction to Critical Path Planning. A. H. CHANCELLOR and J. MEIKLE. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 73–79.—The fundamentals of Critical Path Planning are described in terms of the two main tasks involved: (i) drawing an arrow diagram to define the critical path of all activities which must be completed in sequence and without delay in order to finish the project in the shortest possible time, and (ii) preparation of a project timetable, or succession of timetables, to find the earliest and latest times that each activity can start and finish. The data from the arrow diagram and the activity table are combined to produce a bar chart, which may also include deadline dates by which materials and spares must be made available in order to complete the project. The use of computers in analysing the data, in preparation of a bar chart and in providing information on costs and man-hours is discussed.

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Entrainment prevention at Racecourse mill. A. G. CLAIRE and T. C. MULVENA. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 107–111.—In tests on entrainment prevention by centrifugal separators fitted to the 1st, 4th and 5th effects of a quintuple effect evaporator, the sugar in the vapour was reduced from 725 p.p.m. to 190 p.p.m. in the 1st body, from 11,400 p.p.m. to 155 p.p.m. in the 4th body and from an average of 28,000 p.p.m. to 332 p.p.m. in the 5th body. However, better results have been achieved by fitting baffles to the juice feed inlet and a wooden maze in the top of an evaporator[2], reducing the entrainment to 100 p.p.m., or by installing two wooden mazes, one in the head box and one in the body of a vessel, plus a simple arrestor consisting of single layers of wire gauze below the second wooden maze, to give a reduction to 150 p.p.m.[3]. At one factory where a wooden maze and two half-plate baffles (sloping semi-circular plates extending from the side of a vessel to several inches beyond the centre line) were installed in the last vessel the entrainment was reduced to 90 p.p.m., while a 1st body provided with four half-plate baffles gives less than 40 p.p.m. entrainment. If sufficient head room is available in an effect, the half-plate baffle is considered the best and simplest entrainment separator.

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Monitoring of boiler feed water contamination. J. W. HILL and P. G. ATHERTON. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 113–122.—The two basic sources of feed water contamination are discussed, i.e. raw make-up water and condensates containing sugar. Details are given of a simple monitoring device installed at Plane Creek and Isis sugar factories for detecting relatively large quantities of sugar in pan, evaporator and heater condensates (Isis) and in pan condensate (Plane Creek). The apparatus consists of a relay for over-conductance detection, which incorporates an adjustable comparison resistance, a milliammeter, a conductivity cell consisting of a pair of stainless steel sheet electrodes separated by pillars of "Teflon" (PTFE), and condensate sampling arrangements. When the conductivity of the condensate exceeds a pre-set level, which is recommended to be 50–200 micromho/cm for exhaust condensate and 100–750 micromho/cm for vapour condensate, alarms are actuated. At Isis the alarm was set at an equivalent of 0·5 milliamp, at which 200 p.p.m. of sugar will operate the alarm. At Isis the cell is fed with a composite sample of condensate, and when the alarm operates, the individual condensate causing the trouble is found by running each condensate through the pipeline and taking meter readings or immersing the cell electrodes in individual samples. At Plane Creek the condensates flowing when the alarm operates are diverted from the stream for analysis. The effect of electrode contamination was found to be negligible.

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The application of side feeder carriers in southern Queensland. THE SOUTH QUEENSLAND INSTITUTE OF SUGAR MILL ENGINEERS. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 123–127.—The advantages of side feeder carriers and side feeder tables, which are installed at right angles to the main cane carrier, are discussed with reference to the experience at a number of sugar factories in southern Queensland. Their use has led to more uniform feeding and a considerable reduction in lost time through chokes and carrier slips, while knife power consumption has been reduced, as has the occurrence of severe

[1] "Low grade sugar crystallization" (California & Hawaiian Sugar Refining Corp. Ltd., San Francisco, Calif., U.S.A.) 1948.

[2] BEALE: *I.S.J.*, 1959, **61**, 336.

[3] BEALE and STEWART: *ibid.*, 1962, **64**, 301.

peak loads. The only significant disadvantage found is additional wear on the side of the main carrier in juxtaposition with the side feeder, caused by deposition of soil accompanying the cane; however, use of an outboard roller chain could, it is suggested, prevent this. Extra maintenance when a side feeder is installed is balanced by the reduced maintenance of the knives.

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Further measurements of roll surface pressure in the experimental mill. T. I. SOLOMON. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967. 129–135. In investigations of surface pressure on the rollers of the Queensland University experimental two-roller mill, four ports were drilled in the surface of each roller and connected, one at a time, to a constant-displacement pump and a pressure transducer, water being used as operating fluid. Considerable variation was found in the pressure around the groove form with rotation of the roller, when all other conditions were equal. The roll load calculated from the top tapping was also higher on average than the true load, although by correcting for the slope of the side of the groove, a calculated average load for all tappings was obtained which agreed well with the directly measured load. Comparison of the traces obtained with the pressure pin[1] and with the tappings was good. A linear maximum predicted pressure line was obtained in a graph of compression ratio *vs.* peak pressure when the pressure tapping results were magnified by a factor of 2.

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Investigation of causes of cane hauling derailments. A. K. ROSELER. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*. 1967, 137–140.—Causes of derailments and shunt-outs (potential derailments) of cane trains at Mossman sugar factory during the 1966 season are discussed and details tabulated for each locomotive. Load slipping accounted for 171 out of 198 shunt-outs and for 90 out of 307 smashes; 110 smashes were caused by shunting and pushing back of cane trucks, 65 by defects in rolling stock, 33 by line defects and in 9 cases the cause was unknown. The frequency of load slipping was greater with wooden than with steel trucks. Details are given of the nature of rolling stock and permanent way defects leading to shunt-outs and smashes, and some recommended measures for preventing derailments are listed.

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Pneumatic separation and conveying of bagacillo. R. N. CULLEN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 161–170.—Results of experiments with a test rig stimulated trials of a similar separator at Tully sugar factory. Bagasse was fed down a chute into a vertical chamber through which the air flow was varied from 290 to 650 ft/min through a fan. At the point of entry into the pickup chamber, the bagasse was treated by an agitator. It was found that increase in air velocity was accompanied by increased extraction and decreased the fineness figure (defined as percentage of bagacillo retained on sieve divided by sieve opening), indicating that the proportion of separated coarse particles also increased. The quantity of bagacillo obtained (1·5% on bagasse, compared with a recommended 1·6–5·0%) exceeded the factory's requirements, despite the fact that the bagasse feeding method was considered inefficient and the agitator diameter was only half the width of the chamber. The bagacillo quality was better than that of bagacillo obtained with vibrating of fixed screens. Three recommendations are made: the velocity in the chamber should be variable; the height of the agitator relative to the bagasse entry point should be adjustable; and there should be means of allowing air to bleed into the fan inlet duct in order to permit a finer quantity control. The two systems found most suitable for pneumatic conveying of bagacillo are one in which the bagacillo passes through a suction fan into a pipeline feeding a cyclone, and one in which the bagacillo enters a venturi in the pipeline between a pressure fan and the cyclone. Of these, the latter is preferred because of excessive wear of fan blades where the bagacillo passing through, as in the other scheme, carries dirt. The main factors considered are conveying velocity, pressure loss (due to air flow and to presence of material), and pressure drop across the venturi.

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Automatic truck handling at Inkerman. G. R. FULLER and N. L. CONDIE. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 183–196.—Full details are given of the automatic system installed in 1964 to meet the needs of an increased crushing rate. The system is similar to one described earlier[2] and makes extensive use of static switching[3]. The component parts are described individually with the aid of circuit diagrams. Subsequent extensions to the system included the installation of automatic weight recording, and a punched card system was to be introduced in 1967 to feed the weight signal from the electronic weighbridge head to an information collection centre. Certain teething troubles experienced are briefly discussed.

* * *

Lighting. G. N. THOMAS. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 197–201.—In this discussion of lighting requirements in sugar factories, types of lamps and lighting units available are described and mention is made of the facilities available with lighting unit suppliers for offering lighting layouts for specific parts of a factory.

[1] *I.S.J.*, 1964, **66**, 392.
[2] SHANN and CRANITCH: *ibid.*, 19.
[3] PETERSON: *ibid.*, 393.

Power and energy requirements for cane preparation. J. H. NICKLIN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 171–182.—Full details are given of investigations carried out at four Queensland sugar factories to determine the energy and power requirements of bottom and top knives and of shredders when dealing with whole-stick cane and chopped-up (bin) cane. The average h.p. required per ton of cane/hr was found to be 2·4, 2·5 and 2·3 for bottom knives, top knives and shredders, respectively, when dealing with whole-stick cane, while the corresponding values for bin cane were 0·6, 0·9 and 2·3 for bottom knives, top knives and shredders, respectively. No attempt was made to establish a value for h.p./ton of fibre per hr, it being impossible to distinguish between different varieties of "hard" cane as regards power requirement. (Three "soft" canes still being processed at two of the factories represent only a small proportion of the crop.) A levelling-out of current peaks would considerably reduce h.p. requirements, the reduction in the case of knives handling whole-stick cane being given as approx. 40%. Factors having positive influence on current peak reduction are considered, including the installation of flywheels, the use of resistances in the rotor circuits of motors to increase the slip (drop in speed) between zero and maximum load (a slip of 15% is recommended), the coupling of bottom and top knife shafts, and the mounting of knives.

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Mill pressure chute monitoring. D. S. SHANN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 203–210.—Two systems for monitoring pressure chutes to check pressure increase were compared. One measures the torque input to the pressure feeder, any increase in which is a reflection of increase in chute pressure; the other measures the deflection of the chute wall. While the tail bar torque meter proved quite stable in operation (except for slight slip ring troubles which can be easily overcome), and the chute deflection system suffered from slight inaccuracy due to the effect of temperature, the latter is preferred for normal conditions, since it is less expensive and is sufficiently accurate. However, it is pointed out that should operation conditions become abnormal, e.g. with wide fluctuations in maceration temperature, the tail bar torque system with slip rings added would be better.

* * *

Analogue computer simulation studies of the extraction performance of crushing trains. C. R. MURRY, W. MCWHINNEY and G. E. RUSSELL. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 211–218. The mathematical model developed by MUNRO *et al.* at Queensland University to describe cane mill extraction has been tested by the use of a larger analogue computer than the original digital computer used. The results obtained for a four-mill tandem were in good agreement with the actual milling results obtained at a sugar factory (Cattle Creek) during the 1965 season, so that the model has been used in preliminary investigations of various imbibition systems. Under the test conditions ordinary compound extraction gave the best overall extraction (95·10%), while the maximum cumulative extraction with a modified Killer maceration system, whereby the added Brix was transferred to the imbibition water for the penultimate mill, was only 91·76% (with 1·5° added Brix). None of the other systems offered any advantages over compound imbibition, while dry crushing, without the addition of water or juice recirculation, gave only 86·27% extraction. While the model has provided a better understanding of the physics of imbibition and has permitted further simplification of MUNRO's equations, the programming and mechanization using an analogue computer were so time-consuming that further studies are to be made with a digital machine.

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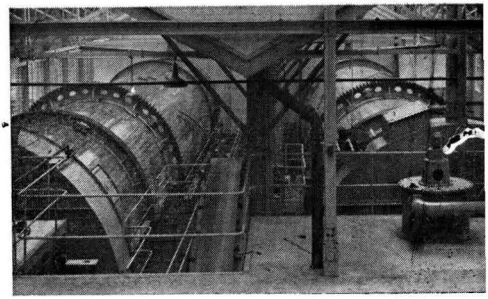
Plant design and modification by digital simulation. B. D. BATSTONE and R. G. H. PRINCE. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 219–224.—Possible applications of simulation by digital computers are discussed and the stages in a simulation study are described. The three steps in which the results of a study may be applied to a chemical process are discussed separately under simulation, optimization and optimal design. Among possible applications to processes in a raw sugar factory which are briefly considered are milling and evaporation.

* * *

Capacity of (evaporator) effet condensers at Babinda mill, 1966. P. N. STEWART. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 245–251.—Three effects were added to the quintuple-effect evaporator at Babinda to form two quadruple-effect evaporators. These operated in parallel, the vapours from the two fourth effects going to separate condensers, an older "plate-and-doughnut" type and a new combined "plate-and-doughnut" and "rain" type. The capacities of the two condensers were measured under normal operating conditions, during which it was found that the new one handled three times as much vapour as the old condenser, but only because the load on the newer evaporator was much greater than on the first evaporator. A number of observations are made, but no recommendations are put forward regarding the maximum capacity for direct contact condensers, although the tests tended to substantiate the view[1] that the vapour capacity of this type of condenser is limited to approx. 100,000 lb/hr.

[1] STRAUSS: *I.S.J.*, 1967, **69**, 51.

Beet sugar manufacture



The angle of slope of upper tube plates in massecuite vacuum pans. V. P. TROINO. *Sbornik Pishchev. Prom.*, 1966, (4), 139–143.—While sloping upper tube plates are considered of advantage for dropping of a strike, they have an adverse effect on massecuite circulation. Equations are presented with which to calculate the optimum tube plate slope, at which all the massecuite is discharged sufficiently rapidly while the detrimental effect on boiling is minimized. It is shown that such a calculation is possible for all concrete cases, and that the optimum angle of slope increases with rise in the limiting shearing stress and decreases with increase in massecuite layer thickness on the tube plate surface and with rise in massecuite density. In the example given, for a massecuite of 92·5°Bx at 75°C, the angle of slope corresponding to a bed thickness of 1 m, a limiting shearing stress of 0·045 g/sq.cm. and a density of 1·46 g/c.c. is calculated as 0°1′, i.e. the plate is practically horizontal.

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Effect of sugar solution on the adhesive strength of latex cement solutions used for ceramics. A. A. DOMASHEVSKII. *Sbornik Pishchev. Prom.*, 1966, (4), 143–150.—Full details are given of tests in which ceramic floor tiles measuring 100 × 100 × 10 mm were bonded in pairs, face to face, with mixtures of cement and synthetic rubber latex or cement and PVA (polyvinylacetate) plasticized with 20% dibutylphthalate. The cements used were Portland, alumina, expanding and quick-hardening types. The bonded tiles were stored under dry conditions, in water and in sugar solution. Tabulated results show that the alumina cement-latex mixture was not stable in sugar solution, but that the other latex-cement mixtures were highly stable. SKS-65 latex was better than SKS-50. The optimum latex content was 15% (dry solids) on weight of cement. The cement-PVA mixtures were only tested under dry conditions where it was found that the seams remained undamaged at a pressure as high as 70 kg/sq.cm.

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The relationship between heat transfer and mass transfer during massecuite crystallization in crystallizers. I. S. GULYI and I. A. BELOKON'. *Sbornik Pishchev. Prom.*, 1966, (4), 151–160.—Empirical equations are derived for calculating the relationship between the amount of heat drawn off the massecuite during cooling and other basic factors in crystallization[1]. The relationships are expressed in graph form. Graphs are also presented showing the close agreement between calculated and measured values in the case of the sugar content in a 2nd product massecuite and the mother liquor solids content as a function of the relative heat reduction during crystallization of pure sucrose. The equations coupled with earlier equations for calculation of crystallization time[2] are considered to give an adequate description of crystallization kinetics. However, for low purity products (3rd product beet massecuite and 4th product massecuite) there was considerable divergence between calculated and measured values.

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Effect of thermal and hydrodynamic conditions during evaporator station operation on the quality of the concentrated juice. N. YU. TOBILEVICH, V. T. GARYAZHA, L. P. REVA and O. N. SIRYI. *Sbornik Pishchev. Prom.*, 1966, (4), 182–192.—Details are given of tests with an experimental quintuple-effect evaporator in which the effects were operated either in series or in parallel, i.e. all bodies as 1st effects. Results, expressed in graph form, showed that at 115–125°C, under 1st effect conditions, colour formation in the juice was comparatively slight. With increase in temperature, particularly above 130°C, the juice colour content increased considerably, and even more so with increase in the invert content. At temperatures above 125°C, if the juice height above the calandria exceeded the optimum, the time taken to evaporate the juice was prolonged and overheating of the juice occurred, thereby leading to the increase in the colour content.

* * *

Rationalization of heat supply in a sugar factory with automation of the evaporators. K. A. UTKINA and V. G. TREGUB. *Sbornik Pishchev. Prom.*, 1966, (4), 193–196.—The two most usual methods of raising heating steam potential where evaporators are automatically controlled (making up live steam and operating with a constant back-pressure on the turbine) are considered inefficient, and instead steam jet compressors for exhaust steam are advocated. Details and a diagram are given of the scheme worked out for one Soviet sugar factory which includes a compressor to raise the turbine exhaust steam from 2·8 to 3·5 atm and which is claimed to permit a 13·3% increase in the steam turbine capacity provided a reduction in back-pressure from 3·5 to 2·8 atm is possible.

[1] *I.S.J.*, 1964, **66**, 264.
[2] *ibid.*, 1965, **67**, 147.

Regeneration of anion exchange resins with intensive purification of sugar juices. T. A. KLOCHKOVA, G. A. CHIKIN and V. B. VOITOVICH. *Trudy Labor. Ionoobmen. Protsessov Sorbtsii* (Voronezh), 1966, **1**, 198–204; through *Ref. Zhurn. Khim.*, 1967, 9R309.—In an intensive process[1] EDE-10P anion exchange resin was regenerated with 4% NaOH at the rate of 2 equivalents per equivalent of resin, the last 0·5 equivalents being re-utilized. The linear rate of the regenerant should be no greater than 5 m/hr. The exchange capacity of the resin fell to 60% of its original value after the first few cycles and remained at this level. It is recommended to carry out double regeneration with acid followed by alkali, at intervals of 50–60 cycles, in order to restore the original capacity and remove adsorbed colour.

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Examination of Soviet kieselguhr. V. A. KOLESNIKOV and YU. G. GONCHAROV. *Sakhar. Prom.*, 1967, **41**, (4), 24–28.—Although comparative tests with "Hyflo Super-Cel" and a Soviet kieselguhr showed the former to be somewhat superior in certain physico-chemical properties and in colloid removal from syrup and 2nd carbonatation juice, the kieselguhr is still considered suitable as pre-coat for candle filters treating 2nd carbonatation juice.

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Effect of length of boiling tubes and circulation ratio on increase in the colour of juice during evaporation. M. L. VAISMAN, V. N. GOROKH, E. S. KISLENKO and YA. N. YAMPOL'SKII. *Sakhar. Prom.*, 1967, **41**, (4), 28–35.—Tests with an experimental multi-tube evaporator showed that at boiling tube lengths in the range 1·5–5 m increase in the length had practically no effect on juice coloration under test conditions [heating steam temperature 104–140°C, juice temperature 75–132°C and Brix 20–65°, relative juice level 10–100%, circulation ratio (ratio between downtake cross-section area and total tube cross-section area) 0–104% and a juice retention of 2–25 min]. An optimum circulation ratio was established, at which coloration was minimal, the value increasing with juice concentration. A value in the range 15–25 is recommended for all effects, the upper value referring to the last effect.

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Performance of a single-drum dryer-cooler for sugar at Salivonkovsk factory. V. V. SPICHAK. *Sakhar. Prom.*, 1967, **41**, (4), 35–37.—A single-drum dryer-cooler reduced the moisture content of sugar from 0·39 to 0·029% and cooled it from 50 to 25°C at a throughput of 18·75 metric tons/hr, consuming less energy than did a fluidized bed dryer-cooler[2] which had a throughput of 18·12 tons/hr, reduced the moisture content from 0·44% to 0·056% and cooled the sugar from 61°C to 45°C.

Slide gate for regulation of beet feed to the sugar factory. A. A. ROKITSKII. *Sakhar. Prom.*, 1967, **41**, (4), 38–41.—Details are given of a flume beet gate which is automatically controlled by a signal based on the power input to the beet washer driver or on the level of beet in the hopper above the slicers.

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Level sensing element for the beet-water mixture in a flume. A. A. ROKITSKII. *Sakhar. Prom.*, 1967, **41**, (4), 41–42.—The device measures the level and hence beet feed rate in the flume and causes a signal to be transmitted to the beet yard so that compensatory action can be taken when the level is too low or too high.

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Method for calculating the sugar balance in the purification station. K. I. MUSOLIN. *Sakhar. Prom.*, 1967, **41**, (4), 43–46.—A nomogram is presented for determining the extent of non-sugar removal in liming and carbonatation without the need for calculating melassigenic coefficients. It comprises three scales: (i) purity of treated juice, Py_1, (ii) purity of untreated juice, Py_2, and (iii) purification efficiency, F. It is based on the formula

$$F = 100\left[1-\left(\frac{Py_1}{100-Py_1}\right)\times\left(\frac{100-Py_2}{Py_2}\right)\right]$$

Three sample calculations are given.

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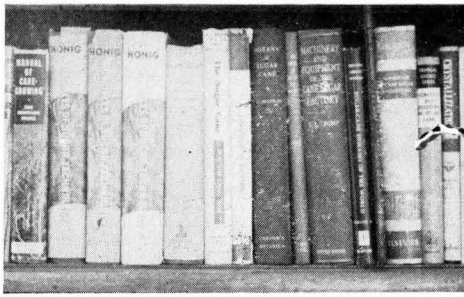
Apparatus for pneumatic cleaning of heating surface. A. P. DROBOTENKO and F. I. GLAZER. *Sakhar. Prom.*, 1967, **41**, (4), 51–53.—A simple compressed air device is described, which applies air at 3–4 atm pressure to the heating surfaces of heaters and evaporators and requires only one operator.

* * *

Conclusions from a study of the phenomenon of molasses formation in sugar production. L. A. SAVVIN. *Sakhar. Prom.*, 1967, **41**, (5), 11–13.—The first main (static) factor discussed is the formation of complexes between alkali metal salts (AR), sucrose and water, having compositions $[AR.C_{12}H_{22}O_{11},2H_2O]nH_2O$, where n has a value in the range 3–9. The complex undergoes hydrolytic decomposition and forms further molasses when mixed with so-called "ballast" non-sugar, i.e. the residual available non-sugars. However, when molasses is diluted with water to a given Brix, the alkalis lose their melassigenic properties, while concentration of the molasses has the reverse effect. Although the "ballast" non-sugars are not strictly melassigenic, they play a very significant rôle in molasses formation purely by virtue of their mass, increasing both viscosity and yield. The second (dynamic) factor involves the available (active) water in molasses. Both factors are considered in some detail.

[1] MELESHKO *et al.*: *I.S.J.*, 1967, **69**, 86.
[2] SHEVTSOV & MILYUTENKO: *ibid.*, 1966, **68**, 211.

New books



Sugar year book 1966. 364 pp.; 3½ × 5½ in. (The International Sugar Council, 28 Haymarket, London S.W.1.) 1967. Price: £2 0s 0d.

The 20th edition of this pocket book comprises tables of statistics for 123 countries (Laos is a newcomer), in most cases covering the period 1960–1966. The data are submitted by the International Sugar Agreement member countries under the Rules of the Agreement, while those of non-member countries are either supplied by the governments concerned or are extracted from statistical publications. The data cover world centrifugal sugar production in calendar years, expressed, where possible, as 96° pol raw sugar and tabulated by countries in alphabetical order. A warning is given in the introduction to the book that figures for individual countries, particularly those for the more recent years, are constantly being revised and that the true figure may differ from the tabulated value. Other tables towards the end of the book give general information, including world sugar production, imports, exports and consumption (absolute and per caput), sugar stocks in selected countries, world sugar prices 1952–1966, export quotas (1966 and 1967) under the British Commonwealth Sugar Agreement, U.S. sugar quotas for 1965 and 1966, white refined sugar retail prices in selected countries in 1965, 1966 and 1967, and equivalent weights and measures. The book is a very handy source of world sugar data and the tables are well laid out and easy to read.

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Sugar beet glossary in English, French, German, Latin. 178 pp.; 5¾ × 7¾ in. (Elsevier Publishing Co., P.O. Box 211, Amsterdam, Holland.) 1967. Price: 65s 0d.

This book has been prepared with the assistance and co-operation of a number of members of the Institut International de Recherches Betteravières at Tirlemont, in Belgium. It is pointed out that while numerous technical dictionaries are available for a wide variety of subjects, research workers and those engaged on the technical problems in the production of sugar beet have so far lacked the assistance of any such publication. This volume is intended to fill the gap.

The book deals with agricultural matters concerning sugar beet in the broad sense, including mechanization and transport. Altogether 1500 terms are listed and the volume consists of three main parts, each of some fifty pages, viz. English-French-German, French-English-German and German-English-French. Perhaps at some future time it may be possible to publish editions which include other languages, notably Italian, Spanish and Russian. Names or terms concerned with the pests, diseases and weeds of sugar beet are dealt with in appendices, only the more important being considered.

The material is generally well presented. It could be argued that the number of entries is too small, but in the compilation of specialist dictionaries it is always difficult to know where to draw the line. There are few criticisms that can be made about the standard of the work, although some minor points spring to mind: the English terms are sometimes archaic, e.g. "saccharose" instead of "sucrose", and "manures" instead of "fertilizers". Nevertheless, the book may be highly recommended for those concerned with literature on sugar beet agriculture.

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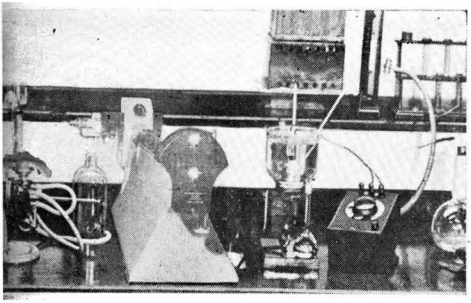
Zuckerwirtschaftliches Taschenbuch 1967. (Sugar economic pocket book.) 191 pp.; 4 × 5¾ in. (Verlag Dr. Albert Bartens, Berlin-Nikolassee, Lückhoffstr. 16, Germany.) Price: DM 14.40; 26s 0d.

The 14th edition of this pocket book contains 74 tables and 14 graphs plus a number of maps and abundant sugar data. It is divided into three main sections, Section I being subdivided into four parts. The first of these gives details of beet and cane areas and yields per ha in Europe and North America and of sugar production in all countries of the world. Sugar consumption, imports and exports, and balances and prices are also given. The next part covers Europe, giving information on the sugar industries in EEC countries as well as some data on EFTA countries, the US and the USSR. The third and fourth parts cover West Germany and East Germany, respectively. Section II gives details of trade regulations, while Section III presents information on international and German sugar organizations and sugar factories in West and East Germany and in Western Europe. The data have been updated to 1965/66 with estimates for 1966/67. Captions and headings to the tables in Section I are in English, French and German. The information is presented in a clear manner and the book is to be highly recommended.



Laboratory methods & Chemical reports

Beet saponin. M. FRIML and R. ČEJKOVÁ. *Listy Cukr.*, 1967, **83**, 85–90.—Determination of the saponin content in refined sugars and white sugars from different sources in Czechoslovakia showed that the average values ($4{\cdot}2 \times 10^{-5}$ % in refined sugar and $7{\cdot}6 \times 10^{-5}$ % in white sugar) were considerably lower than the value given in the literature as the lower limit at which floc is formed. A colorimetric method was used to find whether any correlation exists between the saponin content of molasses and the yields from certain fermentation processes using molasses. Examination of molasses samples from a number of campaigns showed that generally the citric acid yields were high from molasses with a high saponin content.

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Statistical contribution to the determination of melassigenic coefficients of mineral and organic non-sugars. J. STAMBUL. *Sucr. Franç.*, 1967, **108**, 108–111.—The true purity (*P*) and organic matter:ash ratio (*Ko*) in 352 molasses samples were calculated and the values substituted in a formula to give mean values of the melassigenic coefficient of the ash (*Mc*) and that of the organic matter (*Mo*). These were found to be 3·57 and 0·78, respectively. Hence, for French molasses (having low reducing matter and lime salts contents), the purity is given by $\frac{P}{100} = \frac{3{\cdot}57 + 0{\cdot}78\,Ko}{4{\cdot}57 + 1{\cdot}78\,Ko}$. A correlation coefficient of 0·80 was found between experimental purities and those calculated from the formula, which is of use for determining the technological value of beet, after micro-purification, according to the molasses yield. A similar formula was derived for calculating the apparent purity, based on melassigenic coefficients of 3·00 and 0·84 for ash and organic matter, respectively. Wide differences were found between the organic matter:ash ratio and the sugar:(K + Na) ratio, the latter ratio being found to be highly variable and not suitable for calculation of molasses purity.

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Thermo-physical constants of water-alcohol-sugar solutions. S. E. KHARIN and A. A. KNIGA. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1967, (1), 128–129. The thermal conductivities and heat contents of water-alcohol-sugar systems containing 5%, 20%, 30% and 40% sugar and 38%, 20%, 21% and 24%, by weight, of alcohol, respectively, were determined calorimetrically and electrically at 0, 10, 20, 30 and 40°C and the results compared with values obtained from formulae based on the rule of additivity. Agreement between the values was good, confirming that an aqueous alcohol solution is a solvent for sucrose. Both thermal conductivity and heat content fell with increase in the sugar concentration. Calculations of the Prandtl number in terms of composition and temperature showed that it fell with increase in temperature, while it rose with increase in sucrose concentration at constant temperature.

* * *

Phase equilibria in the system sucrose-glucose-fructose. F. H. C. KELLY and D. W. BROWN. *J. Appl. Chem.*, 1967, **17**, 125–126.—The melting points of mixtures of sucrose, glucose and fructose have been determined over the full range of concentrations in the two- and three-components systems. A Kofler hot bar, consisting of a narrow stainless steel surface, was heated in such a manner that a nearly linear temperature gradient was established along it, from about 270°C to 50°C. The temperatures were measured to within an accuracy thought to be ±1·0°C from measurements of pure chemicals of known sharply defined melting points. The melting points for the analytical reagent grades of sucrose, glucose and fructose were 185°C, 144°C and 107°C, respectively. Up to 4 min was found to be the most suitable time for establishment of thermal equilibrium. The following eutectics were also found: sucrose-glucose (0·3 sucrose mass fraction and 137°C); sucrose-fructose (0·3 sucrose mass fraction and 97°C); glucose-fructose (0·27 glucose mass fraction and 93·2°C); and a ternary eutectic, the temperature of which was only very slightly different from that of the glucose-fructose eutectic and was difficult to determine accurately. It is given as sucrose (0·175 ± 0·025 mass fraction)-glucose (0·225 ± 0·025 mass fraction)-fructose (0·600 ± 0·005 mass fraction) with a temperature of 93·0°C.

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Reducing matter content in sugar beet. K. VUKOV. *Zucker*, 1967, **20**, 301–304.—It is pointed out that while the invert content of beets depends to a certain degree on their source, it depends to a larger extent on the conditions to which they are exposed between harvesting and processing. The ranges of invert contents in beets in various countries and different areas of the Soviet Union are compared, showing that beets from the U.K. and from White Russia contain more invert than those from the other countries named. The invert content was greater when the crowns were cut high, and also increased with length of storage, temperature in the beet pile, and with deterioration in the health of the beet. The data are presented in a number of tables, and 31 references are given to the literature.

Auto-inversion of sucrose and its technological significance. S. Z. IVANOV. *Zeszyty Probl. Post. Nauk Roln.*, 1966, (62b), 355–364.—See *I.S.J.*, 1963, **65**, 57.

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Cane diffusion. D. G. PADALKAR. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (2), 76–78. Tests with a laboratory batch diffusion system of four 20-gal storage tanks filled with juice heated to 70–82°C and maintained at constant level, temperature and Brix (9°, 7°, 3° and 0·8°, respectively) are described. Bagasse (1 kg) was fed from the crusher to a circulation tank to which 16 litres of juice from the 1st tank was also added. After 10 minutes' mixing followed by drainage, the juice was returned to the 1st tank. The same procedure was used with juice from the other three tanks, the bagasse then being discharged from the circulation tank and squeezed. The juice extracted was fed to No. 4 tank. Bagasse pol was reduced to 1·6–2·0, and even to 0·4 when shredded cane was used. Juice draught was 100–105%. A drawing is presented of a continuous tower system designed by B. B. BANDI to replace the batch system.

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Comparison of methods of determination of starch in sugar cane juice. N. A. CASHEN and J. J. FRILOUX. *J. Agric. Food Chem.*, 1966, **14**, 434–437; through *J. Sci. Food Agric. Abs.*, 1967, **18**, i–68.—The anthrone-H_2SO_4 colorimetric methods of MCCREADY *et al.* and of HASSID and NEUFELD gave results that were in good agreement and independent of the composition of the starch, while the results of the BALCH iodimetric method decreased with decreasing content of amylose in the starch. Ten references are given to the literature.

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Rheological behaviour and viscosity effect of sucrose solutions. J. DRAGO and H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1967, **94**, 185–193, 251–261.—After defining viscosity, the authors survey the literature on the viscosity of intermediate sugar products, sucrose solutions and sucrose crystal suspensions, and on the effect of dissolved substances on the viscosity of water and sucrose solutions. Pure sucrose solutions are Newtonian. While linear colloids (chain-form macromolecules of 100,000–200,000 M.W.) cause pseudoplasticity, it appears that these are completely or almost completely eliminated by carbonatation, so that molasses, as the most impure sucrose solution occurring in sugar manufacture, is also Newtonian, despite the presence of dextran and laevan. The flow behaviour of impure sucrose solutions was found to conform to the Ostwald equation $D = a\tau^n$, where D = rate gradient, a = fluidity (reciprocal of viscosity), τ = shearing stress and n = slope of the straight line plotted for log D *vs.* log τ. n has a value of 1 for Newtonian fluids. At values greater than 1, pseudoplasticity increases, so that $(n - 1)$ was used as a measure of the degree of pseudoplasticity and can be related to the linear colloid content. The effect of various substances added to pure and impure sucrose solutions on their viscosity conformed to the Arrhenius equation $k = \log \eta_r/\Delta c$, where k = viscosity constant, η_r = ratio of viscosities of the solution with and without additive, and Δc = concentration of added substance relative to the water content of the solution. Values of k are tabulated for various electrolytes and ions, as are values of B, a coefficient expressing the effect of a given substance or ion on the viscosity of water and to which k is proportional. In sucrose solutions k was only slightly influenced by the original dry solids content, whereas temperature exerted a considerable effect. In pure sucrose solution it decreased slightly with increase in concentration. It has identical values for beet and cane molasses and for pure sucrose solutions and molasses if the reaction with added substances is neutral. Any difference occurring when an alkaline substance is added to pure sucrose solution is caused by the change in pH. Tabulated values of k for molasses at temperatures in the range 20–60°C show that added substances can be divided into three groups according to their effects on viscosity: (1) those which reduce sucrose viscosity, (ii) those which raise the viscosity but by a smaller amount than would sucrose added in the same quantity, and (iii) those which raise the viscosity by a greater amount than would the same amount of added sucrose. With increase in temperature B underwent a smaller increase in value, for various substances, in sucrose than in water, and in some cases it had a negative value.

* * *

Further data on c.c.s. loss in whole stalks and chopped cane after storage. B. T. EGAN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 157–159. The apparent c.c.s. loss in stored cane at Mulgrave factory in 1966 was estimated to be 0·62 units, compared with 0·77 units in 1963. The loss was greater in chopped cane than in whole-stalk cane, this difference being 0·64 units in 1966 compared with 0·91 units in 1963. The loss could be estimated either from a split rake (where part was crushed before the weekend and the remainder on the following Monday morning) or by comparison of the c.c.s. with that in prior and subsequent samples.

* * *

Gum content and pH as measures of the losses due to sour storage rot. B. T. EGAN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 257–262.—To obtain some indication of seasonal variations in the gum content of cane as milled, determinations were made at approximately monthly intervals on 1st expressed juices collected by the automatic juice sampler at Mulgrave mill. While the gum content of juice from fresh cane remained reasonably constant throughout the season, with no statistically significant differences

between whole-stalk and chopped cane, the gum content of juice from stored chopped cane was considerably greater than that of juice from stored whole-stalk cane, and both contained more gum than did juice from fresh cane. Over a weekend the average gum content of juice from chopped cane rose from 16·7 mg to 23·1 mg/10 ml of juice, while that of whole cane rose from 2·2 to 9·0 mg/10 ml, the c.c.s. loss, taking into account weight loss, being of the order of 0·1 units and 1·0 units in chopped and whole cane, respectively. The average gum content in juice from chopped cane stored for only a few hours in 1966 was much lower at 6·4 mg/10 ml than that in chopped cane stored for approx. 18–20 hr (10·3 mg/10 ml). While the correlations between gum content and c.c.s. loss and purity drop were high, the correlations between the last two factors and pH were not quite so high, although still sufficiently high to justify regarding pH drop in the juice from stored cane as an indication of cane deterioration. Treatment of stored cane with varying amounts of formalin reduced c.c.s. loss, purity drop, pH drop and gum content in the juice. The pH of juice from stored whole cane inoculated with *Leuconostoc mesenteroides* increased in three trials by 0·01–0·05 units, compared with a drop in juice from chopped cane of 0·44–0·71 units. An increase in the c.c.s. of the juice from the whole cane was insignificant.

* * *

Determination of the diffusion coefficient of sugar in capillary-porous bodies. A. P. VERKHOLA and V. M. LYSYANSKII. *Sbornik Pishchev. Prom.*, 1966, (4), 94–100.—Sets of porous glass plates of four different pore diameters (100–120, 40–50, 20–25 and up to 10μ) were saturated with sugar solutions of varying concentrations and placed first in a vacuum boiling unit for 1½–2 hr at 60°C, after which the columns of plates were transferred to a different chamber, and subsequently centrifuged at 5000 r.p.m. to remove the solution from the pores. Results, expressed in the form of a graph of diffusion coefficient *vs.* temperature, showed that of the four different plates, that with the smallest pore diameter gave a value closest to the diffusion coefficient for sugar in beet. This plate also differed from the others in that the pore diameter was practically constant over the whole plate surface. The values found by the method were as follows: for sugar concentrations of 5% and 20% in the temperature range 20–90°C—between $4·5 \times 10^{-10}$ and 12×10^{-10} sq.m./sec; for 20 and 40% sugar concentration at 35–95°C—between 7×10^{-10} and $10·5 \times 10^{-10}$ sq.m./sec; and for 40 and 60% sugar concentration at 35–95°C—between $4·0 \times 10^{-10}$ and 9×10^{-10} sq.m./sec.

* * *

Experimental determination of the mass transfer coefficient from the surface of a porous body to a fluid. A. P. VERKHOLA and V. M. LYSYANSKII. *Sbornik Pishchev. Prom.*, 1966, (4), 100–106.—A porous glass plate of pore dia. up to 10μ (see previous abstract) was saturated with 20% sugar solution in the vacuum boiling unit and then clamped between the two sections of a diffusion "aperture", which was heated to a given temperature for 40 min, after which it was incorporated in a continuous circulation system comprising a header tank, an upper and a lower constant level tank, rotameter, holding tank and a centrifugal pump. The flow of liquid was carried out for 1 hr at 50°C. The mass transfer coefficients were calculated from the measurements by a formula which is presented (together with a sample calculation) and the relationship between the coefficient and the flow rate of the extraction fluid is plotted on a graph drawn from data obtained by the present authors and others. It was found that at a flow rate up to 0·05 m/sec the mass transfer coefficient was determined by natural convection and remained constant at $6·5 \times 10^{-7}$ m/sec. In the flow range 0·05–0·376 m/sec the value varied from $3·0 \times 10^{-7}$ m/sec to $6·5 \times 10^{-7}$ m/sec, the sharpest increase being from 0·05 to $0·25 \times 10^{-7}$ m/sec. For a KDA-58 tower diffuser a mass transfer coefficient of $17·5 \times 10^{-7}$ m/sec was found by the plate method, corresponding to an average flow rate of 0·167 m/sec.

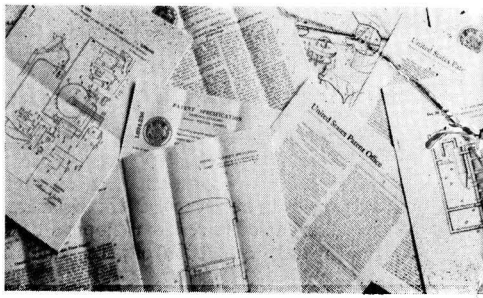
* * *

Effect of physico-chemical depression on hydrodynamic depression and height at which sugar solutions boil in tubes. I. M. FEDOTKIN and G. S. DEMCHUK. *Sbornik Pishchev. Prom.*, 1966, (4), 197–205.—Heat and hydrodynamic balance equations are used to derive equations for calculation of the height at which sugar solutions boil and of the hydrodynamic depression. These are modified to take into account the supplementary pressure loss in the creation and development of a rate profile, and show that the physico-chemical temperature depression, i.e. the ratio between the rise in boiling point of a solution and the boiling point of the pure solvent at the same pressure, affects hydrodynamic depression (pressure due to temperature) and the height at which sugar solutions boil.

* * *

Thermodynamic equation for sucrose nucleation. S. I. SIRENKO and I. G. BAZHAL. *Sbornik Pishchev. Prom.*, 1966, (4), 205–212.—The process of nucleation is examined mathematically from the viewpoint of the work expended on the formation of an interface and the work gained in the formation of a crystal mass, as though separated from its surface. A thermodynamic equation is derived for calculation of the probability of sucrose nucleation, and two extreme cases are examined: when the probability of nucleation of a new phase per unit volume and unit time is equivalent to zero, and when the probability is equivalent to unity. The dependence of the probability of nucleation on the limiting supersaturation is discussed and expressed in graph form. After theoretical determination of the upper and lower limits of the metastable zone, an explanation is offered as to why nucleation does not occur in the metastable zone despite the theoretical probability.

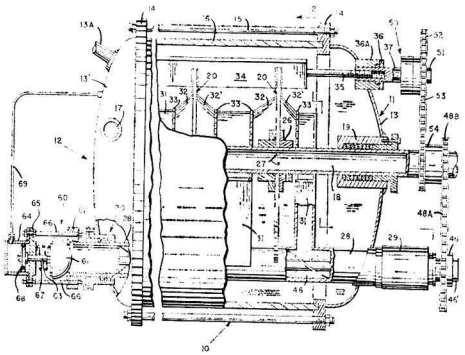
Patents



UNITED STATES

Pressure leaf filter. K. A. ANDERSON, *assr.* AMETEK INC., of New York, N.Y., U.S.A. (A) **3,270,885.** 29th November 1963; 6th September 1966. (B) **3,270,888.** 22nd August 1963; 6th September 1966.

(A) The filter casing is a cylinder 16 having ends 12, 13 held against the flanged ends. Feed slurry enters through port 17 while the source of pressure is connected through port 13A. In the centre of the filter is a hollow shaft 18 supported by sealed bearing 19 and carrying a series of annular leaf elements 20.



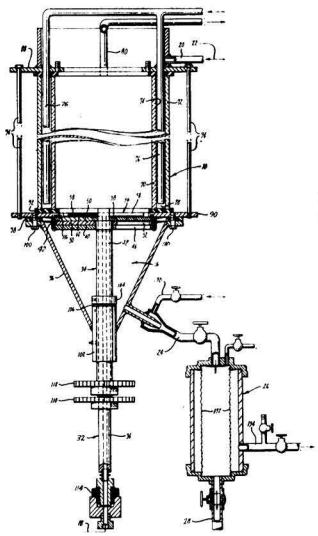
These are provided with screens and exit ducts to carry filtrate through corresponding holes 27 into the hollow interior of shaft 18. In operation, the pressure forces liquid through sections of the elements 20 which are below the liquid level while above this level the passage of air dries the filter cake formed on the element. Sets of scraper blades 32, 32′ are hinged at the tops 33 of collector troughs 31 and cam-induced reciprocal motion of the bar 34 causes these blades to move, scraping the dried cake off the filter elements 20 before they re-enter the slurry. The shaft 37 is linked to the rotating hollow shaft 18 by a chain drive and so is the lower scroll conveyor 46 housed within tube 28 into which the discharged filter cake falls. The open end of the tube 28 is closed by a poppet valve 61 held against its seating by spring 67 and connected by shaft 63 to a piston 68 within a chamber 64 connected by pipe 69 to the interior of the filter. The areas of piston, valve and seating are the same, so that the forces acting are approximately balanced and the force required to open the valve 61 to discharge the cake is independent of the pressure within the filter.

(B) In another form of the filter the blades of the scroll conveyor within tube 28 form a close seal with its interior so that little or no pressure loss occurs, and the filter cake is conveyed along the tube to a sump into which it drops under gravity.

* * *

Withdrawal of adsorbents from columns. W. A. SACKETT, *assr.* SPRECKELS SUGAR CO., of San Francisco, Calif., U.S.A. **3,270,886.** 25th April 1963; 6th September 1966.

Continuous removal of bone char, granular carbon, etc. at a required rate from the decolorization or sweetening-off column 10 is achieved by means of a rotary valve at the base. This comprises a series of discs mounted on a vertical shaft 36, driven through gearing 110 and held by collar 104 which is fixed to sleeve 34 surrounding shaft 36 and rests on anti-friction washers 106 supported on the collar 102 located at the bottom of the column. The discs



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

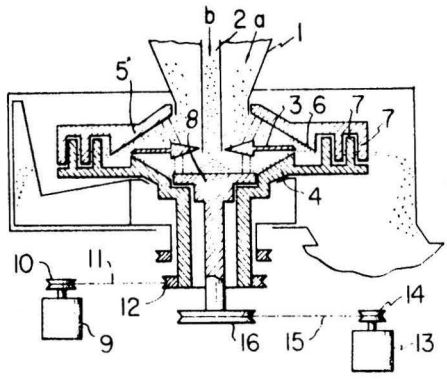
include an upper disc 38 with large apertures, an intermediate disc 50 with smaller apertures 52 and a lower disc 40 with small apertures 46 which are somewhat larger than apertures 52. The intermediate disc 50 is of smaller diameter than the other and is located within an annular spacer ring. Disc 38 is fixed to shaft 36 and the lower disc is bolted to the upper disc 38 by bolts which pass through the spacer ring. The intermediate ring 50 is fastened to the sleeve 34 which surrounds shaft 36 and passes through the central aperture in lower disc 40 and so to the collar assembly. The shaft 36 and sleeve 34 are independently driven through gearing 110, 112 so that their relative speeds govern the rate of withdrawal of bone char or carbon slurry, which falls into the cone 16.

Shaft 36 is hollow and carries at its top perforated distribution arms 58 so that sugar liquor for treatment or sweetening-off water is supplied through the bottom of the shaft at 18, passes up to the arms 58 and rises through the column and is discharged through port 20. The adsorbent is added through a suitable feed arrangement at the top of the column. The slurry in cone 16 passes into nozzle 24 aided, if necessary, by additional liquid introduced through pipe 130. It falls into the separation unit 26, the liquid content draining through the screen 132 and so out through port 134 while the adsorbent is dumped at intervals through port 28.

* * *

Solidification of saccharide solutions. H. OIKAWA, of Yokohama, Japan, *assr.* YOKOHAMA SEITO K.K. and TAKARA K.K. **3,271,194.** 24th July 1964; 6th September 1966.

Soft sugars are prepared by mixing of a high grade refined sugar with a refined dextrose solution, followed by drying and disintegration. This is achieved by



use of a mixer in which the seed sugar *a* is admitted through opening 1 and falls onto the disc 3 which, with the upper disc 5 and central disc 8, is driven by motor 13 through pulleys 14, 16. The sugar is flung off by centrifugal force and forms a thin outward-moving layer on the surface of upper disc 5. The dextrose solution, of e.g. 81% concentration and at 80°C, is admitted through opening 2 and falls onto disc 8 which flings it outwards to disc 4.

It passes over the edge of the step in this disc and forms a continuous thin film which moves outwards and strikes the thin layer of sugar at the part 6 of the disc 5 where the sugar and dextrose become intimately mixed. Cooling of the dextrose solution during passage of the sprayed film causes it to crystallize on the sugar film so that the combined material passes in solid form to the mutually-meshing ridges 7 between the discs 4 and 5 which, since they rotate in different directions, cause disintegration of the mixed particles.

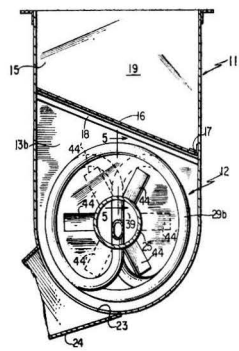
* * *

Process for pulping bagasse with ammonium hydroxide and oxygen. M. M. GASCHKE and M. L. SPECTOR, *assrs.* PULLMAN INC., of Chicago., Ill., U.S.A. **3,274,049.** 25th February 1965; 20th September 1966. Bagasse is treated with an aqueous alkaline solution containing ammonium hydroxide as essentially the sole alkalinity-producing reagent, and having a pH of 9–12·2. A free oxygen-containing gas is dispersed through the solution at a partial pressure of the oxygen of 25–250 p.s.i., maintaining at 130–150°C for 0·5–1·5 hours, to produce a fibrous pulp in a yield not less than 40% on the weight of dried and depithed bagasse.

* * *

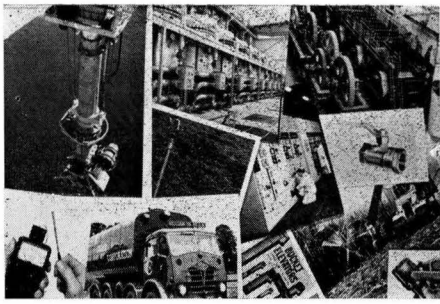
Mingler for temperature conditioning sugar masses. R. J. HUSER, *assr.* THE WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **3,272,649.** 25th May 1964; 13th September 1966.

In the type of mingler or crystallizer in which heating or cooling coils are mounted on and spaced



apart from a central rotating shaft, the material between the coils and shaft has been found to move as a solid core and not to benefit from the heating or cooling effects of the medium within the coils. In order to prevent this by better agitation of the magma or massecuite, blades 44 are fixed to the shaft so that rotation of the shaft causes the sugar mass to be directed outwards to the coil and in the opposite direction to that in which the coils themselves direct the mass.

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.

MCRO-450 pressure filter. Sparkler Manufacturing Co., Conroe, Texas, 77301 U.S.A.

Full details are available of the Sparkler MCRO-450 pressure filter which incorporates perforated, ribbed filter plates, allowing high flow rates for highly viscous syrups. Mono-filament polypropylene cloth is used with a diatomite pre-coat. Flow rates of 8–10 gal/sq.ft./hr are obtainable with 68–70°Bx syrups at pressures of 5–40 p.s.i. over a period of 20–24 hr, giving filter surface requirements of 0·3–0·43 sq.ft. per ton of beet. Sluicing is carried out by means of a header provided with jets placed at one of three different angles in sequence, providing 48 streams of high-pressure water (75–200 p.s.i. depending on nature of cake) as the header advances at a rate of 8 ft/min to give a total sluicing time of 2 min. The filter tank is easily retractable to allow easy and rapid inspection of all plates, each of which is easily removable for repairs. A number of filters have been sold, ranging from 100 to 1000 sq.ft. Details of the filter are contained in a folder which illustrates a typical model having 18 plates, 40 in wide × 48 in high. Charts and tabulated data from a series of runs in a beet factory are also presented. The filter is applicable to cane as well as beet juices.

* * *

Turbidity indicator/controller. Jacoby-Tarbox Corp., 808 Nepperhan Ave., Yonkers, N.Y., 10703 U.S.A.; Stella-Meta Filters Ltd., Laverstoke Mill, Laverstoke, Whitchurch, Hants., England.

The Jacoby-Tarbox Model A turbidity indicator/controller is a continuous measuring unit. It comprises a light source and photo-electric scanner mounted on opposite sides of a flow cell, which is located in a pipeline. Changes in the turbidity of the liquid affect the amount of light transmitted to the scanner and are directly shown on the indicator/controller meter. The instrument can measure turbidity in any liquid down to 1 p.p.m. A control relay can be set to any desired meter reading and used to activate an alarm or control as well as red and green pilot lights provided on the indicator/controller unit. Continuous recording or proportional control are provided for. Amongst users of the unit are certain well-known American sugar firms, since the instrument is particularly useful for raw sugar and other sugar syrups.

* * *

PUBLICATIONS RECEIVED

CROFTS "FREE SPACE" HYDRAULIC COUPLINGS AND DRIVES. Crofts (Engineers) Ltd., Thornbury, Bradford 3, Yorkshire, England.

Publication 6517A EXP illustrates and describes (in English, German, French and Spanish) these couplings and drives. A selection table is provided, as are dimensions of the two types, maintenance details, filling tables, spare parts data, and a summary of advantages.

* * *

CANE CARRIERS WITH OUTBOARD ROLLERS. Link-Belt Co., Dept. PR, Prudential Plaza, Chicago, Ill., 60601 U.S.A.

Folder 2940A, which has been revised, gives information on the company's range of apron-type cane carriers with outboard rollers, especially designed to meet the high throughput requirements of modern sugar factories. The folder discusses and illustrates principal features of the equipment, gives appropriate data and includes photographs of typical applications.

* * *

"FUNDA" FILTERS. Chemap A.G., Alte Landstr. 415, 8708 Männedorf, Zürich, Switzerland; Alfa-Laval Co. Ltd., Great West Road, Brentford, Middx., England.

Literature is available giving details of "Funda" filters type A and type R. Type A is a completely closed filter with back-flushing and automatic extraction, while type R differs from type A in that it is designed for recovery of the residue in a dry state. The basic filter is a horizontal-leaf type with centrifugal cleaning. Features of the process, standard dimensions, and operational details are included in the brochure.

* * *

75 YEARS BROWN BOVERI. Brown, Boveri & Co. Ltd., Baden, Switzerland.

A well-produced 290-page book has been published to celebrate the 75th anniversary of the founding of this very large concern, which is well known in the field of high-voltage electrical equipment, including generators, transformers, static converters, switchgear, radio, electronics, automation, etc. The book gives details of the origins of the firm, its history and developments, and of its associated companies in a number of countries. Numerous illustrations are given, many of them multi-coloured.

World Sugar Production Estimates 1967/68[1]

Beet sugar	1967/68 Estimate	1966/67*
	(metric tons, raw value)	
EUROPE		
Belgium-Luxembourg	570,000	415,700
France	1,750,000	1,825,000
Germany, West†	2,050,000	1,955,078
Holland	760,000	586,180
Italy	1,644,000	1,404,784
Total E.E.C.	*6,774,000*	*6,186,742*
Austria	300,000	363,180
Denmark	330,000	319,000
Finland	60,900	67,111
Greece	123,000	116,950
Ireland	136,000	111,492
Spain	550,000	585,493
Sweden	252,000	223,133
Switzerland	62,000	59,564
Turkey	789,000	716,490
UK	996,000	955,831
Yugoslavia	525,000	588,392
Total West Europe	*10,897,900*	*10,293,378*
Albania	14,000	15,000
Bulgaria	225,000	225,000
Czechoslovakia	833,000	853,000
Germany, East	800,000	686,744
Hungary	422,000	469,333
Poland	1,826,000	1,721,417
Rumania	460,000	518,804
USSR	9,600,000	9,165,000
Total East Europe	*14,180,000*	*13,654,298*
TOTAL EUROPE	*25,077,900*	*23,947,676*
OOTHER CONTINENTS		
Afghanistan	10,000	8,233
Algeria	65,000	60,000
Azores	12,000	12,000
Canada	145,000	151,489
Chile	178,000	165,469
China (Manchuria)	600,000	570,000
Iran	380,000	248,400
Iraq	3,500	3,100
Israel	35,000	33,333
Japan	261,000	221,749
Lebanon	8,000	8,000
Morocco	60,000	51,000
Pakistan	15,000	11,300
Syria	25,000	23,707
Tunisia	7,800	6,409
Uruguay	65,000	60,000
USA	2,450,000	2,580,900
TOTAL BEET SUGAR	29,337,200	28,105,066
Cane sugar		
EUROPE		
Spain	45,000	45,023
NORTH AND CENTRAL AMERICA		
British Honduras‡	76,000	59,253
British West Indies		
Antigua‡	6,000	4,823
Barbados‡	210,000	203,822
Jamaica‡	460,000	463,398
St. Kitts‡	40,000	39,142
Trinidad‡	210,000	201,021
Costa Rica	120,000	120,000
Cuba	5,200,000	6,128,287
Dominican Republic	750,000	759,469
French West Indies		
Guadeloupe‡	153,000	136,000
Martinique‡	55,000	50,000
Guatemala	155,000	187,230
Haiti‡	50,000	52,000
Honduras	55,000	50,431
Mexico	2,375,000	2,538,487
Nicaragua	125,000	115,000
Panama	70,000	65,418
Salvador	140,000	124,000
USA—Mainland	1,225,000	1,101,597
Hawaii	1,115,000	1,089,000
Puerto Rico	670,000	742,340
TOTAL NORTH AND CENTRAL AMERICA	*13,260,000*	*14,230,713*
SOUTH AMERICA		
Argentina	833,000	1,070,246
Bolivia	107,000	90,000
Brazil‡	4,150,000	4,112,805
Colombia	620,000	600,000
Ecuador	190,000	185,000
Guyana	350,000	345,000
Paraguay	41,000	36,773
Peru	815,000	775,000
Surinam	19,500	19,000
Uruguay	10,000	10,000
Venezuela	400,000	394,938
TOTAL SOUTH AMERICA	*7,535,500*	*7,638,762*
AFRICA		
Congo (Brazzaville)	60,000	57,100
Congo (Kinshasa)	40,000	35,000
Ethiopia	78,000	85,409
Ghana	10,000	11,000
Kenya	90,000	78,000
Madeira	3,000	3,000
Malagasy	110,000	110,000
Malawi	5,000	3,411
Mauritius‡	645,000	561,762
Nigeria	25,000	23,638
Portuguese East Africa‡	180,000	175,573
Portuguese West Africa‡	70,000	70,500
Réunion‡	230,000	224,429
Rhodesia	200,000	265,800
Somalia‡	32,000	33,000
South Africa	1,724,000	1,627,572
Sudan	107,000	78,000
Swaziland‡	165,000	151,000
Tanzania	86,000	86,000
UAR (Egypt)	360,000	350,910
Uganda	160,000	155,000
TOTAL AFRICA	*4,380,000*	*4,186,104*
ASIA		
Burma	80,000	78,000
Ceylon	11,000	10,492
China	1,900,000	1,850,000
India	2,700,000	2,360,000
Indonesia	600,000	565,000
Iran	40,000	38,600
Japan	96,000	102,661
Nepal	10,000	9,000
Pakistan	500,000	474,000
Philippines	1,650,000	1,570,000
Ryukyu Islands	218,600	194,879
Taiwan	873,000	770,436
Thailand‡	198,000	232,412
TOTAL ASIA	*8,876,600*	*8,255,480*
OCEANIA		
Australia	2,475,000	2,446,000
Fiji	315,000	326,000
TOTAL OCEANIA	*2,790,000*	*2,772,000*
TOTAL CANE SUGAR PRODUCTION	36,887,100	37,128,087
GRAND TOTAL	66,224,300	65,233,153

[1] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (33), 1–5.
* Partly estimated.
† Including production from desugaring of molasses.
‡ *tel quel*

Brevities

Barbados sugar industry report[1].—Dr. H. W. KERR, the internationally-recognized authority on agronomic matters connected with sugar cane, in a report submitted to the Barbados Sugar Producers' Association, has come down against the replacement of the island's 16 sugar factories by four or five 40,000-ton factories. Dr. KERR believes that this would be an unsound capital investment and would achieve little more than is being achieved at present, while at the same time it would add to the number of unemployed. His report recognizes the vital importance of the sugar industry and the value of its contribution to the Barbados economy. In reviewing the island's agricultural practices, Dr. KERR pays tribute to the energy and initiative of the planters of the island and sees in the fact that the 1967 crop promised to create a new record in sugar production eloquent testimony to the soundness of current techniques. Dr. KERR observed that the current situation in the industry was "delicately poised" so long as free quota sugar was sold at below production cost.

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Caroni Ltd. 1967 Report.—The cumulative effect of late cropping in the last two years and unseasonable rains during the harvest in the Ste. Madeleine area inevitably resulted in low yields of cane and sugar. Only 1,935,268 tons of cane were crushed and, as the cane:sugar ratio was no better than in 1966, production of sugar fell from 186,670 to 177,451 tons. On the other hand, the crop was reaped expeditiously and without serious incident. The problems at Ste. Madeleine factory, which were partly responsible for a long and late crop in 1966, have now been solved and the new installations worked smoothly. The use of self-loading trailers for cane was considerably extended during the year and nearly 300,000 tons of cane were handled by this means, compared with 120,000 tons in 1966. Two Cary combine harvesters have passed from experimental to operation production and further units will be in use in 1968 so that a significant tonnage of cane is expected to be reaped mechanically. Most successful trials were carried out on the control of froghopper by aerial application of insecticides which resulted not only in appreciable savings in cost over ground application but in more effective control.

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Ecuador sugar factory[2].—A Swedish enterprise intends to erect a cane sugar factory in the province of Los Ríos. Production is expected to be 55,000–60,000 tons of sugar per year.

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Bulk sugar terminal for Cuba[3].—It was hoped to begin work in 1967 on a bulk sugar terminal at Nuevitas in the northern part of Camagüey province. The installations, completion of which is estimated in 1970, will include storage for 100,000 tons of sugar, with an annual export capacity of 1,400,000 metric tons and a delivery rate of 800 metric tons of sugar per hour. The terminal will be the fourth in Cuba.

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Barbados sugar crop, 1967[4].—The 1967 crop of 200,612 long tons was approximately 25,000 tons more than the previous five-year average of 175,707 tons. The increase in production was due entirely to good rainfall as the factory recovery was the same for both 1967 and 1966. Production would have been even higher had it not been for a great increase in the number of acres burnt, from 3000 to over 9000.

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Tunisia beet crop, 1967/68[5].—The beet harvest in Tunisia is set at 50,000 tons which will permit the production of 6000 tons of sugar.

New Indian sugar factories[6].—It has been announced that the Government of Madras is to start two cooperative sugar factories during the Fourth Plan period at an estimated cost of 4 crores of rupees (£2,200,000). One of the factories is to be at Dharmapuri.

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Italy beet sugar campaign 1967/68[7].—Italy has had the longest and most abundant sugar campaign in its history. The area planted to beet was 14% greater than in 1966/67 and was 12% more than the record area of 1959/60. The average yield per hectare was 2·35% greater than in the previous year, while the sugar content was 0·14% higher than in 1966/67. The sugar yield per hectare was 5·22% above that of 1966. The average campaign length was 66 days for the 76 factories and 3 juice stations, while the minimum length and maximum length were 40 days and 135 days, respectively. Comparative data are:

	1967/68	1966/67
Area, ha	349,000	300,000
Beets harvested, metric tons	13,400,000	11,250,760
Beet yield, tons/ha	38·4	37·5
Sucrose content, %	14·15	14·01
Sugar production, tons	1,460,000	1,189,685
Sugar yield, tons/ha	4·18	3·97

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Rum distillery in Dutch West Indies[8].—Construction of a rum distillery is scheduled to start within a few months on St. Maarten in the Dutch West Indies. It will be built near Point Blanche and will have a capacity of 6000 gallons per day.

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Brazil sugar production, 1968/69[9].—The president of the Instituto do Açúcar e do Alcool, Sr. EVALDO INOJOSA, announced recently that the 1968/69 sugar crop is to be maintained at present levels to assist the reduction of stocks. The 1966/67 crop amounted to 66·6 million bags (4 million metric tons) and stocks at the end of 1967 were expected to be 12 million bags (720,000 tons) against requirements of 7 million bags (420,000 tons).

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Bagasse board plant in Jamaica[10].—A new bagasse board manufacturing plant is nearing completion at Spanish Town. It is to be operated by Standard Building Products Ltd., one of the Esso Group of Companies, and will cost U.S.$8·4 million. Products to be manufactured include hardboard smooth on both sides, exterior siding boards, medium-density board similar to other particle boards, concrete form boards and boards for roof deckings, partitions and doors. The boards, which are termite-proof and water-resistant, can be painted or decorated. Prices are expected to be equal to the landed duty-paid cost of replacement products and supplies should be available by early 1968.

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[1] *W. Indies Chron.*, 1967, **82**, 605.
[2] B. W. Dyer & Co., 20th October 1967.
[3] *Cuba Foreign Trade*, 1967, (1–2), 33.
[4] *West Indies Sugar Association Rpt.*, 1966/67, 3.
[5] *Agence France-Presse*, 4th November 1967.
[6] *Indian Sugar*, 1967, **17**, 392.
[7] *C.I.S.S.*, 15th December 1967.
[8] *West Indies Chron.*, 1967, **82**, 653.
[9] *B.O.L.S.A. Review*, 1967, **1**, 678.
[10] *Sugar y Azúcar*, 1967, **62**, (12), 37.