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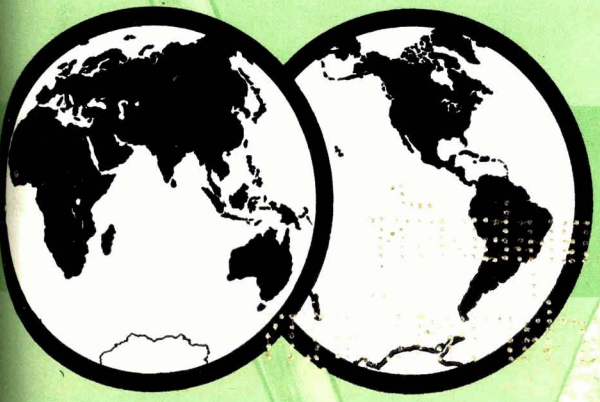

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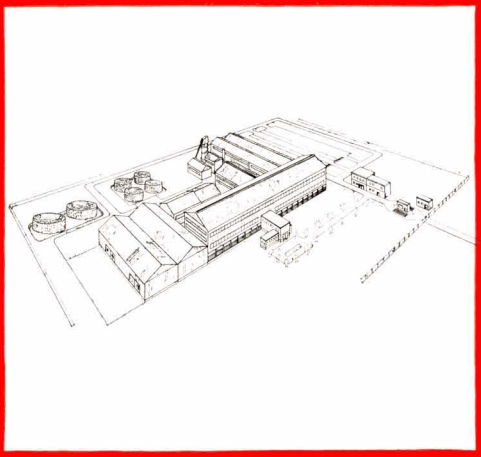

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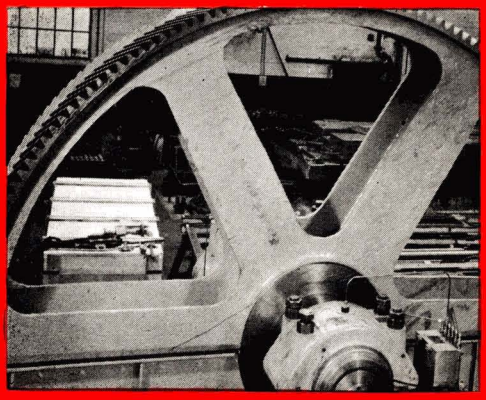

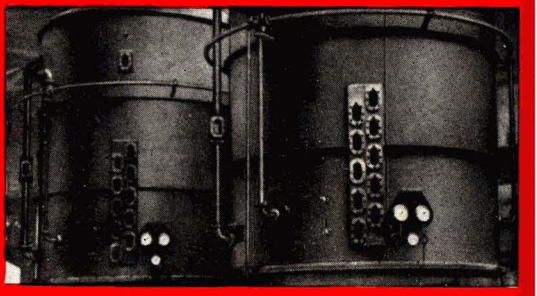

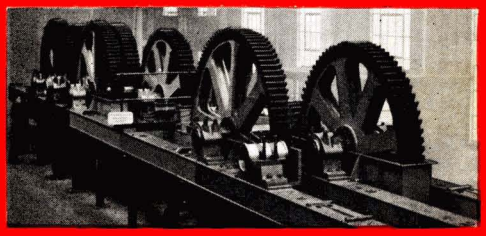

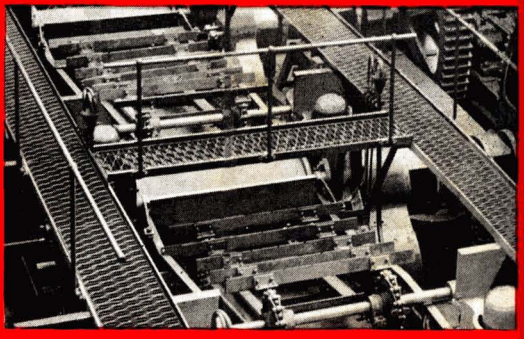

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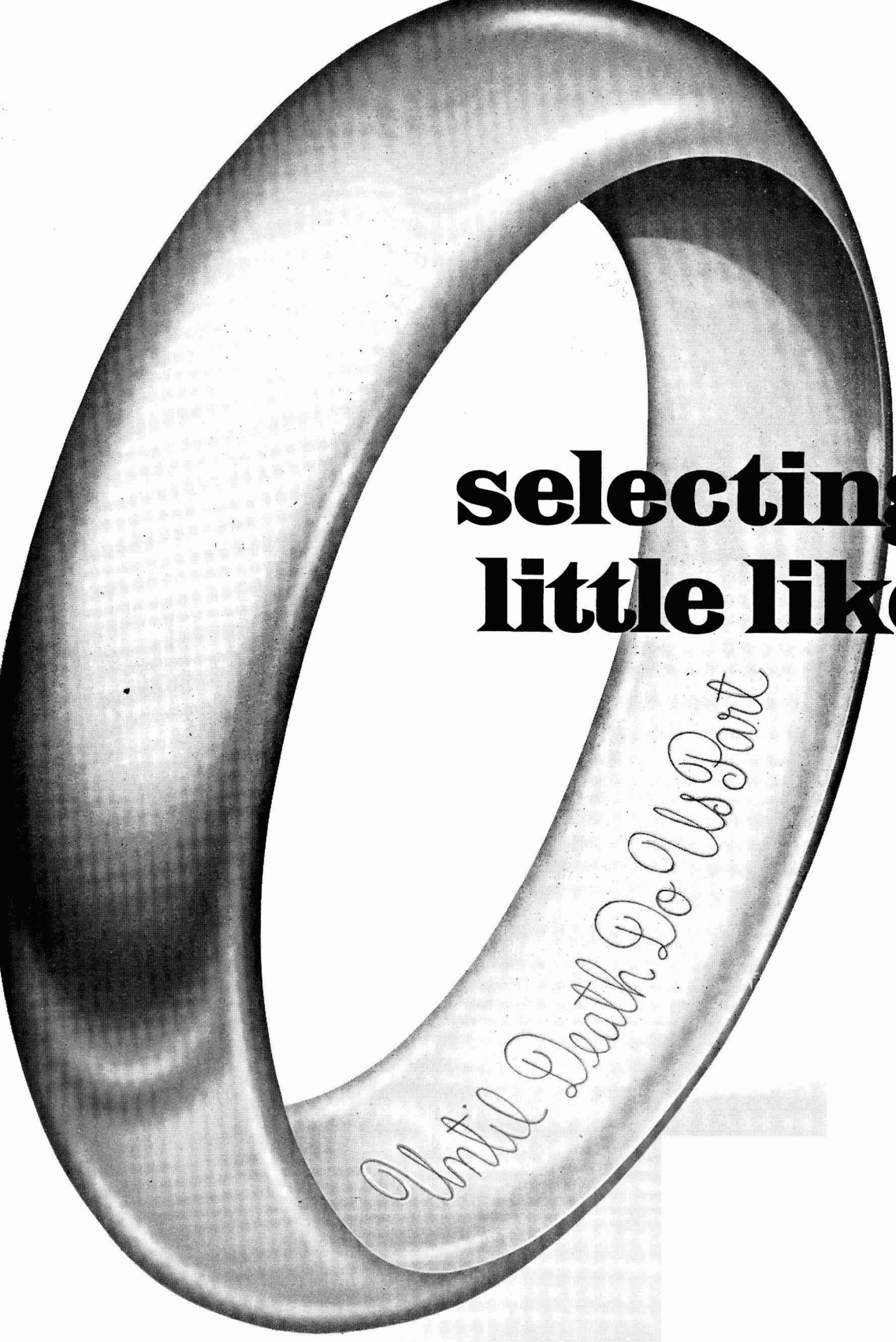
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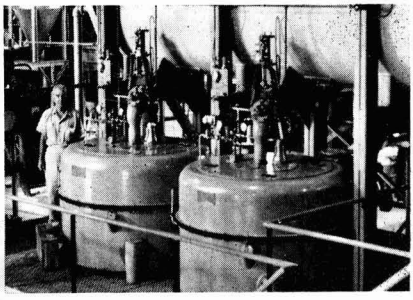

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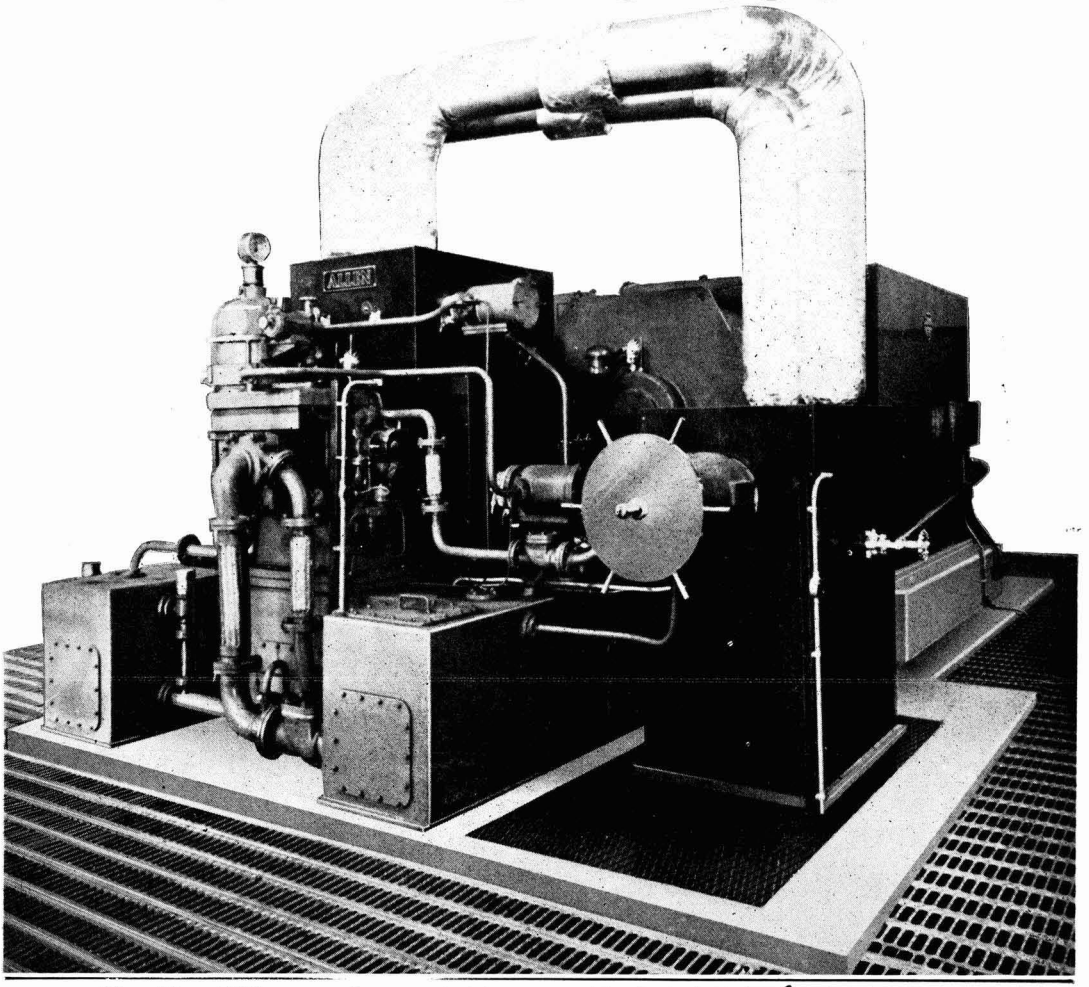

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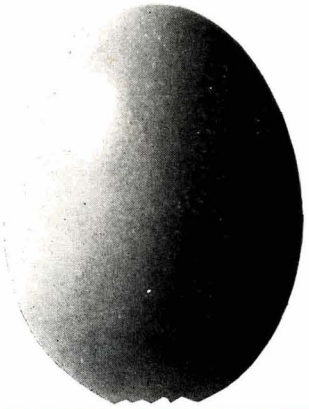

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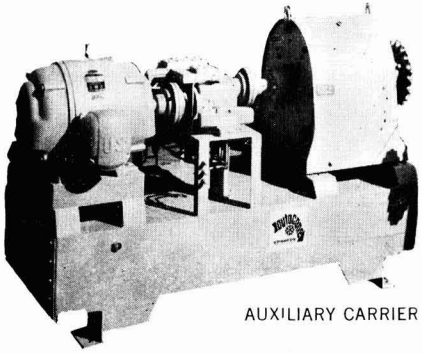

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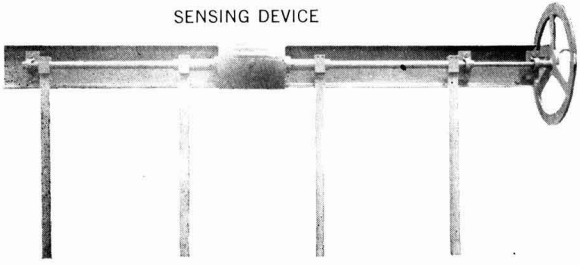

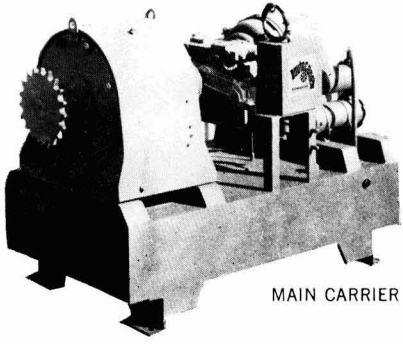

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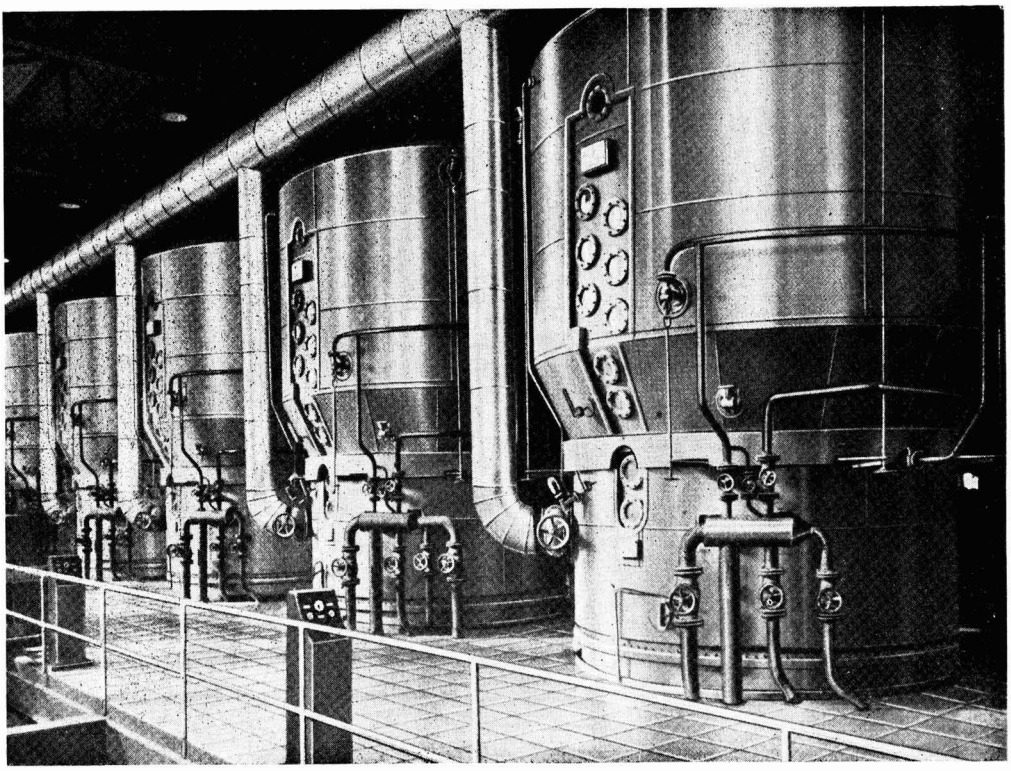

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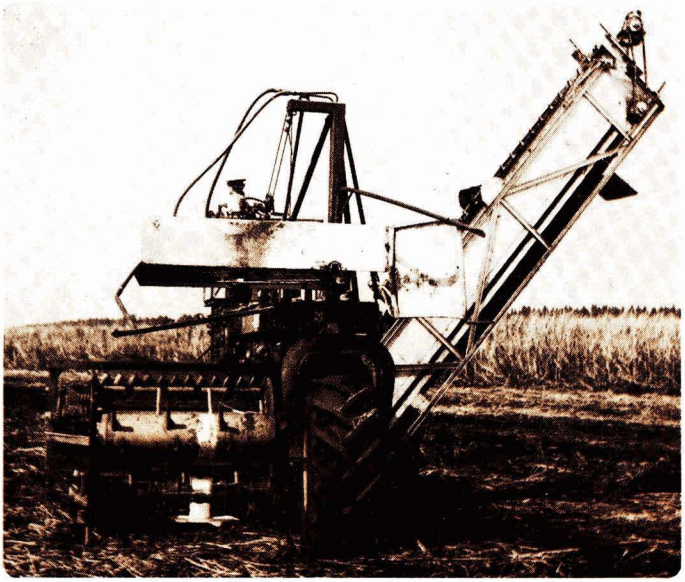
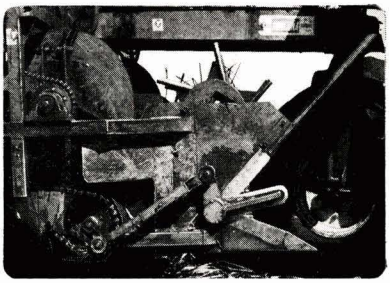


Duncana Combine—World's first mat cane harvester in mass production.



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The new Duncaña Combine solves the problem of labor shortages and rising costs. On an average day, it cuts and loads more than an acre an hour—out-performing 25 above-average workers. And it's easily rigged for night cutting, so you can operate around the clock.

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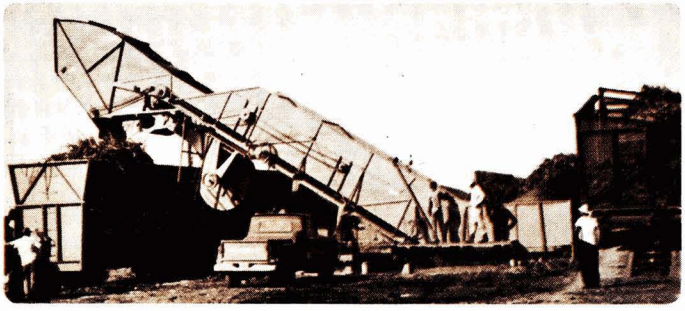

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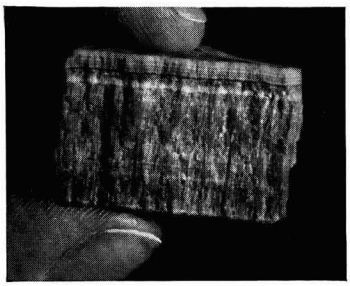

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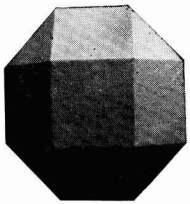

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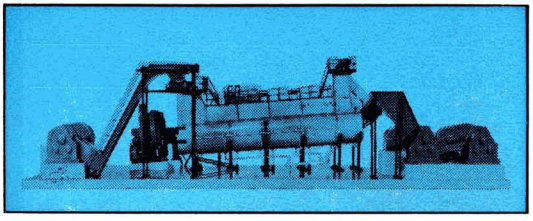

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La mécanique de broyeurs à marteaux oscillants rotatifs. 1-ère partie. W. R. CRAWFORD. p. 259–262

L'auteur présente une analyse théorique de l'opération de broyeurs à marteaux oscillants rotatifs. Dans la première partie de l'article il considère le comportement général d'un broyeur, l'oscillation et le déplacement des marteaux pendant le broyage, aussi bien que les forces agissant sur un marteau.

* * *

Des polysaccharides comme agents causatifs dans la formation de cristaux de saccharose élongés à partir de jus de cannes. G. J. LEONARD et G. N. RICHARDS. p. 263–267

Les auteurs rapportent quelques investigations qui avaient pour but l'identification des agents causatifs, dans le jus de cannes détérioré, de l'élongation de cristaux de saccharose. On a isolé des polymères du jus et les séparé en trois fractions, desquelles chaque s'est montrée capable de causer l'élongation de cristaux de saccharose cristallisés à partir d'un moyen synthétique.

* * *

Quelques observations sur la formation de sous-sol concrétionné. H. MARTIN-LEAKE. p. 267–268

L'auteur décrit quelques phenomènes qu'il a observés dans les sols des hautes terres en Angleterre et indique les similarités entre ces phenomènes et la formation de "concrétions" dans les sols de la Plaine du Gange dans l'Inde. La signification de la formation de "concrétions" pour la culture de produits agricoles, y compris la betterave sucrière, est discutée.

Die Mechanik von Schreddern mit rotierenden Schwinghammern. Teil 1. W. R. CRAWFORD. S. 259–262

Der Verfasser gibt eine theoretische Analyse der Arbeit von Schreddern mit rotierenden Schwinghammern. Im ersten Teil des Aufsatzes betrachtet er das allgemeine Verhalten eines Schredders, die Schwingung und Verschiebung der Hämmer während des Zerschneidens, wie auch die Kräfte, die auf einen Hammer wirken.

* * *

Polysaccharide als ursächliche Mittel bei der Bildung von verlängerten Saccharose-Kristallen aus Rohrsaft. G. J. LEONARD und G. N. RICHARDS. S. 263–267

Man berichtet über Untersuchungen zum Zweck der Identifizierung der ursächlichen Mittel der Verlängerung von Saccharose-Kristallen in verschlechtertem Rohrsaft. Polymeren wurden vom Saft isoliert und auf drei Fraktionen eingeteilt. Es wurde gefunden, dass jede Fraktion das Vermögen hatte, die Verlängerung von Saccharose-Kristallen beim Kristallisieren aus einem synthetischen Mittel zu verursachen.

* * *

Bemerkungen über die Bildung von hartem Untergrund in Erden. H. MARTIN-LEAKE. S. 267–268

Der Verfasser beschreibt einige von sich selbst beobachtete Phänomene in englischen Hochlandserden, und weist auf die Aehnlichkeiten zwischen diesen und den Besonderheiten der Bildung von hartem Untergrund in den Erden der Ebene des Ganges in Indien hin. Die Bedeutung der Bildung von hartem Untergrund für den Anbau von solchen Produkten wie Zuckerrüben wird besprochen.

La mecánica de desfibradoras de martillos giratorios. Parte I. W. R. CRAWFORD. *Pág.* 259–262

El autor presenta un análisis teórico de la operación de desfibradoras de martillos giratorios. En el primer parte de su artículo trata de la conducta general de una desfibradora y la oscilación y desplazamiento de un martillo mientras su operación, así como las fuerzas que se aplican al martillo.

* * *

Polisacáridos como agentes causales en la producción de cristales alargados de sacarosa de jugo de caña. G. J. LEONARD y G. N. RICHARDS. *Pág.* 263–267

Se hace un informa acerca de investigaciones apuntado a identificar los agentes en jugo deteriorado de caña que causan alargamiento de cristales de sacarosa. Polímeros se aislan del jugo y se separan en tres fracciones; cada una se muestra capaz de causar alargamiento de cristales de sacarosa cuando se cristalizan de un medio sintético.

* * *

Observaciones sobre formación de toscas en suelos. H. MARTIN-LEAKE. *Pág.* 267–268

El autor describe fenómenos que ha observado en suelos de terreno elevado en Inglaterra y indica semejanzas entre estos y características de la formación de toscas en los suelos del lleno del río Ganges de la India. Trata de la significación de formación de toscas para la cultivación de cosechas, tal como remolacha azucarera.

THE
INTERNATIONAL
SUGAR JOURNAL

VOL. LXXI SEPTEMBER 1969 No. 849

Notes & Comments

Cuban sugar statistics, 1968.

The International Sugar Organization has recently published details of Cuban sugar production, exports, consumption and stocks for the years 1966–1968 inclusive[1], and these are reproduced elsewhere in this issue. The data are for calendar years, not crop years, so that production in the 1968 crop was presumably less than the 5,315,197 tons recorded for the calendar year, as production in the closing months of the year was higher than at the start of the 1968 crop.

More than two-thirds of Cuba's sugar went to the East European countries and Mainland China in 1968, the largest recipient being the USSR of course. The total for non-Communist countries was just over 1,400,000 tons and this compares with a current free market quota of 1,935,000 tons under the International Sugar Agreement. Since the 1969 crop is likely to be well under that of 1968 (F. O. Licht's latest estimate is 4,700,000 metric tons, raw value), it would seem likely that deliveries to the Communist countries will have to be cut this year and/or there will have to be a considerable shortfall from the ISA entitlement.

C. Czarnikow Ltd.[2] comment on the figures for Cuban domestic consumption: "Cuban consumption appears still to grow at a remarkable rate. For 1968 a total figure of 681,613 tons has been shown. In past years it has been assumed that a substantial tonnage must have been utilized in the cattle feed industry. However, it is specifically mentioned that the total quantity used for this purpose in 1968 was 20,052 tons, which leaves 661,561 tons for human consumption. Assuming a population of eight million, this would indicate a level of offtake last year of no less than 82·7 kilos a head. Rationing has since been introduced and it will be interesting to see what effect this has upon consumption in Cuba. Presumably it will not be necessary to wait a full year before comparative figures can be seen as under the Rules of the ISA statistics of sugar movement must be made available on a much more frequent basis."

EEC sugar proposals[3].

The substantial surpluses of sugar which have been produced in the Common Market, and the high cost to the European Agricultural Fund which this has entailed, has for some time been the cause of concern to the EEC Commission. They have now submitted a paper to the Council of Ministers, indicating their proposals for amendments to the current sugar policy.

The Commission suggest that with normal yields the output in 1969/70 will be in the region of 7·2 million metric tons, white value, or a little more than 118% of self-sufficiency. They mention that when base quotas were fixed in 1966 at 6,480,000 tons it was assumed that consumption would have caught up to this figure by 1969/70, whereas according to present estimates it is expected to be about 5% below this figure.

The Commission therefore recommend that for the time being quotas should be reduced to bring them into line with consumption. Furthermore, the quantity for which a guaranteed payment is made should be reduced after the 1970/71 capmaign to a level equal to 100% of human consumption, rather than 105% as at present.

In this way, the Commission state, sugar production within the Community can be limited so that it will not exceed human consumption by more than 600,000 tons each year, which will make it possible for the minimum beet prices for the 1970/71 campaign to be maintained at their present level.

As could be expected, the Sugar Beet Producers' Association and Sugar Manufacturers' Committee have not been prepared to leave this paper unanswered and have submitted a closely reasoned reply. They point out that beet prices were fixed in July 1966, since when production costs have increased substantially. Factories' processing margins were fixed on the

[1] *I.S.O. Stat. Bull.*, 1969, **28**, (5), 30–31.
[2] *Sugar Review*, 1969, (924), 109.
[3] C. Czarnikow Ltd., *Sugar Review*, 1969, (926), 119.

basis of actual manufacturing costs in 1964/65 and these costs have also grown considerably during the intervening time period.

Attention is drawn to the fact that base production quotas were fixed for a period of seven years and producers and factories have been guided in their investment policies accordingly. Therefore it is not acceptable that the Council should reconsider their decision only one year after it became effective, quite apart from the fact that such a step is not warranted. Furthermore they suggest that the surplus indicated by the Commission is unlikely to be reached in 1969/70, whereafter it will in any case decrease from year to year.

* * *

International Sugar Council.

The Executive Committee of the International Sugar Council met in London on the 28th July but no press communiqué was issued. It is understood, however, that the main points discussed were the procedures for administering the Agreement's "hardship relief fund", and the current market situation. Under the terms of the Agreement the Council must establish a special hardship fund each year of up to 150,000 tons but is not required to allocate this amount. This year only a few countries appear to be entitled to or in need of such a quota in addition to their normal quota.

It was confirmed that Mexico had reported to the Committee that it wished to use its full quota of 86,400 metric tons in 1969; this had been relinquished earlier but the outlook for the Mexican crop had improved and reinstatement was requested. Mexico made it clear that it would not try to sell sugar in a way which might have an adverse effect on prices. C. Czarnikow Ltd.[1] note: "It is understood that the Committee have acceded to Mexico's request; indeed, it is difficult to see how they could have refused as this would have discouraged others in the future from making early notification. It would, of course, have been quite another matter had the shortfall already been redistributed among other exporters."

* * *

World sugar prices.

During June and July there was a decline in sugar prices on the Terminal Markets, the London Price falling from £38 10s to £34 10s per ton c.i.f. UK, while a further fall to £34 per ton occurred on the 5th August at which price it has remained to the date of writing. The futures prices fell away, partly owing to the expense of holding such positions as a result of high interest rates. The slide appeared to arise with the ready availability of white sugar from the USSR, Poland, Rumania and Czechoslovakia, although the first two have withdrawn from the market for the time being.

E. D. & F. Man[2] comment: "It is becoming clearer that, however well-balanced overall statistics could be under the I.S.A., there looks like continuing to be a shortage of raw sugar sellers and a surplus of white sugar sellers. This has been partially corrected by some raw sugar buyers purchasing white sugar and by several sellers not exporting any white sugar at all or exporting less than usual, preferring to concentrate on raw sugar. The protective duties that exist in many countries prevent a bigger swing to the purchases of white sugar and so the problem looks like continuing. In 1970 we expect quite a considerable tightness in the cane raw sugar position. For 1970 as a whole we believe that the I.S.A. mechanism will be able to control supply and demand and we look for higher prices then."

* * *

World sugar production, 1968/69[3].

The third estimates of world sugar production issued by F. O. Licht K.G. appeared on the 31st July and represent an increase of 621,000 tons on the second estimates in March, to give a total of 68,591,772 metric tons, raw value. The revised figures, with the corresponding corrected figures for 1967/68, appear elsewhere in this issue.

As far as beet sugar is concerned, final production figures for most European countries were available in March so that the new data show mostly insignificant changes, the relatively large ones being 58,000 tons more for Spain and 64,000 and 39,000 tons less for East Germany and Czechoslovakia, respectively. Outside Europe, Japan's production is set 61,000 tons higher and Mainland China's 50,000 tons higher, other beet sugar figures being little changed.

In regard to cane sugar production, all other changes are of little importance compared with an enormous increase in the forecast for India from 2,775,000 tons in March to 3,900,000 tons, a figure confirmed by recently published production figures from India. Elsewhere, the Cuban estimate is reduced by a further 300,000 tons to 4,700,000 tons, and the Puerto Rican figure is also cut by another 210,000 tons. Other reductions include 80,000 tons for the US mainland cane area and 118,000 tons for the West Indies, 165,000 tons for Brazil, 35,000 tons for Venezuela and 24,000 tons for Bolivia. On the other hand, improved conditions have led to an increase of 188,000 tons in the Mexican estimate. In Mainland China, cane sugar production has also been set higher than the March estimate by 150,000 tons.

The new figures indicate an increase of production this crop year of 1,411,000 tons more than in the crop year September 1967/August 1968, representing considerably less than the increase in consumption during the period and thus a substantial fall in world stocks.

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[1] *Sugar Review* 1969, (929), 131.
[2] *General Remarks on the Sugar Situation*, 1969, (216).
[3] F. O. LICHT, *International Sugar Rpt.*, 1969, **101**, (21), 1-5.

Mechanics of swing-hammer shredders

By W. R. CRAWFORD, D.Sc., Ph.D., M.Sc., Whit. Sen. Sch.

Paper presented to the 36th Conference of the Queensland Society of Sugar Cane Technologists, 1969

PART I

Introduction

ALL but the most anachronistic operators are agreed that to obtain high juice extraction, whether by conventional milling or by diffusion, a high level of cane preparation is essential.

The twin objectives of preparation are to rupture the greatest number of juice cells while still retaining shreds of length sufficient to promote mill feeding, through felting of the feed blanket. Achievement of the second objective also leads to blankets of good permeability.

The behaviour of shredders has thus become, very properly, a subject for study.

Experience over many years has shown that, to date, the two objectives can best be achieved by the use of swing-hammer shredders with the hammers operating over a breaker sector consisting of a series of breaker bars, or a washboard-like arrangement.

Many measurements have been made of the power absorbed by shredders, but it is only recently that the mechanics of the process has received any attention.

SHANN and CULLEN[1] have discussed certain aspects of hammer design. Their paper contains a tacit implication that the criterion of efficient shredding is a constant angle of hammer swing-back. While this may well be true, the writer is not aware of any experimental work which justifies it, nor, indeed, of any which could show that by so operating a shredder, the energy input may be increased without affecting the stability of operation.

A shredder is essentially a stable machine, in the dynamic sense, provided care is taken to feed it at a reasonably uniform rate, because the rotating hammers form a system which always tends to a state of minimum potential energy.

PAYNE, in a paper on diffusion[2], has given some results which show the effect of change of shredder speed on preparation, and also changes resulting from two-stage shredding, each stage being a separate shredder.

The present paper is a dynamical analysis of swing-hammer shredders in which the over-simplification of SHANN and CULLEN is discarded. Because of this it contains different concepts of shredder behaviour.

It should be realized that any analysis of this type is made possible only by the fact that the hammer *does* swing during operation.

General Behaviour of a Shredder

Before delving into the dynamics of the problem it is useful to establish a mental picture of the way in which a shredder behaves. This helps when formulating equations of motion, and in the selection of reasonably based simplifying assumptions, should this prove necessary.

When an empty shredder reaches operational speed the hammers will be oscillating about their pivots, and at this stage the forces which determine the movement of a hammer are: its own weight directed vertically downward, a tangential force due to the resistance of air to the hammer movement, the inertia forces due to hammer accelerations, and a friction force at the pivot arising mainly from the inertia forces. As a force, the weight of the hammer is very small compared with the inertia forces, and may be neglected.

As already stated the hammer oscillations are inherently stable, and given sufficient time will virtually vanish, because of the damping actions of pivot friction and windage.

During shredding, which requires contact with the cane, the hammers are forced back from the radial position. The cane thus does work on the hammers, and, conversely, the hammers do work on the cane by shredding, or otherwise deforming it.

On release from the treated cane the hammer commences an oscillation which may, or may not, be completed before the hammer again contacts the ingoing cane.

These matters are examined, in more detail, below.

Free Oscillation of a Hammer

It is necessary to examine the oscillatory motion of a hammer, after it leaves the cane, to see what part, if any, this motion plays in the operation of the shredder.

To do this we use the mathematical trick of bringing the moving pivot to rest by applying to every element of the hammer an acceleration equal, and opposite, to that of the pivot.

We will use the following nomenclature:—

Ω = angular velocity of rotor	rad/sec
W = weight of hammer	lb
R = disc radius at pivot	ft
h = distance of hammer C.G. from pivot	ft
k = radius of gyration of hammer about C.G.	ft
τ = pivot radius	ft
μ = coefficient of friction at pivot	

Since the shredder is rotating at constant speed the only acceleration of the pivot is $\Omega^2 R$, directed radially toward the axis of rotation of the shredder.

Referring to Fig. 1, we may therefore (mentally) bring the pivot A to rest by applying a force $\frac{W}{g}\Omega^2 R$

[1] *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 95.
[2] *Paper presented to the 13th Congr. I.S.S.C.T.*, 1968; *I.S.J.*, 1969, **71**, 82.

to the centre of gravity, B, of the hammer, in a direction parallel to the disc radius OA, as indicated.

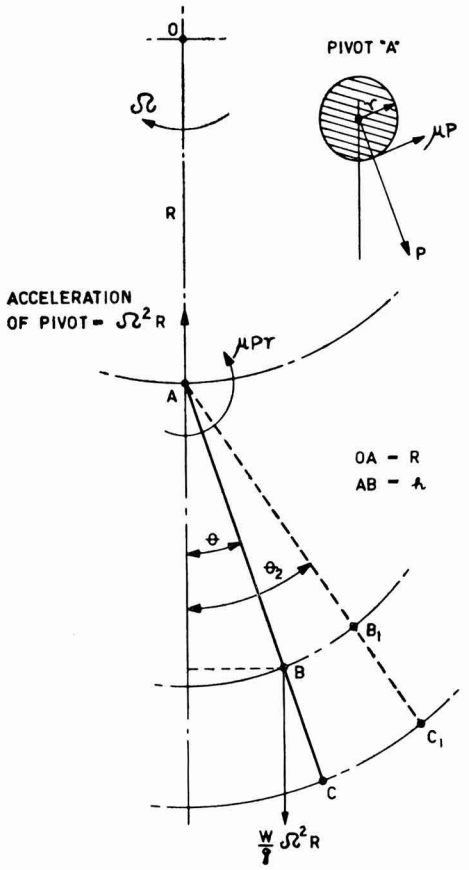

Fig. 1. Hammer oscillation

The pivot may now be regarded as an origin of co-ordinates, and we may take moments about it as though it were fixed in space. When this is done, then, ignoring windage, the differential equation describing the motion of the hammer is closely approximated to by:

$$\frac{d^2\theta}{dt^2} - \frac{\mu\tau h}{k^2+h^2}\left(\frac{d\theta}{dt}\right)^2 = \frac{\Omega^2 R}{k^2+h^2}(\mu\tau\cos\theta - h\sin\theta).$$

This equation is rather intractable but with minimal rejection of terms which, in the light of practical hammer dimension, are insignificant, its solution is:

$$\theta = \alpha + \beta\cos\left(\sqrt{\frac{\Omega^2 R h}{k^2+h^2}}\cdot t\right) \text{ rad, where}$$

$$\alpha = \frac{\mu\tau}{h}\left(1 + \frac{2h^2}{k^2+h^2}\right) \text{ is the friction term.}$$

The factor β changes at each half swing. If θ_2 is the swing-back angle at commencement of the oscillation and it is assumed that at that instant, when $t = o$, $\frac{d\theta}{dt} = o$, then for the first half swing $\beta = (\theta_2 - \alpha)$, and the angular displacement at the end of the half swing is $(\theta_2 - 2\alpha)$. For the second half swing β then has the value $(\theta_2 - 3\alpha)$ and at its completion the value of θ is $(\theta_2 - 4\alpha)$, and so on. To sum up, the initial swing-back angle is reduced by 2α rad every half cycle.

This solution holds only for *small* oscillations which means that the value of θ shall be such that its squares and higher powers are negligible in comparison with unity. This is the case even for $\theta_2 = 16$–$17°$, which has previously been suggested as a likely swing-back angle.

If the pivot were frictionless the term α would vanish, and the oscillation would be:

$$\theta = \theta_2\cos\left(\sqrt{\frac{\Omega^2 R h^2}{k^2+h^2}}\cdot t\right) \text{ rad.}$$

The time of a complete swing, or cycle, in both cases is:

$$T = \frac{2\pi}{\Omega}\sqrt{\frac{k^2+h^2}{Rh}} \text{ . sec.}$$

We thus see that the periodic time is independent of pivot friction, the weight of the hammer and the amplitude of its swing. It is inversely proportional to the angular velocity of the shredder, and is a function of the disc and hammer dimensions.

To illustrate the above discussion two shredders have been selected:

1. The Racecourse shredder discussed by SHANN and CULLEN, where for the rectangular hammers, $R = 16{\cdot}385$ in, $h = 3{\cdot}115$ in, $k = 2{\cdot}78$ in.

2. A heavier shredder which is being used, and for which $R = 13$ in, $h = 7{\cdot}66$ in, $k = 7{\cdot}65$ in.

It has been assumed that both shredders run at 950 r.p.m. and that the coefficient of friction at the pivot is 0·05, and Fig. 2 has been constructed from these data.

It is seen that the larger hammer has an appreciably longer periodicity. The reduction in the original swingback angle, per swing, is not much different for the two hammers, α being 0·0255 rad for the Racecourse hammers, and 0·0206 rad for the heavier hammer.

The actual displacement from the radial position at any time after commencement of the oscillation depends, of course, on the initial swing-back angle, θ_2, and the coefficient of friction μ.

The value $\mu = 0{\cdot}05$ may, or may not, be realistic, but as will be shown in the next section it is the writer's view that the swing-back angle is very much smaller than previously suggested, and consequently the oscillation will have virtually died out by the time the hammer again contacts the cane. It may then be confidently assumed that it is in a radial position of

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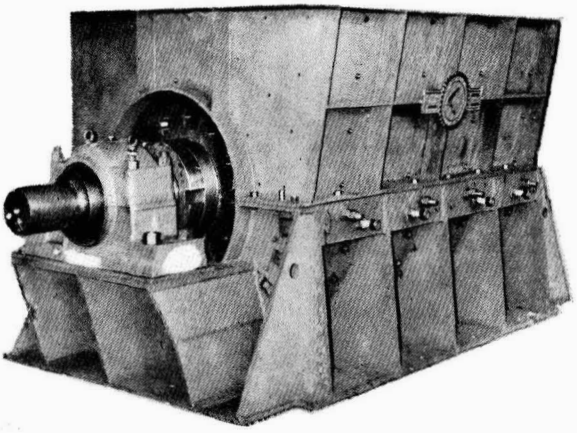

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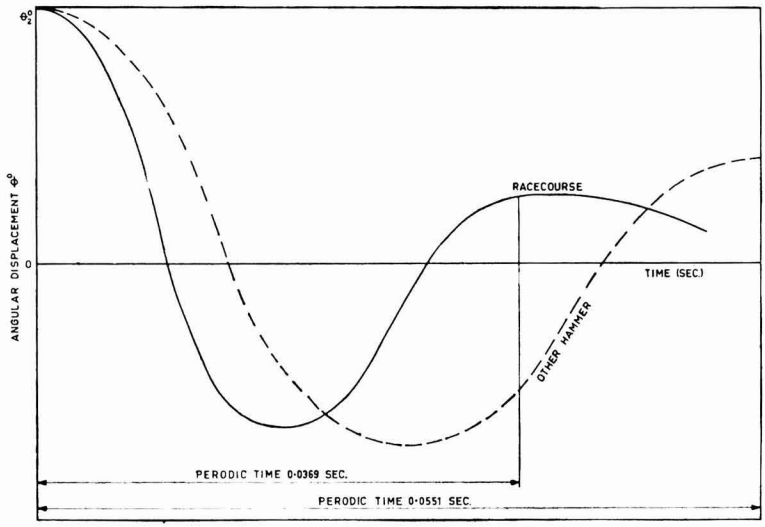

Fig. 2. Hammer oscillation

equilibrium, and thus moving as a rigid body with the disc at the commencement of the shredding action.

Work done by a Shredder

In Fig. 3 the axes OX and OY are fixed in space. The shredder disc OA, and a hammer AC, are shown relative to the axes OX and OY at a time t after first contact with the ingoing cane, at the position OA_1C_1. As stated in the discussion on hammer oscillation, it has been assumed that in this position the hammer has zero angular velocity relative to the disc.

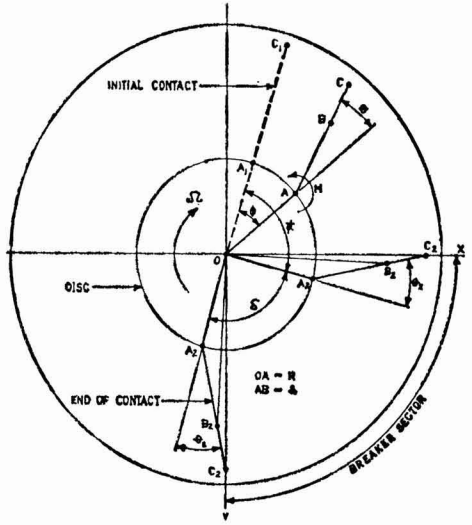

Fig. 3 Hammer displacement during shredding

The action of the cane on the hammer is to apply a turning moment, or couple, M, to the hammer about its pivot, as indicated in Fig. 3.

The work done by the rotor of the shredder, as it turns at constant speed, is the work required to move the couple, M, in space.

In the position OAC the disc has turned through an angle φ, and the hammer has turned through an angle minus θ relative to the disc, so that the hammer has turned through an angle $(\varphi - \theta)$ in space.

If the disc now turns through an additional small angle, $d\varphi$, the corresponding small angle turned through by the hammer (in space) is $(d\varphi - d\theta)$. As a consequence of this the work done by the rotor during this short interval is :

$$M\,(d\varphi - d\theta),$$

because the work done by, or against, a couple moving in its own plane, is the product of the couple and the angle through which it turns.

It follows that the total work done by the rotor—per hammer—during contact with the cane is

$$u = \int_{\varphi = o}^{\varphi = (\psi + \delta)} M\,(d\varphi - d\theta)$$

where in accordance with Fig. 3,

ψ = angle swept from initial contact with the cane to the start of the breaker sector;

δ = angle swept over the breaker sector.

This is an *exact* expression since it is a plain statement of known fact, which contains no assumptions or approximations. However, the integral cannot be evaluated unless we know the relationship between M, φ and θ—which we do not!

If practical, and basically sound, relationships are assumed, we may, however, establish a general expression for the work done, which will enable us to appraise the relative values of the parameters involved.

The above expression for the work done by a hammer is radically different from that used by SHANN and CULLEN. Allowably neglecting pivot friction, they assumed that the total work done by a hammer during the shredding operation was equal to the work done by the cane in turning the hammer about its pivot. The value of this is $\frac{W}{g}\Omega^2 Rh(1-\cos\theta_2)$,

which is the reduction in kinetic energy of the hammer. This change in energy depends only on the initial and final positions of the hammer, and is thus independent of the angle swept during the shredding process. It is evident that this swept angle *must* have an important influence on the work done.

If rotation of the hammer took place instantly and the hammer rebounded from the cane, never to touch it again, then the change in kinetic energy would represent work done on the hammer, but not on the cane. It is also evident that the reduction in kinetic energy is accompanied by an equal increase in potential energy, which is restored to the system when the hammer clears the cane. In the writer's opinion the impact concept is untenable.

A finite time is required to move the hammer about its pivot, and to move both through the complete arc of shredding. It must be emphasized that work is done by the rotor only when the hammer is in contact with cane.

It is shown in the Appendix that the quantity $\frac{W}{g}\Omega^2 Rh\ (1 - \cos\theta_2)$ is only a small, and negligible, fraction of the total work done.

Evaluation of the Hammer Couple

At time t, when the hammer is in position OAC (Fig. 3), the couple M, neglecting windage, is the sum of two components:

1. A couple overcoming friction at the pivot.

2. A couple which is overcoming the inertia forces on the hammer. Refer now to Fig. 4. An initial contact with the hammer in position OA_1C_1 the impressed inertia (centrifugal) force is:

$$P_1 = \frac{W}{g}\Omega^2 R(1 + \frac{h}{R})$$

This force, being radial, exerts no moment on the hammer, but does create a potential friction couple of value:

$$M_1 = \mu\tau P_1 = \mu\tau \frac{W}{g}\Omega^2 R(1 + \frac{h}{R}) \quad \text{lb ft}$$

The hammer will commence to swing back at the instant when the couple applied by the cane is equal to this frictional couple, and at that instant the coefficient μ will be that of limiting friction.

At this stage we must enter the field of conjecture. Relationships between M, φ and θ must be assumed.

The writer's first assumption is that at the instant of reaching the breaker sector the hammer ceases to move about its pivot, and that over the breaker sector the swing-back angle $\theta = \theta_2$, remains constant. To the writer this seems a reasonable and practical assumption, if only because the weight of cane per unit escribed gap volume remains constant. It may, of course, be argued that because the shredding is progressive the bulk cane density increases through he breaker sector, and hence the swing-back angle may decrease. However, in the absence of guidance, we will adhere to constant angle of swing-back.

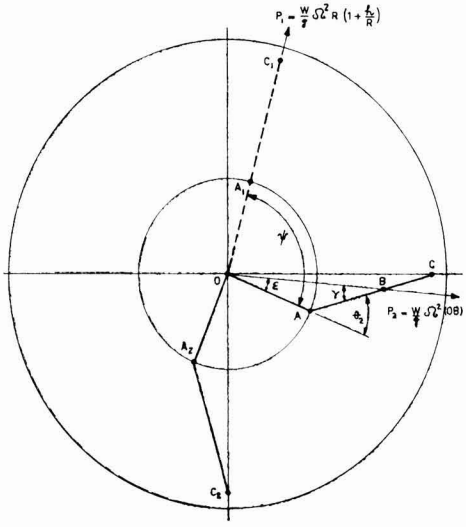

Fig. 4. Forces on hammer

For positions OAC and OA_2C_2 the load on the pvot is:

$$P_2 \cos\gamma = \frac{W}{g}\Omega^2\,(\text{OB})\cos\gamma$$

The frictional couple is:

$$\mu\tau P_2 \cos\gamma = \mu\tau \frac{W}{g}\Omega^2\,(\text{OB})\cos\gamma$$

The inertia couple is:

$$\frac{W}{g}\Omega^2 R\,(\text{OB})\sin\varepsilon$$

The moment exerted by the cane on the hammer is thus:

$$M = M_2 = \frac{W}{g}\Omega^2[R\,(\text{OB})\sin\varepsilon + \mu\tau\,(\text{OB})\cos\gamma]$$

From the geometry of the system:

(OB) $\sin\varepsilon = h\sin\theta_2$

(OB) $\cos\gamma = h + R\cos\theta_2$, and on substitution we find:

$$M_2 = \frac{W}{g}\Omega^2 R[h\sin\theta_2 + \mu\tau(\cos\theta_2 + \frac{h}{R})] \text{ lb ft}$$

(To be continued)

Polysaccharides as causal agents in production of elongated sucrose crystals from cane juice

By G. J. LEONARD* and G. N. RICHARDS†

Introduction

CERTAIN types of polysaccharides commonly called dextrans and probably arising from growth of micro-organisms such as *Leuconostoc*, have previously been isolated from juice obtained from stale cane (e.g. [1,2]). Methylation analysis of such products indicates that they are glucose polymers (glucans) containing both 1,6 and 1,4 glucoside linkages[1], although such results are to some extent ambiguous in the absence of reliable evidence that the polysaccharide fractions used were homogeneous. NICHOLSON & LILIENTHAL[2] and SUTHERLAND[3] have paid more attention to the separation of different polysaccharide species as detected by electrophoretic mobility, but have only tentative evidence of molecular structure based on periodate oxidation studies[2]. Such polysaccharides have been associated with problems of syrup viscosity and tentatively with juice filtration problems[4].

SMYTHE[5] has recently considered the effect of dextran on viscosity and on crystal growth rate during sucrose crystallization but did not indicate any effect of dextran on crystal habit, although he did demonstrate the ability of certain oligosaccharides to produce elongated sucrose crystals. Recently, Japanese workers[6] have also concluded that oligosaccharides are the most important factor and gums a secondary factor in production of elongated crystals. On the other hand, KENIRY, LEE and DAVIS[7] measured dextran, gum, and lactic acid levels in deteriorated cane and concluded that dextran level was the best indicator of the processing quality of "chopped-up" cane.

The aim of the present investigation was to identify, in syrups known to produce elongated crystals under simulated factory conditions, the causative agents responsible for the abnormal crystallization. These syrups were produced from deliberately deteriorated cane, specially prepared to aggravate this undesirable condition. During this work we have considered the possible involvement of all molecular weight ranges of organic substances and also of inorganic constituents.

Experimental

Collection and processing of samples

The samples of syrups (or derived molasses), I, II, III and IV, were obtained from selected batches of chopper-harvested cane of accurately known history which had been deliberately allowed to deteriorate after harvesting. In all cases the cane samples were crushed and first mill juice collected at the sugar factory. The juice was processed in an on-site pilot plant designed to simulate normal factory procedures up to and including concentration to approximately 65°Bx. The syrup was finally stored in this condition at −2°C. In the case of samples I, II and III, one crop of sugar crystal was removed in the pilot vacuum pan before further work was carried out on the derived molasses. Sample IV, however, was used from the concentrated syrup stage.

Sample I was obtained from green, chopper-harvested cane (Pindar variety, Mackay area) after storage in the open for 5 days (post-harvest period) before crushing.

Sample II was obtained from burnt cane (Pindar variety, Mackay area) chopper-harvested approximately 14 hr after burning and stored in the open for 5 days before crushing.

Sample III was obtained from burnt cane (Trojan variety, Burdekin area) chopper-harvested approximately 14 hr after burning and stored in the open for 3 days before crushing.

Sample IV was obtained from burnt cane (Q83 variety, Innisfail area) chopper-harvested approximately 14 hr after burning and stored in the open for 3 days before crushing.

Isolation of "crude polymer"

Usually, a syrup (or molasses) was diluted with water to approximately 17°Bx followed by centrifugal removal of debris at 1800*g* for 15 minutes before addition of 3 volumes of ethanol to precipitate polymer from the solution. The precipitate was collected by centrifugation (1800*g*, 15 min), washed with 75% ethanol and recentrifuged. The polymer was then either lyophilized after re-solution in water or alternatively dried to a powder in a vacuum oven (40°C) over calcium chloride after further washing with absolute ethanol and methanol.

Dialysis

In the case of crude polymer, dialysis was carried out in "Visking 18/32" tubing for 12–18 hr against running tap-water and subsequently against de-ionized water for 12–18 hr at room temperature. Chromatographic fractions, however, were dialysed only against de-ionized water for 12–18 hr.

Fractional ethanol precipitation

Fractional precipitation was carried out either from 1% aqueous solution of polymer powder or on

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† Department of Chemistry, University College of Townsville, Townsville, Queensland, Australia.

[1] BRUIJN: *I.S.J.*, 1966, **68**, 331–334.
[2] NICHOLSON and LILIENTHAL: *Aust. J. Biol. Sci.*, 1959, **12**, 192–203.
[3] *ibid.*, 1960, **13**, 300–306.
[4] SUTHERLAND: *I.S.J.*, 1960, **62**, 185–186.
[5] *Aust. J. Chem.*, 1967, **20**, 1097–1131.
[6] KAMODA *et al.*: *Paper presented to the 13th Congr. ISSCT*, 1968; *I.S.J.*, 1969, **71**, 90.
[7] *I.S.J.*, 1967, **69**, 330–333.

dilute (approximately 17°Bx) syrup after first centrifuging to remove insoluble material. Ethanol was added slowly into the rapidly stirred aqueous solution. Centrifugation was carried out at regular intervals or when sufficient material had precipitated. The resulting precipitates were washed with absolute ethanol and methanol and dried at approximately 40°C under reduced pressure to constant weight.

Gel permeation chromatography

Both analytical and preparative scale columns were used. In general, the packing material ("Sephadex" or "Sepharose"*) was allowed to equilibrate in aqueous medium for several days before de-aeration (under reduced pressure), then packed into a column by pouring a slurry. The packed column was allowed to equilibrate with eluant, using the same hydrostatic head for flowrate control as used in the actual run, for at least 15 hours before use. Whenever possible a reverse-flow[8] (against gravity) technique was adopted.

Monitoring of chromatographic columns was achieved by the phenol-sulphuric acid colorimetric method, used either manually[9] or automatically with a Technicon "Auto-Analyser" by a modification[10] of the method of ROBYT and BEMIS[11].

"Sephadex G-200", "Sepharose 2B" and "Sepharose 4B" are claimed to have molecular weight exclusion limits of 200,000, $20 - 30 \times 10^6$ and $3 - 4 \times 10^6$, respectively.

Acid hydrolysis and paper chromatography

Usually 10 mg of polymer was mixed with 0·1 ml of 72% sulphuric acid at 30°C for 1 hr before dilution with 2·8 ml of water and subsequent boiling under reflux for 3 hr. The hydrolysate was neutralized with solid barium carbonate and then centrifuged.

Descending paper chromatography was carried out in duplicate so that both silver nitrate spray[12] and *p*-anisidine hydrochloride spray[13] could be used. In the case of neutral sugars the irrigating solvent system was 8:2:1 v/v/v ethyl acetate:pyridine:water while the acid solvent system 18:3:1:4 v/v/v/v ethyl acetate:acetic acid:formic acid:water was used for uronic acids.

Crystal-growing methods

The polymer fraction under test was normally dissolved in water and added to the crystal-growing medium (approximately 50 ml in a 100-ml round-bottom flask) followed by thorough mixing and evaporation, by rotating under reduced pressure in a water bath at 76°C, until the syrup was approximately 80°Bx. Powdered refined sucrose was added, the flask stoppered, and the mixture equilibrated at 76°C with rotation for approximately 1 hr. Excess solid sucrose was quickly removed by centrifugation and the resultant supernatant solution equilibrated at 80°C until all crystal nuclei were dissolved. The bath temperature was reduced to 70°C, selected seed crystals (from a bulk stock used throughout this work) added and crystal growing allowed at this temperature in a continuously rotating (approximately 50 r.p.m.) vessel. Crystal growing was usually carried out overnight. Some 20 to 30 crystals were then selected at random, examined under a projection microscope, the ratio of long axis (*c*-axis) to short axis (*b*-axis) was measured and results expressed as arithmetic means.

Crystal-growing media

These included:

(i) "base" medium, obtained from a sugar cane syrup by removal of polymer with 3 volumes of ethanol and subsequent concentration and removal of ethanol on a Buchi "Rotavapor" under reduced pressure at < 50°C,

(ii) "artificial" medium, composed of 95 g refined sucrose, 3 g glucose [B.D.H.‡ "Analar" (analytical reagent) grade], 3 g fructose (B.D.H. laboratory grade), 6 g potassium sulphate (B.D.H. "Analar" grade) and a suitable amount of de-ionized water, and

(iii) sucrose (twice re-crystallized B.D.H. "Analar" grade) alone in water.

RESULTS AND DISCUSSION

Preliminary indication of polymeric causative agents

Early experiments showed that the polymer fraction precipitated in 75% ethanol from sample III molasses could be resolved into two polysaccharide components by use of "Sephadex G-200" gel permeation chromatography (g.p.c.). The first peak, at the exclusion limit of the column, when assayed by a quantitative[14] test for elongating ability, produced significantly elongated crystal, when grown in synthetic medium[14]. The second (low molecular weight) peak produced no elongated crystal[14]. Acid hydrolysis of each polysaccharide (collected by freeze-drying) followed by paper chromatography and quantitative gas chromatography[15] revealed the following results:

	glucose	galactose	arabinose	xylose (relative amounts)
Peak 1	47	2·8	1·6	1·0
Peak 2	5	4·4	1·8	1·0

Ion-exchange fractionation of the acid hydrolysates followed by paper chromatography failed to detect significant amounts of uronic acids[15].

Fractional precipitation experiments

The first fractional precipitation was conducted on a 1% aqueous solution of "crude polymer" from sample III after dialysis. Polymer fractions collected up to 45% ethanol (fraction A) and between 45% and 75% ethanol (fraction B) were examined for monosaccharide type after the usual acid hydrolysis. Glucose only could be detected on fraction A while fraction B indicated mainly glucose but with appre-

*A.B. Pharmacia, Uppsala, Sweden.
‡ British Drug Houses, Ltd., Poole, Dorset, England.
[8] ROTHSTEIN: *J. Chromatog.*, 1965, **18**, 36–41.
[9] DUBOIS *et al.*: *Anal. Chem.*, 1956, **28**, 350.
[10] IVIN: Unpublished data (Sugar Research Institute).
[11] *Anal. Biochem.*, 1967, **19**, 56–60.
[12] TREVELYAN *et al.*: *Nature*, 1950, **166**, 444.
[13] HOUGH *et al.*: *J. Chem. Soc.*, 1950, 1702.
[14] DAY and WHAYMAN: Unpublished data (Sugar Research Institute).
[15] BLAKE and RICHARDS: Publication pending.

ciable amounts of galactose plus some arabinose and xylose. The first "step" in the precipitation curve (similar to sample II, Fig. 2) would be expected to be approximately equivalent to peak 1 from the Sephadex G-200 experiment. These results indicate, therefore, a superior first stage fractionation by fractional precipitation.

Correlation of polymer fractionation with crystal elongation

"Crude polymer" powders from samples I and II were prepared and fractionated by ethanol precipitation. Sample II was known to be capable of producing elongated crystal having a dimension ratio of 3–4:1 (Fig. 1) in a pilot vacuum pan.

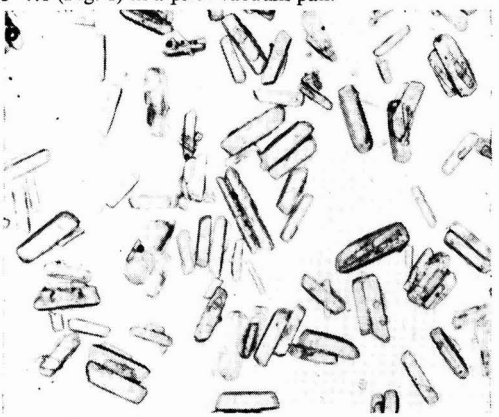

Fig. 1. Elongated sucrose crystals produced from deteriorated cane sample II

Comparison of the fractionation curves (Fig. 2) revealed that a large proportion of the polymer was precipitated below 40% ethanol in the case of sample II (from burnt, deteriorated cane) whilst only a very small proportion was precipitated below 40% ethanol in the case of sample I (from green, deteriorated cane).

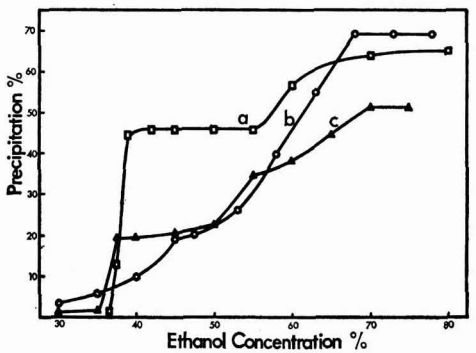

Fig. 2. Fractional precipitation curves for 1% aqueous solutions of "crude polymer" (a) dialysed, sample II, (b) dialysed, sample I, (c) sample IV

When these precipitation curves are compared with the results of g.p.c. fractionation of the same crude polymers (Fig. 3, 4) there appears to be some correlation between the two fractionation methods. In the fractionation of sample II, the relative magnitude of the excluded peak from both "Sephadex G-200" and "Sepharose 4B" columns could be related to the first "step" on sample II ethanol precipitation curve. In the case of sample I, however, the "Sepharose 4B" separation would seem a closer approximation to the precipitation curve than the "Sephadex" separation.

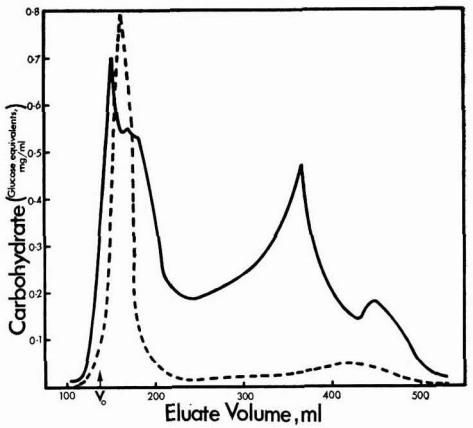

Fig. 3. Gel permeation chromatography of dialysed "crude polymer" on a "Sephadex G-200" column (2·5 × 94 cm) eluted with de-ionized water. ——— Sample I (150 mg on column), - - - - - Sample II (52 mg on column)

This is probably because the first peak, in this case obtained from "Sephadex G-200" (Fig. 3), contains more than one molecular species (owing to exceeding the exclusion limit of the gel), whereas these species are resolved by "Sepharose 4B" (Fig. 4). In other words, sample I contains polysaccharides which have molecular weights lying between the exclusion limits of "Sephadex" and "Sepharose".

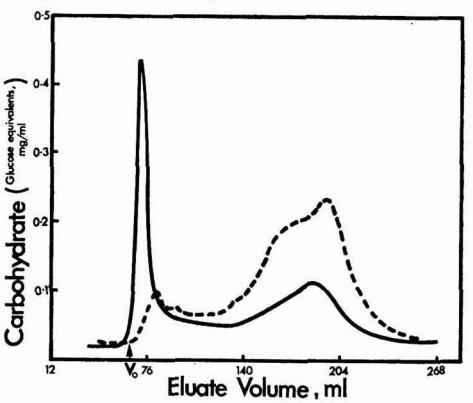

Fig. 4. Gel permeation chromatography of dialysed "crude polymer" on a "Sepharose 4B" column (2·5 × 42 cm) eluted with 0·025M phosphate buffer. ——— Sample II (16 mg on column, - - - - - Sample I (20 mg on column)

This circumstantial evidence, then, implicates the large molecular size fraction with elongation of the crystal since sample I, which contains little of the first peak on "Sepharose 4B" and very little material precipitated by 0–40% ethanol, produces only slightly elongated crystal. Sample II, on the other hand, produces elongated crystal and contains a much larger amount of the higher molecular weight fraction.

In order to verify this conclusion, crystal-growing tests were carried out on sample II and on sample II after addition of 45% ethanol, centrifugation to remove polymer and concentration under reduced pressure, with the following results:

Test Sample	*Elongation ratio*
II	ca. 3:1
II minus 45% ethanol precipitate	ca. 1:1
IV	ca. 3:1
IV minus 45% ethanol precipitate	ca. 1:1

These results could mean either that the 45% ethanol precipitate is a necessary factor in causing elongation or that the ethanol used in the precipitation has deactivated some elongation factor in the supernatant solution. However, recombination of freshly isolated 45% precipitate with the supernatant solution, removal of ethanol and concentration, again produced elongation (ca. 3:1) when assayed by the elongation test. This indicated that the 45% ethanol precipitate contained a factor (or factors) necessary for the elongation effect. These results clearly indicate that the predominant causative agent in crystal elongation is polymeric and conversely that oligosaccharides are not an important primary cause of the elongation in these samples.

The 45% ethanol precipitate was therefore chosen for further fractionation studies (Fig. 5). This material (at least in sugar cane work) would normally be termed the dextran fraction. The first fractionation of the 45% ethanol precipitate was by "flow-through" centrifugation of a 1% aqueous solution in a Sharples centrifuge at approximately 60,000*g*. This provided separation into sediment ("A") and supernatant ("B") which were recovered after lyophilization in a mass ratio of 1:4. Crystallization experiments conducted in "base" medium on various quantities of "A" and "B" indicated that both fractions, added in sufficient quantity, could cause elongation. "B", however, appeared more active than "A" in elongation ability when 0·3–0·4% (w/w) of the fraction was added to base medium.

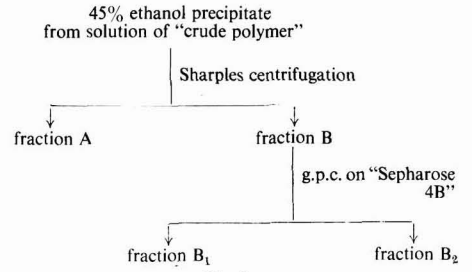

Fig. 5

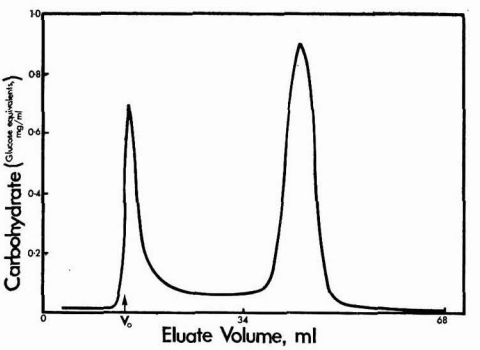

Fig. 6. Gel permeation chromatography of lyophilized fraction "B" (Fig. 5) on a "Sepharose 2B" column (1·5 × 28 cm) eluted with 0·025M phosphate buffer

Fraction "A" was shown to contain no significant amounts of cell debris by optical and electron microscopy (kindly carried out by D. BEVAN of Sugar Research Institute). Fraction "B" was further fractionated by analytical g.p.c. on "Sepharose 2B and 4B" to give two peaks (Fig. 6, 7).

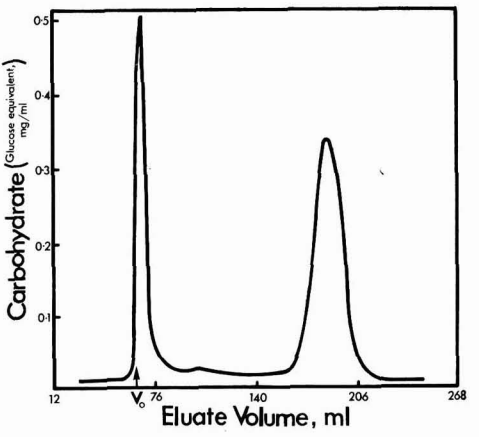

Fig. 7. Gel permeation chromatography of lyophilized fraction "B" (Fig. 5) on a "Sepharose 4B" column (2·5 × 24 cm) eluted with 0·025M phosphate buffer

The two carbohydrate peaks were isolated by subsequent preparative-scale g.p.c. on "Sepharose 4B", using the same experimental conditions, then dialysed and lyophilized prior to crystal elongation assay. The first peak gave highly opalescent aqueous solutions, while a brown colour was associated but not coincidental with the second carbohydrate peak. When these fractions were assayed for crystal elongation in "base" medium, in synthetic medium or in pure sucrose medium, elongated crystals (ca. 2:1) were produced in each case.

It thus appears that all of the polymer fractions in Fig. 5 are capable of producing elongated crystal. The opalescent fraction (B_1) is approximately at the

exclusion limit of the "Sepharose 4B" column which means either unusually large molecular size or, more likely, the occurrence of molecular aggregates. After acid hydrolysis of both the opalescent fraction (B_1) and the coloured fraction (B_2) glucose was the only monosaccharide detected by paper chromatography. In the case of fraction "A", glucose was again the major component but with trace amounts of galactose, mannose and arabinose. Fractions A, B_1 and B_2 all gave no significant blue coloration with iodine/potassium iodide solution and it was concluded that they were free from starch.

SUMMARY

The elongation of sucrose crystals obtained from the juice of different samples of deliberately deteriorated cane has been shown to be caused by polysaccharides. These polymers have been removed from the juice and separated into three fractions, each of which has been shown to be capable of causing elongation of sucrose when crystallized in a synthetic medium. At least two of the polymer fractions are glucans, possibly of dextran type, and their chemical structure will be the subject of further investigations.

In the samples studied, oligosaccharides are not an important primary cause of crystal elongation, although we cannot at present eliminate the possibility of any synergistic effect which may involve both oligosaccharides and polysaccharides.

ACKNOWLEDGMENTS

One of us (G.J.L.) wishes to acknowledge the permission of Sugar Research Institute to publish this paper and acknowledges the financial assistance provided by the Rural Credits Development Fund.

Observations on pan formation in soils

By H. MARTIN-LEAKE, Sc.D.

EXPERIENCE gained from work on the biological aspects of that long defunct indigo industry of Bihar during the first years of the century disclosed certain peculiarities of the soils of that area of the Gangetic plain and of the system of cultivation adopted which have wider implications and, in consequence, seem to be worthy of being placed on record.

Bihar lies in the Eastern section of the Gangetic plain, the soils of which are a deep, relatively recent alluvium even over 1000 ft deep. The rains cease around the end of September and the following dry season, often completely rainless, lasts till about mid-June, this dry season being divided into the cold weather, October to February, and the hot weather, March to mid-June. Yet indigo was sown in February to March, germinated and survived despite drought and heat. This posed the problem: whence came the essential moisture even for survival?

Light was thrown on this problem by a study of the specialized system of cultivation adopted prior to sowing. Shortly after the cessation of the rains, the land was repeatedly ploughed to a depth of some four inches until a fine insulating layer of dry soil was produced—in that windless season, wind erosion offered no risk. A month or so before sowing, the land was repeatedly run over by a "patha", a heavy, ox-drawn flattened beam on which stood a man, with the result that the surface soil became so compacted that, at dawn, the surface had the appearance of wetting by a heavy shower of rain and the surface 6 inches had a moisture content equal to that immediately following the rains. It was that moisture that ensured germination and survival of the indigo plant until the rains commenced.

Further study indicated that, by 2 p.m., the top 6 inches of soil had lost some 28 tons of water per acre, and that this loss was made good by the next morning. The problem arose: whence came *this* moisture? It was not, in planter parlance, rolling in the dew, for there was no dew. Clearly, the only source was the water-table lying at a depth of some 18 ft. Here, again, a difficulty arose; throughout the dry season, the water-table fell only a few inches, quite insufficient to make good the loss. This suggested infiltration from the many streams issuing from the Hills to become dry water courses.

Another characteristic of the area now came into the picture. Scattered throughout are swamps (jheels). Normally, rain falls first in the Hills and the streams come down in spate, filling the swamps by the backflow, carrying a fine silt for deposit in the swamp. Turn now to the older alluvium of Western Uttar Pradesh, bounded to the North West by the Ganges. Here the same deep, porous alluvium exists, but through it are scattered, vertically at different levels, lenticular impervious layers of varying thickness and, often, so hard that they form the road material of the area. Consider the history of the valley, a deep rift gradually filled with detritus from the Hills, deposition first taking place in the West. The lenticular layers are seen to be former swamps, increasingly compacted with age, formed by streams changing their courses. The history of the valley is written horizontally in passing from South East to North West and vertically in the Western area.

In the West some of these hardpans, as they may be called, have become exposed and form the barren (usar) areas, often saline. They may be afforested as with the Dhak tree, the host of the lac insect, but, for success, the thickness of the layer must be determined and a hole of sufficient diameter and a depth to penetrate the layer be made to enable the roots to spread in the porous matrix below. They also play an important rôle in installing tube wells for irrigation when a trial bore must first be dug, the position of the layers and their thickness determined and a tube

consisting of alternate sections of solid and porous piping constructed and sunk so that the solid sections coincided with the impervious layers.

With this personal experience of hardpans in the Gangetic valley followed by some 30 years study of sugar cane cultivation wherever it is grown, it was natural to wonder whether the Ganges valley is unique; might not the same phenomena be repeated in, say, the Mississippi valley or the flat lands of Fiji on which cane is cultivated? In a wider sphere, what is the position in the Gezira and Sudd areas of the Sudan? Opportunity for a personal study of these areas has not presented itself, and no special study appears to have been made of these areas. It would seem unlikely that the Mississippi valley repeats the Ganges pattern, for it has no such outstanding mountain range ending abruptly in the plain, yet, from time to time, references occur which suggest that hardpans do occur. Thus, H. G. STOREY, in an article on deep tillage in Louisiana[1] noted:

". . . on plots prepared by deep tillage, no increase in yields was secured from the application of fertilizer or irrigation. Those plots with no fertilizer and no irrigation, gave higher yields than the plots with ordinary preparation, which were irrigated and given fertilizer applications." Although this is definite evidence of the presence of hardpans in Louisiana, it would be wrong to assume that they are comparable to those of the Gangetic plain.

Once attention was attracted to the subject of hardpans, it was natural to ask whether their existence was not more general than had hitherto been realised and, in particular, whether they might not occur in shallow, alluvial soils and in regions with a temperate climate. A search of the literature suggests that this is the case. As long ago as 1945, a GEORGE TURNER, describing a crop after sub-soiling, noted (*Farmer's Weekly*, 21st May 1945):

". . . at present it is looking as luxuriant as anything can be except about a quarter of an acre which is not sub-soiled." Personal observation in various parts of the country have strengthened the view, that they are more common than suspected in such soils. In the UK, an abrupt change in the crop on a single field is noted[2] in the following terms:

"investigation of the soil shows, some inches down, a layer where clay and sand have separated to form an impervious sheet"
and again,
". . . below, the soil was like a concrete pavement for three or four inches. Below this, again, it was more or less normal."

How suggestive of a hardpan similar to those of the Gangetic plain!

Certain personal observations would seem to confirm the view that hardpans are more common in upland soils than has hitherto been realized, the more striking of which are here noted:

(1) On a Wiltshire farm, high on the chalk downs, was a field of wheat so swamped with *Equisetum* that it was difficult to say what the crop was. A hardpan was diagnosed and the farmer sub-soiled half the field, laying the whole field down to potatoes. An excellent crop was gathered on the sub-soiled half, while the crop on the other half was barely worth lifting. So striking was the difference that the farmer adopted sub-soiling after the grass ley as a routine practice over the whole farm.

(2) On a farm in Cambridgeshire the existence of a hardpan was suspected; the field had a slight slope to a brook, a belt was sub-soiled up and down the slope and the whole field sown to beet. This belt was identifiable from across the farm through the rich colour of its foliage, sharply contrasting with the colour of the beet on the rest of the field. Unfortunately, yields were not obtainable; but may not beet yellows be, in part, encouraged by a weakened plant on land with an underlying pan? The opium poppy in India was strikingly freed from disease by similar means.

(3) Again, in Cambridgeshire was a field of beet on land sharply sloping to a hedge and road. Following a heavy autumn shower, the whole surface soil had slid down, carrying the crop with it, to be piled against the hedge. What could this be but an underlying hardpan forming a toboggan slide for the surface soil?

In all these cases, the mode of formation of the hardpan is certainly not that which explains the position in the Gangetic plain. Another explanation must be sought, and it is indicated in Sir ALBERT HOWARD's "Farming and Gardening for Health or Disease" (1936). In it, he described how certain plots of the Woburn permanent fertilizer experiments had become crop-sterile and covered with a growth of *Equisetum*. The profile showed pan formation at a depth of six to nine inches below the surface. The explanation advanced by him, and surely the correct one, was that excessive dressings of fertilizer had so stimulated microfloral growth that the humus had been destroyed, destroying with it the crumb structure of the soil on which the all-essential soil aeration and water-holding capacity of the soil depends.

The above observations give cumulative evidence of a growing tendency towards pan formation in upland soils which is inimical to healthy plant growth. Particularly would this be the case with deep-rooted plants such as beet, of which the second case cited above is a good example. The explanation advanced by HOWARD seems justified; since the days of LIEBIG, emphasis has been directed to the question of adequacy of the supply of plant nutrients to the neglect of the as important physical and biological aspects of the soil. Where several essentials are involved, their relative importance lies in the ease with which each can be destroyed. There appears to be a clear case for a combined chemical, physical and biological investigation.

[1] *Sugar Bull.*, 1955, **2**, (3).
[2] *Brit. Sugar Beet Rev.*, 1955, **24**, (1).

Sugar cane agriculture

Water requirements of plant cane. Preliminary results. F. A. FOGLIATA. *Rev. Ind. Agric.* (Tucumán), 1967, **45,** (1), 13–26; through *Hort. Abs.*, 1968, **38,** 855. Under the climatic conditions of Tucumán, Argentina, the consumptive use of water by plant cane was shown by lysimeter studies to be highest in January and February (8·74 mm daily) and lowest in October and November (3·93 mm daily). The consumptive figures were closely related to the evaporating power of the air. With a yield of 104·78 metric tons of cane per ha, the production of each ton of cane required 12·24 mm of water and for each ton of sugar 137·62 mm were necessary.

* * *

Leaf silicon in sugar cane, field corn and St. Augustine grass grown in some Florida soils. R. A. BAIR. *Proc. Soil Sci. Soc. Fla.*, 1966, **26,** 64–70; through *Hort. Abs.*, 1968, **38,** 857.—Details are given of a survey made of the silicon content of cane leaves grown on various soils and of the clay and silicon content of the soils. In two areas high yields were associated with high leaf silicon. In general, where soluble soil silicon was high the plant silicon content was also high, but this could not be predicted from soil determinations of silicon or clay and no relationship was found between soil clay and soluble silicon content. No correlation was found between leaf silicon and the phosphorus or iron content. Determinations of major and minor nutrients for cane leaves were very similar for good and poor soils, except that silicon was high in good and low in poor producing areas.

* * *

Soil and plant silicon and silicate response by sugar cane. R. L. FOX *et al. Proc. Soil Sci. Soc. Amer.*, 1967, **31,** 775–779; through *Hort. Abs.*, 1968, **38,** 857.—Calcium silicate slag at 4·5 tons/ha increased sugar yields by 8–12 tons/ha under conditions in which extractable silicon levels in the soil and in the leaf sheaths were both about 20 p.p.m. Leaf freckle was markedly reduced by the slag, but not by phosphorus or lime. Leaf sheath silicon was closely correlated with the logarithm of soil silicon. The rôle of irrigation waters in supplying silicon is briefly discussed.

* * *

The relationship of arthropod predators to crop damage inflicted by the sugar cane borer. A. A. NEGM and S. D. HENSLEY. *J. Econ. Ent.*, 1967, **60,** 1503–1506; through *Hort. Abs.*, 1968, **38,** 858.—Soil application of "Heptachlor" had significantly more destructive effects on ground-inhibiting predaceous arthropods han "Endrin" or "Azinphosmethyl" in sugar cane fields in Louisiana. The last mentioned had the least drastic effects on predator populations, particularly ants. Generally, percentages of joints bored by the sugar cane borer *Diatraea saccharalis*, as well as percentages of infection, were found to be negatively correlated with numbers of predaceous soil arthropods. Direct observations in the field indicated that ants are among the more important natural control agents that determine the degree of infestation of the borer.

* * *

Successful biological control of the sugar cane borer, *Proceras sacchariphagus*, in Malagasy by an introduced parasite *Apanteles flavipes*. M. BETBEDER-MATIBET and P. MALINGE. *Agron. Trop.* (Paris), 1967, **22,** 1196–1220; through *Hort. Abs.*, 1968, **38,** 859.—This paper gives the results obtained during 1966 and 1967. The maximum percentages of parasiticism occurred between February and April. They coincided with maximum borer populations, reducing them by half, and decreased thereafter to a stable level of about 20% in May and June at the beginning of harvest.

* * *

***Heteronychus* white grubs on sugar cane and other crops.** P. T. WALKER. *Pest Articles News Summ. Sect. A*, 1968, **14,** 55–68; through *Hort. Abs.*, 1968, **38,** 859.—This review was prepared following damage to sugar cane by this pest in Swaziland. Possible control measures and choice of insecticide are discussed.

* * *

"Dieldrin" in the soil of sugar plantations at Nakambala and Kafue. P. O. PARK. *Pest Articles News Summ., Sect. A*, 1968, **14,** 152–153; through *Hort. Abs.*, 1968, **38,** 859.—Results are reported of soil analyses for residual "Dieldrin", which had been applied at 2 lb/acre a.i. to control *Heteronychus* spp. At one site the original "Dieldrin" application at about 660 mg/sq. mile had been reduced to 273 mg/sq. mile after a month and this residue was further reduced by 10–20% after a further 4½ months.

* * *

Bionomics and control of *Pyrilla pusana* in the Peshawar region. M. R. KHAN and S. KHAN. *Agric. Pakist.*, 1966, **17,** 385–414; through *Hort. Abs.*, 1968, **38,** 859.—A study of the life history of this sugar cane leaf-hopper is reported. Local sugar cane varieties are listed according to their susceptibility to the pest. Practical control measures are discussed.

Effects of variable "Diuron" and nitrate on sucrose content plus enzyme activity of sugar cane grown in sand culture. A. G. ALEXANDER. *J. Agric.* (Univ. Puerto Rico), 1967, **51**, 316–324; through *Hort. Abs.*, 1968, **38**, 860.—"Diuron" was supplied to sugar cane in factorial combination with variable nitrate. Plant growth was not affected by "Diuron" but the latter suppressed leaf sucrose content and increased fructose as main effects. Results demonstrated the ability of "Diuron" action upon nitrogen status.

* * *

High sucrose levels and abnormal enzyme activity as a function of nutritional stress in sugar cane. A. G. ALEXANDER. *J. Agric.* (Univ. Puerto Rico), 1967, **51**, 325–333; through *Hort. Abs.*, 1968, **38**, 860.—Deficiencies of N, P, K and Ca were gradually reduced in sugar cane grown in sand culture. All plants subjected to nutritional stress accumulated higher leaf sucrose than control plants, regardless of the nutrient withheld. Nutritional stress appears to trigger variations in sugar level with nutritional imbalance rather than actual deficiency being a critical factor. The sensitivity of amylase to changing nutrient supply is discussed.

* * *

The relationship between sugar cane mosaic virus and mosaic viruses of maize and Johnson grass in Australia. R. H. TAYLOR and R. D. PARES. *Australian J. Agric. Res.*, 1968, **19**, 767–773.—These viruses were compared serologically and closely observed under laboratory conditions. The differences in particle size are described.

* * *

Relative rôle of sunnhemp tops and roots in contributing to the green-manuring benefits to sugar cane. S. C. SRIVASTAVA and S. N. PANDIT. *Ind. J. Agric. Sci.*, 1968, **38**, 338–342.—Reference is made to earlier work and the belief that nitrogen in the aerial parts of sunnhemp (*Crotalaria juncea*) may be lost through rapid decomposition before the cane is old enough to make full use of the nitrogen. Mixing the tops with low-nitrogen organic matter (wheat straw) was carried out to retard nitrogen loss. Results are discussed.

* * *

Chromosome transmission by *Saccharum robustum* in interspecific crosses. S. PRICE. *J. Heredity*, 1968, **59**, 245–247.—The hybridization work discussed was carried out as part of the breeding work of the Experiment Station, Hawaiian Sugar Planters' Association. It is pointed out that several species of *Saccharum* transmit unexpected chromosome numbers to their hybrid progeny. Details of chromosome numbers are given.

* * *

Sugar cane diseases (in Réunion). M. HOARAU. *Ann. Rpt. Recherches Agron. Trop. Réunion*, 1967, 39–65. Current work on the troublesome sugar cane diseases of the island is discussed, the diseases including gummosis, ratoon stunting disease, chlorotic streak and Fiji disease.

Wrestling with the sugar cane borer (in Réunion). J. ETIENNE. *Ann. Rpt. Recherches Agron. Trop. Réunion*, 1967, 67–82.—Details are given of the active laboratory programme in controlled breeding of *Tachinid* parasites for the cane borer. Figures are given in regard to parasites raised. These were released in different parts of the island on a number of different varieties of cane.

* * *

***Bipolaris rostrata*, the cause of disease in sugar cane and other grasses.** B. A. BOURNE. *Sugar y Azúcar*, 1968, **63**, (8), 19–24.—Inoculation experiments on several varieties of sugar cane and selected grasses are described. A list of 31 host grasses has been assembled.

* * *

The effects of different depths of planting on germination and yield of sugar cane on fine sandy soil. V. G. CASTRO, V. L. EBRON and E. B. DIMSON. *Sugarland*, 1968, **5**, (3), 8–12, 14.—Experiments are reported in planting cane at different depths (6, 8, 10, 12 and 14 inches) in fine sandy soil at the Luzon Experiment Station, Philippines. The highest percentage germination was the 10-inch depth of planting. Maximum cane and sugar yield were obtained from the planting depth of 10–11 inches, an indication that germination may actually have an effect on sugar yield.

* * *

Improvement of sugar cane varieties (in Réunion). D. D'EMMEREZ DE CHARMOY. *Rpt. Sugar Cane Breeding Sta., Réunion*, 1966–67, 6–12.—Details are given of the breeding work in progress or envisaged, different varieties being required for the three different climatic regions of the island—the dry northern region, the humid region of the north east, and the very humid region of the south east.

* * *

Inflorescence decay in sugar cane. N. E. VAZQUEZ DE R. *La Ind. Azuc.*, 1968, **74**, 133.—In 1966 and 1967 premature decay of the inflorescence of sugar cane plants subjected to temperature and light control to induce flowering was recorded in Tucumán. The potential importance or menace of the malady in breeding work is stressed. Observations on the disease, believed to be due to *Fusarium moniliforme*, are recorded.

* * *

A note on foliar fertilization. R. S. VENKATARAMANA and A. S. SRINIVASAMURTHY. *Proc. 1st Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1968, 12–18.—Experiments are described to find out the safe concentration and optimum doses of different fertilizers in foliar application with cane and to compare the efficiency of foliar sprays with soil applications. Plots sprayed with urea did not show spectacular increase, probably because of droughty conditions. Further work is planned.

Studies on late maturing sugar cane varieties at Anakapalle. M. LAKSHMIKANTHAM, K. K. P. RAO and M. R. RAO. *Proc. 1st Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1968, 79–89.—In trials some of the late maturing varieties, Co 62175, Co 1287 and B 37172 were compared with the standard late variety for the area, Co 419, over two seasons. Co 62175 was found to be a suitable substitute for Co 419. It is less susceptible to smut and red rot disease and is not brittle.

* * *

Distribution of seed cane (São Paulo). J. A. G. C. SOUZA and J. T. DE ALMEIDA F. *Brasil Acuç.*, 1968, **72,** 23–25.—The Sugar Cane Experiment Station at Araras, São Paulo, continues to be active in the distribution of planting material of selected or improved varieties of sugar cane, the total quantity distributed annually exceeding one million kg. Details of distribution are given.

* * *

Varieties of sugar cane. A. DE PADUA F. *Brasil Açuc.*, 1968, **72,** 26.—Reference is made to a circular letter distributed among sugar cane estates and growers in Minas Gerais drawing attention to the superior varieties of sugar cane now available.

* * *

Central Aguirre develops overhead irrigation. E. WILLIAMS. *Sugar J.*, 1968, **31,** (3), 26–27.—Initially portable big-gun irrigation equipment and solid-set sprinkler systems were tried (in Puerto Rico). The latter proved to be more efficient and were adopted. The benefits from overhead irrigation, especially on the light or gravelly soils, are described.

* * *

Flooding cane fields before planting. R. L. WALKER. *Sugar J.*, 1968, **31,** (3), 28–30.—Experiments on flooding (in Florida) are reported. Advantages were that the nematode and wireworm populations were reduced as well as weeds, especially grass weeds.

* * *

Intercropping of sugar cane. B. K. MATHUR, A. SINGH and V. S. BHADAURIA. *Indian Sugar*, 1968, **18,** 43–48. Intercropping trials are reported with potatoes and other crops in eastern Uttar Pradesh. The conclusion was reached that the late planting of cane, after harvesting some other crop (a common practice), is less profitable than judicious intercropping because of the low cane yield of the former.

* * *

Yield and quality of cane juice as influenced by "Agallol" treatment with various levels of seed rates and times of nitrogen application. S. S. CHEEMA and K. SINGH. *Indian Sugar*, 1968, **18,** 49–53.—Trials are reported which show the advantages to be derived from treating setts with "Agallol", an organo-mercurial fungicide, in improving germination and leading to a greater number of millable stalks per unit area. Early nitrogen application is an advantage with the vigorous young plants from "Agallol" treatment.

A new device to measure brittleness of sugar cane varieties. H. P. FANGUY. *Sugar Bull.*, 1968, **46,** (21), 11–14.—Preliminary results are given of a new stalk breaking device (with photograph) used to test 8 varieties of cane. The results agreed with growers' experience with the same varieties.

* * *

Biology of the sugar cane borer (*Diatraea saccharalis*) under Cuban conditions and possible physical methods of control. C. B. CUETO. R. *Bol. Ofic. A.T.A.C.*, 1967, **22,** (4–5), 28–40.—The activity of this cane borer varies with climatic conditions or the environment to which it is exposed. Observations on the insect's behaviour over a number of years are recorded as are the results of breeding under laboratory conditions.

* * *

Occurrence of a cyst nematode on sugar cane in India. K. SINGH and S. R. MISRA. *Plant Disease Reporter*, 1968, **52,** 626.—This is reputed to be the first record of *Heterodera* on sugar cane in India. It showed close similarity with *H. sacchari.*

* * *

Composition of representative stalks of the cane varieties cultivated in experimental plots. M. MENÉNDEZ A. *Bol. Ofic. A.T.A.C.*, 1967, **22,** (6), 13–21. Details are given of analyses for sugar content of varieties of cane of different ages and condition.

* * *

Irrigation of sugar cane. C. B. CUETO R. *Bol. Ofic. A.T.A.C.*, 1967, **22,** (6), 22–49.—This is a general discussion of the irrigation of cane in Cuba with a dissertation on the importance of soil moisture to the sugar cane plant.

* * *

A study of ground water development in Taiwan. W. C. HSU. *Taiwan Sugar*, 1968, **15,** (3), 10–16. Recent well construction in Taiwan is discussed. The average life of wells in Taiwan is 15–20 years, but life and efficiency depend upon construction technique, materials used, geological formation, water quality and maintenance. These factors are discussed.

* * *

Possibilities of increasing outturn of sugar by intercropping sugar beet with sugar cane in subtropical India. P. S. GILL. *Indian Sugar*, 1968, **18,** 147–153. The increasing tendency to grow both sugar cane and sugar beet in many subtropical countries is referred to. Experiments at the Indian Institute of Sugar Cane Research at Lucknow are reported in which sugar beet was grown as an intercrop with sugar cane, the time of year chosen being of course critical. Sugar cane was also cultivated after sugar beet. The highest total sugar yield was from growing the two crops together.

Sugar beet agriculture

Interaction of nitrogen, potassium and sodium fertilizers on uptake of nutrients and on their distribution in the leaf parts of the sugar beet. Y. GUTSTEIN. *Zucker*, 1968, **21**, 358–364, 415–420.—An account is given of field trials in West Germany in which the main effects and interactions of N, K and Na fertilizers on the uptake of nitrate nitrogen, K, Na, Ca and Mg were determined and their distribution in the leaf parts of the sugar beet plant shown. Determinations were made at two different stages of growth. It was concluded that fertilizing with K considerably favours the uptake of all elements referred to.

* * *

Sugar beet variety trials in Northern Ireland, 1965 and 1966. R. H. STEWART, D. J. ALLOTT, S. M. BROWN and D. M. B. CHESTNUTT. *Rec. Agric. Res. N. Ireland*, 1968, **16**, (2), 109–112; through *Field Crop Abs.*, 1968, **21**, 262.—Results are given of trials at 3 sites for % sugar and yields of roots, sugar and tops. The varieties Anglo-Maribo Poly and Sharpe's Klein E gave the highest average yields of sugar. The varieties Sharpe's Klein Poly, Triplex and the Irish Sugar Company's variety also gave satisfactory yields of sugar.

* * *

The effects of potassium and magnesium fertilizers on yield and composition of successive crops of ryegrass, clover, sugar beet, potatoes, kale and barley on sandy soil at Woburn. J. BOLTON and A. PENNY. *Ann. Appl. Biol.*, 1968, **61**, 303–311.—An 8-year field experiment, with potassium and magnesium sulphates, is described. Percentage yield response to K followed the order: potatoes, clover, barley, sugar beet, kale, ryegrass. Magnesium increased yields by 3 to 10%. Magnesium deficiency diseases recently reported are attributed to local liming materials containing only small amounts of magnesium and to less farmyard manure being used than formerly.

* * *

The influence of foliar applications of sugars on the susceptibility of sugar beet to downy mildew. G. E. RUSSELL. *Ann. Appl. Biol.*, 1968, **61**, 381–386.—Spraying sugar beet seedlings in a glasshouse with 1% or 10% solutions of sucrose 24 hours before inoculation with *Peronospora farinosa* significantly reduced their susceptibility to downy mildew. Spraying 1 and 2 days before inoculation was more effective than spraying shortly before inoculation. The mechanism whereby the spraying functions is not properly understood but it is thought the main effects occurred inside the host plant rather than externally.

Sugar content of sugar beet roots. ANON. *Rothamsted Experiment Sta. Rpt.*, 1967, 95–96.—A study of the causes of variation of sugar content of sugar beet is reported, with special reference to the effects of shading and of applying additional nitrogen at different stages of growth.

* * *

Sugar beet trials. ANON. *National Inst. Agric. Bot. Rpt.*, 1967, (48), 22–24.—An account is given of the various trials with sugar beet carried out during 1966 and 1967. Trials of 17 commercial varieties were successfully conducted at 15 UK centres in 1966 and of 17 varieties at 17 centres in 1967. The trials included virus yellows tolerance trials. A study was made of varietal susceptibility to downy mildew and to bolting. In 1967 a commencement was made in a study of varietal differences in emergence. Time of harvest trials at two centres were also carried out. It has been urged that the monogerm variety Bush Munro should be placed on the recommended list and that the variety Zwaanesse 111 be removed from it. The variety Camkilt is recommended for special use for very early sowing only.

* * *

Investigations made into male sterile beets. H. A. CORTESSI. *Euphytica* (Wageningen), 1967, **16**, 425–432; through *Plant Breeding Abs.*, 1968, **38**, 616. The expression of male sterility is influenced by environmental conditions and pretreatment of the material.

* * *

A new, useful flowering characteristic in *Beta vulgaris*. J. HAVEL. *Euphytica* (Wageningen), 1967, **16**, 410–412; through *Plant Breeding Abs.*, 1968, **38**, 617.—A plant with all the flowers opening simultaneously and distributed regularly and with all glomerules of the same size and ripening at the same time was observed in a stock nursery. The properties were fixed by further cultivation.

* * *

Picking the right sugar beet variety. L. A. WILLEY. *Farm and Country*, 1968, (223), 187–190; through *Plant Breeding Abs.*, 1968, **38**, 617.—Yields of sugar and percentage of bolters in recommended varieties (11 multigerm and 3 monogerm) are given by means of a table. Six multigerm varieties produced above-average sugar yields and Camkilt, also multigerm, was particularly resistant to bolting.

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Double Carbonatation Producing
Commercial White Sugar.

1953 LEIAH West Pakistan
1,000—1,200 Tons Cane/Day.
Double Carbonatation Producing
Commercial White Sugar.

1956 THAKURGAON East Pakistan
1,000 Tons Cane/Day. Suitable
for future extension to 1,500 Tons.
Double Sulphitation Producing
Commercial White Sugar.

1962 KHANPUR West Pakistan
1,500 Tons Cane/Day. Suitable
for future extension to 2,000 Tons.
Double Carbonatation and Double
Sulphitation Producing Direct
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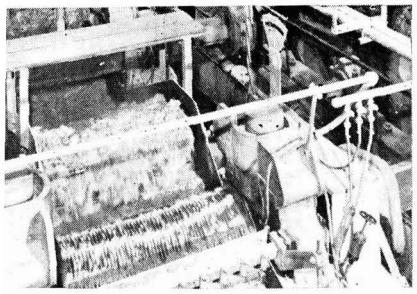

Cane sugar manufacture

The Buckau-Wolf/Burnett diffuser. ANON. *Sugar y Azúcar*, 1968, **63**, (9), 54–57.—See *I.S.J.*, 1969, **71**, 62.

* * *

The principles of pan boiling. B. B. GAIROLA. *Indian Sugar*, **18**, 139–146.—The principles are discussed under the following headings: supersaturation, rate of crystallization, open-pan boiling, vacuum boiling, crystal content of massecuite, crystal size, graining, maturing of grain, finishing the strike, and instrumentation.

* * *

Cane deterioration trials: Fairymead mill. L. K. KIRBY. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 11–17.—Trials during 1967 showed that the average fibre content of chopped cane was 0·49% lower than that of whole-stalk cane. Small losses in c.c.s. content were found after 24 hours' storage but were not statistically significant. The losses became significant after 2 days in the case of chopped cane and after 3 days for whole-stalk cane. The c.c.s. loss for chopped cane after 3 days (the normal week-end shut-down delay) is 3½ times that for whole-stalk cane, and represents a serious loss to both grower and miller. Juice purity and pH fall and acidity rises significantly in chopped cane after 2 days, while increases in reducing sugars and gums were significant even after 24 hours' storage.

* * *

The Tully area cane deterioration investigation. R. P. VICKERS. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 19–29.—During the months of September, October and November 1967, when weather was likely to favour lower-than-average rates of deterioration, chopped cane deteriorated significantly within 17 hours of harvesting. Whole cane, except for occasional consignments, did not deteriorate appreciably when subjected to delays of about 30 hours. The rate of deterioration of chopped cane was significantly greater during the first 4–17 hours than during the subsequent periods of 17–28 hours.

* * *

Investigations on chemical control of sour storage rot. II. Formalin fumigation. B. T. EGAN. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 31–37. Tests were made in which billets of cane, freshly harvested, after varying delays were exposed to fumigation at different rates and for different lengths of time. The overall picture resulting from the tests is that formalin can reduce the c.c.s. loss to less than half that in untreated billets, but that its effect is smallest under conditions when the deterioration is likely to be greatest, and the residual deterioration is such as to render the treatment uneconomical.

* * *

The research work of T. J. Solomon. M. SHAW. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 57–64.—A summary is made of the work on cane milling carried out by SOLOMON and embodied in his thesis prepared for the University of Queensland.

* * *

A method of determining settings for three-roll mills. G. E. RUSSELL and C. R. MURRY. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 81–93.—A setting formula is developed for three-roll mills and applied to four different types of mill. The total torque required at the input shaft is also calculated. In order to maximize juice extraction, the settings may be determined by means of a computer programmed to solve the first equation, given data including the allowable mill roll load, torque available, mill geometry, and fibre density expected in the feed chute, and subjected to the limits of the openings, selecting the lowest possible speed.

* * *

Some aspects of shredder hammer design. D. S. SHANN and R. N. CULLEN. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 95–99.—Factors in shredder hammer design which will affect performance are studied by consideration of input energy and the angle of swing-back. The last is calculated to be within the range 13–18° and, to remain within this range so that the stability of operation is not affected, increase in input energy may be increased by increasing the hammer mass for a standard hammer profile, by increasing the rotational speed (within limits imposed by high stresses in the rotor), or by designing the profile so as to move the centre of mass of the hammer as far as possible towards the tip.

* * *

Proposal for a direct hydraulic drive. J. W. HILL. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 101–109.—A proposed design is given for a hydraulic drive for a cane mill involving the use of hydraulic motors mounted on a frame surrounding the shaft and operating in sequence by means of ratchets so that high torque is delivered with little pulsation at low speeds[1]. The costs are calculated to be competitive with a conventional drive, and advantages which would result are discussed.

[1] *See I.S.J.*, 1968, **70**, 323.

Conductivity electrode design. P. G. WRIGHT. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 137–140.—A new type of conductivity electrode is described; its active section is a 1-in dia. rod with a stainless steel tip and a "Teflon" (polytetrafluoroethylene) spacer followed by a length of stainless steel rod. An electrical lead passes through the interior of the rod and spacer to the tip of the electrode, and the dimensions are so chosen as to give approximately the same cell constant as the "Bureau" type of electrode used widely within the Queensland industry. A prototype version has been tested in a Webre pan at Farleigh mill, giving an excellent control chart, and versions can be used as a removable downtake electrode, a fixed downtake electrode and a removable wall electrode.

* * *

Dynamic aspects in automatic pH control in the sugar factory. R. J. WILES and P. C. BROOKS. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 141–148.—Some of the time lags and disturbing factors which cause difficulty in pH control during liming are mentioned, and experiments described on a control system which was modified in order to minimize the lags and bring the system as near to "ideal" as possible. It should be possible to elicit information in a questionnaire to identify the causes of non-ideality in an actual liming station to provide the basis for its modification to improve pH control.

* * *

Clarifier studies. P. N. STEWART and K. J. NIX. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 149–156.—Juice flows, Brix, pH and turbidities were measured for a Dorr ATV and old and new Bach clarifiers, and mud was also examined in each case for solids concentration. Capacity of the clarifiers was calculated in terms of settling area and volume. The Bach units gave a lower maximum capacity rating per square foot of settling area, but the new Bach clarifier has a close tray spacing and in terms of volume has a much higher maximum capacity. At this maximum capacity the juice clarity was not always as good as that of the ATV unit, but at equal throughputs per cu.ft., juice clarity from both units was much the same. Consequently the choice between units will depend on installed cost.

* * *

The influence of mud re-mixing on clarifier capacity. K. J. NIX and L. K. KIRBY. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 157–169.—Tests have shown that re-mixing of settled muds with juice feed in a clarifier, which occurs where the mud level is so high that the incoming juice has to pass through it[1,2], could cause a clarifier operating at full capacity to become unstable, since there would be no extra settling area available for the mud entrained in the feed. At appreciable quantities of mud entrainment, the required settling area could be as much as 40% greater than that required where no re-mixing occurred. Modifications to ATV clarifiers and Bach clarifiers of the new type are suggested as a means of eliminating re-mixing, and innovations for future clarifier design are also proposed.

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The introduction of computer services to a Queensland sugar mill. L. J. F. PRINCE. *Proc. 35th Conf. Queensland Soc. Soc. Sugar Cane Tech.*, 1968, 171–174. Experience of electronic data processing at E.D.P. Bureau Services in Brisbane, used by Mossman sugar factory until the factory has its own computer, has shown that not only is processing of accounts for cane payment and production of weekly harvesting reports and variety summaries cheaper than by conventional means, but the information, particularly concerning by-products, is more adequate and will be expected to bring savings because of better control. Conclusions from the author's experience are listed.

* * *

An organizational analysis of engineers' and chemists' positions. D. F. MADDISON. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 175–179.—In this discussion of organization of sugar factory personnel, the example of chief engineer and chief chemist is analysed. It is suggested that, whereas in the traditional sugar factory organization engineers and chemists are expected to adopt subjective positions, i.e. the engineer making decisions against his own interest and the chemist sampling and analysing his own production, chief engineers and chief chemists should be made heads of service departments without direct responsibility for sugar production, the chief engineer no longer supervising cane crushing, and the chemist no longer being concerned with raw sugar production but providing a laboratory service to the whole factory. Advantages of the proposed organization are listed.

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The Tully system of cane quality control. R. P. VICKERS. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 181–191.—Details are given of the cane quality control system operated by Tully sugar mill which covers control of extraneous matter entering the factory and allowances and deductions for cane deterioration, where this is due to delay between delivery and crushing and between burning and delivery, respectively. The system has been successful both economically and technologically.

* * *

Effective maintenance planning. G. S. MCGLASHAN. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 193–198.—Maintenance planning procedures for an effective programme are discussed on the basis of the scheme adopted at Pioneer sugar mill, and the possible benefits of such a scheme are considered.

[1] NIX: *I.S.J.*, 1966, **68**, 371.
[2] *idem ibid.*, 1968, **70**, 83.

Low pressure steam control. G. V. PERSHOUSE. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 203–206.—At Mossman a two-term proportional-plus-reset instrument in the form of a receiver-controller is used to control the steam make-up and exhaust valves so as to maintain a constant steam pressure within the low-pressure range 0–20 p.s.i.g. A typical chart is reproduced and the low-pressure steam control layout is illustrated diagrammatically.

* * *

Evaporator performance at Isis mill. M. D. SULLIVAN. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 207–212.—The 1st effect in a quintuple-effect evaporator (each vessel of 8000 sq.ft. heating surface) was replaced with a 15,000-sq.ft. h.s. vessel and subsequently used as pre-evaporator using vapour from the 1st effect. Tests were then carried out on the evaporator. The results are given in the form of graphs relating heat transfer coefficient to temperature drop and to evaporation coefficient. A system of measuring and controlling juice flow rate as a means of controlling the crushing rate and thus helping to maintain maximum efficiency in the 1st evaporator effect is briefly described. It incorporates a juice surge tank, a control for constant flow from the tank to process, and a regulator for control of the speed of the No. 1 prime mover.

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The installation and maintenance of instruments. F. NEWMAN. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 213–218.—Guidance is given on the installation and maintenance of sugar factory instruments.

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Fluidic controls in a sugar mill. G. V. PERSHOUSE. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 219–223.—"Fluidics" is defined as "the technology of employing general fluid phenomena of wall-attachment and stream interaction in specially designed devices to perform the functions of sensing, logic and control". Application of fluidics is discussed with reference to a bagasse level control device, located on a bypass bagasse chute to divert more bagasse onto the drag conveyor when feed from the milling train is low, and a controller for the level in the boot of a vacuum filter.

* * *

Advantages gained by scheduling locomotives at Mossman. A. K. ROSELER and R. J. BERRY. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 225–228.—Details are given of the scheduling system for the cane trains at Mossman. Among the advantages noted are a 17% saving in operational costs, improved relations with the growers, regularity of cane supply and shorter delays between cutting and crushing.

* * *

Diffusion—together with its effect on process and recovery. E. D. JENSEN. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 229–234.—The performance of the Fairymead Burnett cane diffuser is discussed and results are compared with previous seasons when no diffuser was used and with another Queensland mill of comparable size and milling cane of similar quality. It is shown that the somewhat higher extraction obtained with diffusion is not accompanied by excessive molasses losses. Extraction in 1967 was 96·6% compared with 96·1% at the other factory, while the Fairymead molasses loss figure was 7·63% compared with 7·24% at the other mill. The extraction during the period 1950–1964 at Fairymead fell from 96·7% to 94·9% while the crushing rate rose from 88 to 192 t.c.h. The diffuser is designed to raise the crushing rate to 250 t.c.h. at an overall extraction of about 97%.

* * *

A spinning bed diffuser. W. R. CRAWFORD. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 235–243.—In the diffuser design proposed by the author, prepared cane or bagasse is formed into a hollow cylinder between two concentric cylindrical or frusroconical shells which are so arranged that they, and the material in the annular space, rotate at the same speed about a common vertical axis. The prepared material enters the annular space at the top, moves downwards under gravity, and is discharged at the bottom. The outer shell is perforated and surrounded by a fixed monitor casing containing annular troughs arranged to receive the juice discharged from the several stages of the spinning bed, these juice fractions being recirculated by feeding through apertures in the inner shell at levels higher than those at which they were discharged. With suitable dimensions and a speed of e.g. 50–100 r.p.m. the residence time may be cut to a fraction of that needed for percolation under gravity. The technological problems associated with this centrifugal diffuser are discussed in turn, including pressure within the spinning bed, vertical movement of the bed and flow through the bed. Typical calculations are presented. It is hoped to carry out experiments with a prototype of this design.

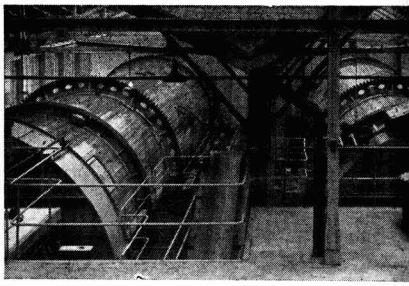
* * *

Cane train braking investigations. R. A. JAMES and C. R. MURRY. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 259–266.—Details are given of tests at Invicta and Tully sugar mills on the use of a brake wagon at the rear of cane trains. Provision of a brake wagon has proved advantageous.

* * *

Thyristor variable-speed drives. J. D. FRICKE. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 267–271.—The advantages of the thyristor or silicon-controlled rectifier are discussed and details given of basic drive circuits (with half- and fully-controlled bridges) used with the shunt D.C. motor type of thyristor drive. Possible applications in the sugar industry are discussed.

Beet sugar manufacture



Japan's Nippon beet sugar enterprise. S. SASADA. *Sugar y Azúcar*, 1968, **63**, (9), 46.—The history of the Japanese beet sugar industry is briefly summarized and an account given of some of the activities of Nippon Tensai Seito K.K. which operates four of the nine factories.

* * *

Performance of automatic control equipment in the 1967/68 campaign. R. ODER and T. CHOMICZ. *Gaz. Cukr.*, 1968, **76**, 188–190.—Observations are presented on automatic regulation of various processes and parameters in Polish sugar factories, including DDS diffusion, liming, steam pressure reduction and heater temperature.

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Effect of improvement in the waste water economy at Lublin sugar factory on the extent of river water pollution. Z. ZAREBA and M. PIOTROWSKI. *Gaz. Cukr.*, 1968, **76**, 191–192.—Modifications to the scheme at Lublin for effluent treatment permitted the average quantity over the campaign to be reduced from 7220 cu.m./day in 1966/67 to 6605 cu.m./day in 1967/68. The BOD_5 was reduced from 534 to 160 mg O_2/litre. As a result, the river water BOD_5 rose by only 3·7 mg O_2/litre in 1967/68 compared with an average rise of 27·4 mg O_2/litre in 1966/67.

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Principles of automatic regulation of massecuite boiling. V. VALTER. *Listy Cukr.*, 1968, **84**, 182–188. Methods of measuring the supersaturation coefficient of sugar solutions and the consistency of massecuites are surveyed with 27 references to the literature. The principles of circuit structure for automatic massecuite boiling control are described.

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Experiment in bulk transporting of raw sugar in special wagons. N. M. KICHIGIN, V. S. YATSENKO and I. I. NOVOGURSKII. *Sakhar. Prom.*, 1968, **42**, (9), 7–11. Information is given on tests conducted with raw sugar transported in self-unloading rail trucks such as used for cement, grain and inorganic fertilizers. The sugar was fed into the top of the trucks and discharged through the bottom into hoppers beneath the rails.

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Modernization of the rotor winding of a BMA centrifugal. K. A. BYKOV, A. I. VINIKIN, YU. A. SHUMILOV and L. B. KUPERBERG. *Sakhar. Prom.*, 1968, **42**, (9), 11–12.—Details are given of modifications made in the USSR to the rotors of the electric pole-change motors used in the automatic BMA centrifugal widely employed in Soviet sugar factories. The alterations were made to lengthen the life of the motors, reduced to 2–3 years mainly because of damage to the side members of the rotor windings.

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Rate of invert sugar destruction as a function of pH and temperature. A. R. SAPRONOV. *Sakhar. Prom.*, 1968, **42**, (9), 19–23.—Values of α and β (catalytic constants of H^+ and OH^- ions, respectively) were calculated from experimental data and then used to calculate the rate constant K for invert sugar destruction in strongly acid ($K = \alpha.10^{-pH}$) and alkaline media ($K = \beta.10^{pH}K_w$, where K_w = ion content of water). In the temperature range 40–140°C, values of K calculated at 10° intervals as a function of pH and temperature lay on the same straight line as experimental values determined by the author and values calculated by other authors. A minimum of invert sugar was destroyed at about pH 3·4, there being a slight shift in the pH value downwards with increase in temperature, i.e. from about 3·7 at 60°C to about 3·2 at 140°C. A decrease in the colour of juices with a fall in pH is attributed to the greater effect of pH on K than of temperature. Values of K were introduced into the equation $x = aK\tau$ to find the amount of sugar destroyed (x) in time τ, a being the initial sugar concentration. The calculated values agreed satisfactorily with experimental values.

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The thermal stability of purified juices. V. A. KOLESNIKOV and V. A. MAKSYUTOV. *Sakhar. Prom.*, 1968, **42**, (9), 23–26.—Details are given of the evaporation stations at a number of sugar factories in the Ukraine, Moldavia and the Russian Federation. The colour of 2nd carbonatation juice and evaporator syrup at sugar factories in these republics in the period 1963–66 is also tabulated, showing that the syrup colour in RSFSR factories was much higher than in the other two republics. Reasons for this are discussed, and it is recommended that the temperature in the 1st effect of a quadruple-effect evaporator with a concentrator should not exceed 120°C.

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Separation of mud from carbonatation juice under the effect of centrifugal forces. D. L. SKORBUN, N. A. BUZYKIN, V. S. FURS and N. F. POLYAKOV. *Sakhar. Prom.*, 1968, **42**, (9), 27.—Preliminary tests have shown that more than 95% of the mud in 1st carbonatation juice was removed in a centrifugal separator,

leaving 0·2–0·3% mud on weight of juice. The separated mud contained 40% moisture. Subsequent treatment of the over-flow in another centrifugal separator gave 73% clear juice completely free of suspension, and 27% in which there was 0·5–0·6% mud. A flow scheme is given.

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System of even regulation of juice feed to an evaporator. L. I. KON, YU. S. DENISOV, M. B. PRIZAND, V. S. POLONIK and YU. P. RADZIEVSKII. *Sakhar. Prom.*, 1968, **42**, (9), 29–30.—An automatic control system is briefly described in which juice feed to an evaporator is governed by the level in the juice tank, so that when the level rises a sensing device transmits a signal which opens the feed valve. Charts demonstrate the evenness of juice feed compared with a system in which only the level in the juice tank is stabilized.

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Experience in grinding beet knives at "Kreshchatik" sugar factory. A. T. SNISAR' and N. K. OSTAPISHIN. *Sakhar. Prom.*, 1968, **42**, (9), 31–32.—Details are given of the sharpening of beet knives at this Soviet sugar factory where a mild steel disc rotating at 4000 r.p.m. can grind one knife in 30 sec. No heat treatment of the knife is necessary.

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Vertical double-cascade dryer. D. N. ZAPOROZHETS. *Sakhar. Prom.*, 1968, **42**, (9), 32–33.—The dryer described is intended for pre-drying of sugar at Selishchanskii sugar factory (USSR). Sugar falls from the top onto a disc 1 m in dia. rotating at 30–35 r.p.m. It is thrown off into a stationary funnel section below and falls through this onto another rotating disc, then again down through a second funnel to discharge at the bottom. An upward flowing steam of air at 98–105°C passes out of the top of the dryer and thence to a cyclone for sugar dust recovery. The number of cascades can be increased. The dryer has operated successfully during the 1966/67 campaign and helped to produce a sugar of required moisture content (0·12–0·13%).

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Influence of boiling point and juice residence time in evaporators on the quality of sugar solutions. N. YU. TOBILEVICH, O. M. SIRYI and V. T. GARYAZHA. *Kharchova Prom.*, 1967, **33**, (3), 26–29; through *S.I.A.*, 1968, **30**, Abs. 68–636.—The factors contributing to high colour development are discussed. The colour intensity observed at Tal'novskii factory is graphed against each of the following, at given values of the other three: heat flow, 15000–45000 kcal/sq.m./hr; juice level, 30–70%; boiling point 120–135°C; concentration ratio, 1·5–1·7; colour is also graphed against juice residence time (0–120 min) at 120, 125, 130 and 135°C. The rate of colour development increased 1·8–2·2 times for each 10°C. Suggestions are made for low juice residence time, especially in 1st effects, where the juice experiences the most unfavourable conditions. Increasing the size of similar apparatus does not affect residence times, but increases average temperatures, owing to larger hydrostatic head. Knowing this temperature rise, the colour increase can be estimated from the graph.

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A technician's thoughts on some of the principal equipment in the sugar industry. E. M. DEMARET. *Ind. Alim. Agric.*, 1968, **85**, 949–961.—A survey is presented of the types of equipment used for juice purification, their merits and demerits being discussed and suggestions put forward. Besides photographs of equipment, a flow diagram is presented for preparing, and removing sand from, milk-of-lime. Liming and filtration are considered in greater detail than the other processes.

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New techniques in continuous purification. M. ROCHE. *Ind. Alim. Agric.*, 1968, **85**, 969–973.—The various carbonatation systems in general use and their effect on juice settling are discussed, as are flocculation aids and filter-thickeners. Particular attention is paid to the Gaudfrin filter.

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Decolorizing resins in the sugar industry. J. J. WOLFF. *Ind. Alim. Agric.*, 1968, **85**, 975–980.—In a discussion of the various types of decolorizing resins used in the sugar industry, emphasis is placed on the significance of the resin structure and its basicity. In laboratory and pilot plant tests the advantages of a resin with a homoporous structure ("Duolite A 140") over one having a macroporous structure were demonstrated as regards flow rate (vol/vol/hr) and syrup decolorizing efficiency. Results from two campaigns are discussed.

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The influence of copper in the corrosion of mild steel tubes in sugar beet factory evaporators. L. LENARD and M. DUSART. *Ind. Alim. Agric.*, 1968, **85**, 983–992. Investigations of the corrosion of mild steel evaporator tubes are discussed. From the results it is concluded that copper originating from the beets is deposited on the tubes, partly in metallic form and partly as CuS and CuO, and that corrosion takes place under the effect of the copper-steel "electrical element" which is created. The characteristics of copper-phosphate steel were more favourable than those of copper-mild steel. Cupramine in the juice is only decomposed in the presence of mild steel in an acid medium. One means suggested for preventing corrosion is the omission of juice demineralization or the use of deliming for only about 80% of the purified juice.

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Viscometric control of low-product massecuites in the sugar industry. J. GENOTELLE and R. MICHEL. *Ind. Alim. Agric.*, 1968, **85**, 1011–1014.—A device for automatically relaying viscosity measurements to an automatic control for dilution where necessary, e.g.

syrup, molasses or massecuite, is described. Developed at the central laboratory of Groupement Technique de Sucreries in collaboration with Société FAREG, it consists of a synchronous motor, the rotor of which is connected to a vertical shaft carrying at its end a measuring disc which rotates in the material being tested. When the rotor turns, the resistant couple is transmitted to the stator, which would turn if not held in place by an opposite and equal couple brought about through a pneumatic balance of forces. The air pressure needed to do this is transmitted to a registering manometer and to any required control equipment. Possible applications are illustrated by diagrams.

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Comparative evolution of sugar stored with conditioning, with conditioning of the warehouse and with dry air blowing through the sugar mass. P. L. DEVILLERS and A. SALSAT. *Ind. Alim. Agric.*, 1968, **85**, 1017–1025. Several tables of data are presented to show the effect of conditioning on sugar stored in bulk or in sacks (paper or jute) compared with storage in unconditioned surroundings. All of the results are expressed in terms of thermophilic, mesophilic and osmophilic counts in the sugar. Best results were obtained with the blowing of dry air between the sacks or through the sugar.

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Waters in beet sugar factories. T. TABOURET. *Ind. Alim. Agric.*, 1968, **85**, 1029–1033.—A brief survey is presented of the different uses of water in a beet sugar factory and the desirable characteristics for each application. Treatment of water for re-use and for disposal is discussed.

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White sugar crystallization in vacuum pans with and without stirrers. H. HARTL. *Zucker*, 1968, **21**, 554–567.—Tests carried out at Tulln sugar factory during three campaigns are described in detail with the aid of crystal photomicrographs. The results, expressed in terms of crystal shape, grain distribution, sugar quality and boiling time, showed that, in the case of "normal" crystal, stirring was of no advantage. For control of boiling, boiling point elevation was used up to graining, while the power consumption of the stirrer motor was used in the final boiling stage.

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Sugar in Czechoslovakia. H. HIRSCHMÜLLER and H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1968, **93**, 531–534.—A survey is presented of the Czechoslovakian sugar industry with a map showing the locations of sugar factories and refineries.

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Application of decolorizing resins in sugar manufacture. V. PREY and E. STEINECK. *Zeitsch. Zuckerind.*, 1968, **93**, 535–543.—Tests in which three unnamed decolorizing resins were used to treat model solutions of molasses, alkaline sucrose decomposition products, melanoidins and caramel are reported in some detail. The composition of one resin was not given while the other two had a polystyrene and a polystyrene-divinylbenzene nucleus, all having trimethylammonium hydroxide active groups. The results are discussed and summarized in tables.

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Working tests on forced ventilation of beet piles during the 1967/68 campaign at Šurany (Czechoslovakia). A. HÁVRANEK, L. SCHMIDT and P. FEKETE. *Listy Cukr.*, 1968, **84**, 193–197.—Tests were conducted on beet piled to a height of 6 m. Results of these and other experiments during a 4-year period are discussed. Forced ventilation reduced losses by 66%, depending on the temperature inside the pile. The most suitable for prolonged storage were beets harvested around mid-October. The maximum recommended axial length of air duct was 7 m. The fans should be automatically controlled to the difference between air and pile temperatures, and should be switched off when the air temperature falls below a specified level.

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Production of high-quality sugar direct from thick juice at Prelouc and Predmerice sugar factories. J. BURIÁNEK. *Listy Cukr.*, 1968, **84**, 197–203.—The processes at the two Czechoslovak factories mentioned in the title are discussed and results reported. To thick juice is added "refined" massecuite run-off (wash liquor from double-cured first product sugar) and liquor produced by remelting single-cured 2nd product and double-cured 3rd product sugar. This standard liquor is boiled to a 1st product massecuite which is spun without washing and mingled with the above remelt liquor before being spun normally, with water and steam washing, to yield "refined crystal". The 2nd product is boiled mainly on 1st product run-off, but also on water wash of the 2nd product sugar and the liquor from the double-cured 3rd product sugar. The 3rd product is boiled on 2nd product run-off with some 1st product run-off; it yields final molasses and a low-grade sugar which is mingled with 1st product run-off and double-cured before remelting.

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Effect of the degree of massecuite curing on colour and massecuite distribution in the pan station. K. WAGNEROWSKI and C. DABROWSKI. *Gaz. Cukr.*, 1968, **76**, 239–242, 256–262.—The relationships between 2nd and 3rd product purity and the colour of the sugar, 1st massecuite purity and 1st product sugar yield are discussed mathematically with the aid of a number of graphs, which also show the effects on other parameters in the pan station.

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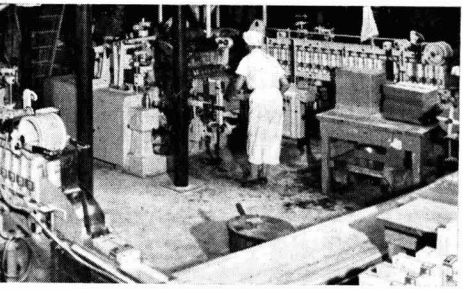
Water economy in a sugar factory. F. GROTTHUZ. *Gaz. Cukr.*, 1968, **76**, 263–266.—The fresh and waste water quality and treatment at a number of Polish sugar factories are discussed, water from each source in the factory being considered in turn.



Sugar refining

Studies on the clarification of affination syrup by means of polyphosphate treatment. I. Discussions of the fundamental conditions of polyphosphate treatment. S. IWASHINA and M. ABE. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1967, **19**, 75–83.—Laboratory tests with a clarification process for low-grade syrup and molasses are discussed. The syrup was diluted to 40–45°Bx with water and adjusted to pH 8·5–9·0 with 1N HCl or $Ca(OH)_2$ at about 50°C and 1·329% on solids of sodium pyrophosphate or sodium tetrapolyphosphate added as aqueous solution. The syrup was then stirred for 5 min at 50 r.p.m. and the precipitated impurities removed by centrifuging at 1000 *g*. The sediment was then washed with 100 ml of 50% methanol followed by 30 ml of anhydrous methanol to remove residual sugars before being transferred to filter paper and dried to constant weight in a vacuum oven at 60°C. Under these optimum conditions a purity rise of 2–3 units was obtainable. The effects of the various factors on the efficiency of the process are discussed with the aid of graphs. The initial syrup Brix and pH were found to be the most important factors.

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Filtration-impeding materials in raw sugars of various origins. V. The improvement of filtrability of carbonatation slurries by the liquefaction of starch in melt liquors. T. KAGA, K. SUZUKI and T. YAMANE. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1967, **19**, 91–95.—The quality of starch in affined sugars was examined and the possibilities of improving filtrability by liquefying starch using α-amylase were investigated. One-third of the starch in affined sugars was found to be highly retrograde and difficult to liquefy, while the remainder was easily liquefied. The filtration-retarding effect of retrograde starch was a little greater than that of the liquefiable starch, but was more easily adsorbed by carbonatation mud than was liquefiable starch.

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Examination of refinery molasses. V. P. PALASH. *Sakhar. Prom.*, 1968, **42**, (5), 12–14.—Sugar losses to refinery molasses generally constitute 65–70% of the total losses. The target standard molasses purity is that which corresponds to a standard Brix of 80·3° at a viscosity of 44 dynes/sec/sq.m. Brix, purity, viscosity and sugar content are given for process, saturated and standard molasses at nine Soviet refineries. The standard Brix for refinery molasses is 1·7% lower than that for beet molasses.

The detrimental effects of impurities occluded in affined sugars on the sugar refining process. T. YAMANE, K. SUZUKI, T. KAGA and Y. TAKAMIZAWA. *Paper presented to the 13th Congr. ISSCT*, 1968.—Of affined sugar colour substances separated into three fractions according to molecular size by gel filtration, the most abundant were those of greatest molecular size. These were easily removed by liquor carbonatation and active carbon decolorization. The substances of medium molecular size were removed by anion exchange treatment. Melt liquors from affined sugars of high colour content gave fine liquors of high colour content. The filtration-retarding impurities in affined sugar were also studied[1–3] with their relation to insoluble matter and starch, and the extent of their removal by washing.

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Raw sugar quality programme in the Hawaiian sugar industry. P. F. MEADS. *Paper presented to the 13th Congr. ISSCT*, 1968.—A quality programme designed to reduce overall sugar processing costs is being carried out in Hawaii in collaboration with Crockett refinery of California and Hawaiian Sugar Co. The programme, which is described, includes research on the refining quality of raw sugar, and a scheme of allowances for higher quality raws has been developed. Problems encountered in the refining of raws of varying characteristics are reported.

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Dynamic characteristics of vacuum pans and control systems of (the) boiling process. M. MORI and Y. UMETANI. *Paper presented to the 13th Congr. ISSCT*, 1968.—In a theoretical discussion of the control variables involved in pan boiling control systems, equations are derived for calculating the various factors The theoretical results were compared with experimental values obtained with a control system designed for a 50-ton capacity calandria pan equipped with a stirrer. Sequential and remote control devices were used, and most of the objectives were attained. Details are given of the auxiliary devices and instrumentation and of computer control under one-man supervision with television monitoring of a station of seven pans as part of the overall computer control system at Nagoya Sugar Refining Co., claimed to be the most automated refinery in Japan.

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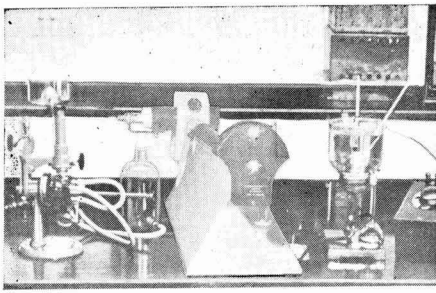
[1] *I.S.J.*, 1965, **67**, 333–337.
[2] *ibid.*, 1966, **68**, 3–6.
[3] *ibid.*, 259–261.

Laboratory methods & Chemical reports



Control of sucrose crystallization in sugar factories. I. Comparison of mathematical and graphical methods for determining the crystal content in massecuites. S. Šušić, V. Stipetić and G. Kukić. *Zeitsch. Zuckerind.*, 1968, **93**, 411–415.—In a comparison of equations derived by various authors for determining massecuite crystal content it is shown that there is wide variation between the values obtained, as demonstrated by graphs. The graphical method of Haucke[1], based on analytical geometry, gives values in close agreement with those obtained using two of the equations presented.

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Analytical methods in sugar technology. R. A. McGinnis. *Candy Ind.*, 1967, **129**, (9), 5–6, 18, 20; through *S.I.A.*, 1968, **30**, Abs. 68–560.—The preparation of specifications for sugar for industrial users is briefly discussed. Preferred methods of sampling, sieve analysis and turbidity measurement are described, and a method of sucrose determination by isotope dilution is outlined[2].

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The TTZ (triphenyltetrazolium chloride) reaction for invert sugars. W. A. Harris. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 593–604.—A modification of the Carruthers & Wootton method[3] for determining invert sugar in beet juice is presented which further reduces manipulation time and the chance of error. A standard curve is established by making up aliquots of a standard invert solution to 2 ml so that they contain 0·05–0·2 mg of invert sugar. To each test tube is added 1 ml of TTZ reagent, made up from equal volumes of a 1·0% solution of TTZ solution in 0·005N HCl and 0·5N NaOH in 1–2% disodium EDTA solution. The solutions are mixed by shaking, stoppered loosely to minimize evaporation, and held in a boiling water bath of 5 minutes. After cooling in a cold water bath, 20 ml of acidified dilute *iso*-propanol (1000:200:10 *iso*-propanol:distilled water: conc. HCl v/v/v) is added and the % transmittance measured at 480 nm against distilled water as the 100% blank. The standard curve is plotted on 2-cycle semi-log paper, and a new curve should be established for each batch of TTZ purchased. The aliquots of the unknown juice samples should be treated in the same fashion with aliquots made up to 2 ml, and the mg invert contained should be read from the curve.

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Bonding of calcium to the carboxyl groups in pectin. R. Kohn. *Zucker*, 1968, **21**, 420–424, 468–475.—The effect of the degree of esterification of pectin on the strength of the bond between Ca and the carboxyl groups in the pectin is descussed and the properties of pectin as a natural ion exchanger is described.

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Filtrability of white sugars. P. Devillers, M. Loilier and J. Roger. *Sucr. Franç.*, 1968, (8/9), 249–251.—A method is described where a 50°Bx solution of the sample sugar is made in filtered water and the volume of filtrate measured after 10 min from the appearance of the first drop, using a filter apparatus fitted with a Millipore RAWP 047 S1 membrane of 47 mm diameter and pore diameter 1·2μ and maintained at a vacuum of 22 in (55·9 cm) of mercury. The filtrability is obtained by multiplying the volume by a factor appropriate to the membrane which is determined by carrying out a similar filtration with a calibration solution (a 50°Bx solution of a good quality white sugar which has been pre-filtered through a membrane of 0·8μ pore diameter) but using 10 in (25·4 cm) of mercury vacuum. The volume of calibration liquid after 5 min (about 400 ml) is divided into 400 ml to give the membrane factor. It is important that the membrane should not be used the wrong way up, since this affects the filtrability measurements greatly.

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New method of (cane) analysis. E. Boyer de la Giroday. *Rpt. Sta. d'Essai* (Réunion), 1966–67, 79–90.—A Jeffco cutter-grinder was employed for reduction of the cane sample and a Mohr press for expression of the juice content. The fibre % cane is given by $F = \frac{b\,(100 - t)}{c\,(1 + g/100)}$ and sugar content by $C\frac{\text{Pol \% } g}{100}(100 - F)$, where b is the weight of bagasse after expression of the juice, c is the weight of the cane sample (300 g), t is the loss % sample weight in the cutter-grinder (found experimentally to average 1·7), g is the residual juice in the bagasse (found experimentally to be 151 g); this reduces the first equation to $F = \frac{39b}{c}$. C is a factor to allow for the fact that the juice expressed is not of exactly the same constitution as normal juice (found experimentally to be 0·97, and Pol % g is the pol content by

[1] *Zeitsch. Zuckerind.*, 1963, **88**, 445–449; *I.S.J.*, 1964, **66**, 88.
[2] Sibley *et al.*: *I.S.J.*, 1967, **69**, 57.
[3] *I.S.J.*, 1955, **57**, 193–194.

weight of the expressed juice. The method was found to give valid results for cane sucrose content when compared with the classical method in which the bagasse was extracted with water in a Waring blender and the bagasse pol measured in the extract. It is emphasized that the experimentally determined factors are only valid for the Jeffco machine and Mohr press; other equipment would require their re-determination.

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Sucrose fermentation in sugar cane juices by coliform bacteria. W. J. NUNEZ and A. R. COLMER. *Sugar J.*, 1968, **31,** (3), 7–10.—Coliform bacteria populations in cane juice samples were determined as were their effects, measured in terms of pH, titratable acidity, gum production, reducing sugars and sucrose content changes. *Eschericia* spp. were few, while *Aerobacter aerogenes* was more prevalent than *A. cloacae*, and had a similar sucrose-destroying power to *Leuconostoc mesenteroides* without, however, producing a dextran slime. Measures taken to diminish development of *L. mesenteroides* should be equally effective for curtailing the harmful activities of the other micro-organisms.

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Effect of sugar cane maturity on invertase activity. T. Y. RIZK and W. C. NORMAND. *Sugar J.*, 1968, **31,** (3), 11–12.—Two invertases have been found in sugar cane tissue[1], one most active under acid conditions and found in immature tissue, and the other most active under neutral conditions and found in mature tissue. Samples of 3 varieties were taken at intervals during the 1966 crop and crushed in a laboratory mill, the juices being treated by dialysis to remove their sugar content and then assayed for the two invertases by adding a known amount of sucrose and measuring the reducing sugars after 4 hr at 30°C under acid and neutral conditions. Both invertases increased through the period and both rates of increase were greater in the earlier part, while both were inhibited as the result of a freeze. However, the relative rates were not the same, and the ratio of acid invertase activity to neutral invertase activity (the A/N ratio) increased through the season (except when it was checked by the freeze) to a maximum, after which it decreased. The ratio may be used, therefore, as an index of cane maturity.

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Enzyme activity and sucrose inversion. T. Y. RIZK and W. C. NORMAND. *Sugar J.*, 1968, **31,** (3), 12–13. Invertase activities in the bottom, middle and top thirds of cane stalks of three varieties were examined to see if there was a relationship to the different sugar components. The highest invertase activities and reducing sugars contents were found in the variety having the lowest purity and sucrose content, and in the upper thirds which were the least mature part of the plants where sucrose content was lowest. There was a direct relationship between the A/N ratio (see previous abstract) and the sucrose content at different growth stages, and the suggestion that this ratio may be a guide to cane maturity is reinforced.

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Colloids and their rôle in sugar manufacture. I. Tyndall effect ultramicroscope; osmotic pressure. K. S. G. DOSS. *Proc. 1st Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1968, (1), 33–37.—Elementary aspects of colloid chemistry are presented in the form of an imaginary conversation.

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The use of filter membranes for determination of insolubles in a refined sugar. T. MOLÉ S. *Bol. Ofic. A.T.A.C.*, 1967, **22,** (4/5), 3–8.—The method of HIBBERT & PHILLIPSON[2] is compared with a variant, due to the DDS company, which uses membranes of 0·8 nm pore size against 5 nm, and a sugar sample of 200 g against 1000 g. The sugar is dissolved in twice its weight of deionized water at ambient temperature (against 95°C). Comparative results indicated an average of three times the insoluble matter trapped by the smaller pore membranes, expressed as p.p.m. of sugar. The results of comparative measurements of filtration rate with Millipore AA (0·8 nm) and SM (5 nm) filter membranes are tabulated; Sartorius MF-100 (0·8 nm) membranes were very slow-filtering. Also tabulated are measurements of the loss in weight of the filter membranes after boiling for 8 min with deionized water (0·4–1·0 mg for the AA membranes and 1·6–2·0 mg for the SM), and the increase in weight for two different membranes used for a blank determination with only deionized water (—0·5 to +0·1 mg for AS membranes, and —1·5 to +1·8 mg for AGF 651-45 membranes).

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Pol:fibre ratio and its influence on pol extraction. M. G. ALVAREZ. *Bol. Ofic. A.T.A.C.*, 1967, **22,** (4/5), 41–50.—Pol extraction varies with cane fibre content, and the reduced pol extraction was devised to allow comparison between mills by bringing to a standard fibre content of 12·5%. This is still not adequate, but it has been found that variations in reduced pol extraction under otherwise equal conditions will vary if the pol:fibre is different for the mills concerned. By adjusting to a pol:fibre ratio of 1 it is possible to provide more meaningful comparisons.

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A method for determination of arsenic in refied sugar. T. MOLÉ S. and A. FERNÁNDEZ C. *Bol. Ofic. A.T.A.C.*, 1967, **22,** (6), 3–12.—A detailed description is given of the method developed by the Danish Sugar Corporation which involves wet ashing of a 10 g sugar sample with nitric and sulphuric acids, adding ammonium oxalate and evaporating, reducing the arsenate present to arsenite with KI and $SnCl_2$ in the presence of HCl, and then to arsene by adding

[1] HATCH & GLASZIOU: *Plant Physiol.*, 1963, **38,** 344–348.
[2] *I.S.J.*, 1966, **68,** 35–44.

granulated zinc to the acid solution in a 3-necked flask which is heated and stirred magnetically while the hydrogen stream carrying the arsene is led away through a cotton wool plug containing lead acetate (to trap entrained sulphuric acid), and into a bubbler tube with a 5% solution in pyridine of silver diethyl dithiocarbamate. The ensuing reaction produces a red colour which is read spectrophotometrically at 540 nm and the arsenic content derived from a calibration curve obtained with known quantities of arsenate.

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Sugar recoveries: how they affect the planters. J. P. STO. DOMINGO. *Proc. 14th Conv. Philippines Sugar Tech.*, 1966, 50–70.—See *I.S.J.*, 1967, **69**, 90.

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Comparative analysis of Luzon molasses. A. S. ROXAS and N. P. AGUILA. *Proc. 14th Conv. Philippines Sugar Tech.*, 1966, 125–128.—Cane molasses samples from seven centrals on the island of Luzon, Philippines, were analysed and the results compared with values obtained by KING & ROTOR[1]. While close agreement was found between the two sets of figures for pH, Brix, dextrose and ash (carbonate) contents and for the proportions of the various ash constituents, the mean values and ranges for pol, sucrose content and apparent and gravity purity were higher in the recent samples than the values obtained by KING & ROTOR. This may be due, it is suggested, to incomplete molasses exhaustion. For a better assessment of their constituents, it is recommended that the final molasses should be analysed also for total solids, moisture, total N, gums, total fermentable matter, assimilable N and the bacterial counts determined.

* * *

Some comments on the "crysts" of raw sugar. C. M. MADRAZO. *Proc. 14th Conv. Philippines Sugar Tech.*, 1966, 173–178.—"Cryst" is a term coined by HONIG to indicate the average grain size and regularity of crystal sugar in place of "grist". Criteria used in some countries for grain size are surveyed and the official Philippines method for determining fines and evaluating export raw sugar is described. Raw sugar grain size distribution is tabulated and graphed for the 13-year period 1953–66 inclusive at San Carlos sugar factory.

* * *

Polarization and refining quality of raw sugar. ANON. *Proc. 14th Conv. Philippines Sugar Tech.*, 1966, 193–206.—An excerpt from a proposed contract for bulk raw sugar drawn up by The American Sugar Co. for implementation from September 1966 is reproduced. It includes the standard permissible range for weight, pol and refining quality, methods of analysis, and examples of penalty and premium calculations.

Enclave inclusions in sugar crystals. D. L. MACKINTOSH and E. T. WHITE. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 245–253.—The mechanism and conditions leading to the formation of "enclave" inclusions in sucrose crystals are discussed with the aid of photomicrographs. The work is a progress report on a project under study at the Dept. of Chemical Engineering of the University of Queensland.

* * *

Polysaccharides of sugar cane bagasse. P. T. MURPHY and G. N. RICHARDS. *Proc. 35th Conf. Queensland Soc. Sugar Cane Tech.*, 1968, 255–258.—Details are given of the techniques used in analysing the pith and fibre of Q 63 cane variety. The holocellulose content in the pith and fibre was 93·42% and 93·19% on dry weight of original material, respectively. This was made up of about 44% α-cellulose, 16–17% hemicellulose A, 16% hemicellulose B and 24–25% hemicellulose C. Paper chromatography revealed a preponderance of xylose plus arabinose and traces of dextrose and galactose in hemicellulose A, mainly xylose plus dextrose and arabinose with a trace of galactose in hemicellulose B, and mainly low M.W. acids derived from lignin degradation in hemicellulose C. The hemicelluloses thus appear to be similar to those isolated from other tropical grasses. No major differences were found between the constituents of the fibre and the pith.

* * *

A laboratory vacuum pan. S. L. PHANSALKAR and H. S. SRIVASTAVA. *Sharkara*, 1967, **9**, 142–143. Details are given of a laboratory vacuum pan constructed by the authors at the National Sugar Institute in India. The pan is heated by a water bath and is provided with a mechanical stirrer. Use of a water bath rather than electrical heating reduced colouring matter formation, and the height of the water could be adjusted easily to the same level as the massecuite within the pan.

* * *

Methods for enzymatic determination of citric and pyruvic acids in sugar factory products. L. BÜSCHING. *Zucker*, 1968, **21**, 531–535.—The method described was developed by GRUBER & MOELLERING[2] and involves the use of citrate lyase, which in the presence of zinc ions catalyses the cleavage of citrate into oxalacetate and acetate. In further stages the oxalacetate is converted to pyruvate enzymatically. The method has been used to determine the citric and pyruvic acid contents in beet factory products. The results are tabulated.

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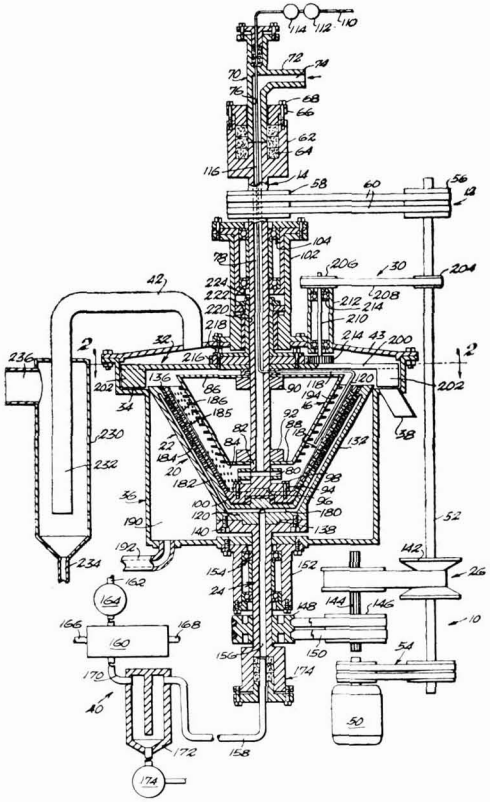
[1] *I.S.J.*, 1932, **34**, 323.
[2] *Biochem. Z.*, 1966, **346**, 85–88.

Patents

UNITED STATES

Continuously operating centrifugal. C. R. CUZA, of Miami, Fla., USA. **3,385,443.** 14th August 1967; 28th May 1968.

The continuous centrifugal is provided with a frustro-conical basket 18 driven from above by the motor 50 through a pulley and belt system 12. The basket is provided with a perforated screen which separates the crystal and molasses components of massecuite supplied through feed port 74 in the stationary housing at the top of and communicating with the hollow passage 78 in drive shaft 14. Surrounding the basket 18 is a spider cone 22 the arm of which are provided with internal passages 182 connected to axial passage in the drive tube 24 by means of which the spider is rotated by the belt and pulley system 26. Air, suitably conditioned for temperature and humidity, is supplied to the passages 182 and is directed inwardly through small apertures 184 in the arms so that it passes through the perforations of the centrifugal basket, causing the crystals to be lifted off the surface of the screen and so assisted towards the upper limit of the cone. The drives 12 and 26 are such as to provide a speed difference of 50–60 r.p.m. between the spider and the basket. Also mounted on shaft 14 is an inner cone 16 carrying horizontal baffles 194 which limit the movement of crystals lifted off the surface of the screen by the air jets, and direct them outwardly back to the screen.



Also driven by motor 50 through another belt and pulley system 30 is another spider carrying arms 200 provided with ploughs 202 which sweep the crystals discharged from the screen from shelf 34 into the discharge outlet 38. The separated molasses, having passed through the spider 22 collects in the chamber 190 and is discharged through port 192.

* * *

L-Glutamic acid production. K. UDAGAWA and M. KOHATA, *assrs.* KYOWA HAKKO KOGYO CO. LTD., of Tokyo, Japan. **3,411,990.** 16th December 1965; 19th November 1968.—*Micrococcus glutamicus* is cultured under aerobic conditions in an aqueous nutrient medium containing as carbon source molasses, glucose, sucrose, starch, acetic acid, citric acid, lactic acid or a keto-acid, together with 0·5–5% by weight of at least one hydrocarbon (kerosene).

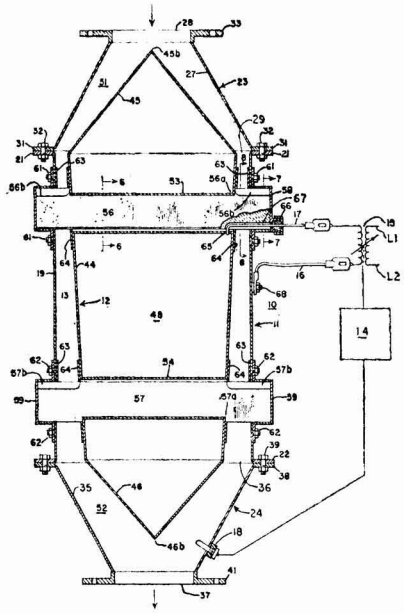
* * *

Resistance massecuite heater. F. B. PRICE, R. J. MORRONI, and N. L. LUCAS, *assrs.* AMERICAN FACTORS ASSOCIATES LTD., of Honolulu, Hawaii, USA. **3,414,436.** 16th September 1966; 3rd December 1968.

Massecuite is subjected to an electric current as it passes through the heater 10 from above to below. The electricity is supplied by leads 16,17 from a

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).

source 15 through a voltage control 14 which may be adjusted manually or automatically as a response to measurement by the thermometer 18. The leads 16, 17 are connected to outer and inner electrodes 11, 12, the former comprising side walls 19 with flanged upper and lower ends, connected to transition section 23, 24 above and below by bolts. The inner electrode 12 has a central section with walls 44



connected to closed section 45 and 46 above and below, so that the massecuite flows between the two electrodes in the passage 13. The cross-section area of passage 13 increases as the distance from the inlet increases; this may be arranged as shown by the walls 44 tapering inwardly or by having the walls 19 of the outer electrode tapering outwardly. The rate of increase of this area and the voltage applied are so arranged as to maintain a constant resistance in the massecuite and thereby a current density of the order of 0·01 amp/sq.cm.

At its upper and lower ends, the central section of the inner electrode is provided with rectangular passages 53, 54 from one side to the other, through which pass bars 56, 57 of insulating material, e.g. a phenolic resin-impregnated linen material, located by notched portions 56a, 57a and held within caps 58, 59 in the walls 19 of the outer electrode 11. The sections of bars 56, 57 over which the massecuite passes are provided with tapered upper surfaces 56b, 57b to prevent accumulation of sugar which might caramelize and become conducting. The lead 17 passes through a packing gland 66 in cap 58 and through bar 56 to meet the inner electrode to which it is connected at 65. Additional insulation material 63, 64 is placed on the inner surface of outer electrode 11 and the outer surface of electrode 12. By passage through the heater the temperature of the massecuite is raised by about 25°F during a residence time of about 100 seconds.

* * *

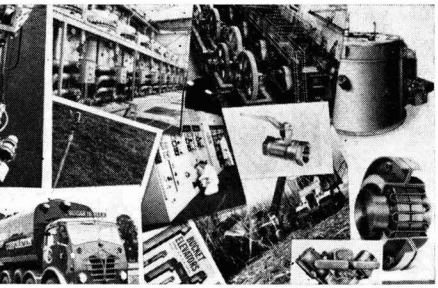
Cane harvester. H. A. WILLETT, of Thibodaux, La., USA, *assr.* CANE MACHINERY and ENGINEEPING CO. INC. **3,414,285.** 22nd August 1966; 3rd December 1968.

* * *

Separation of fructose and glucose. C. B. MOUNTFORT, B. CORTIS-JONES and R. T. WICKHAM, *assrs.* THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **3,416,961.** 22nd December 1964; 17th December 1968.—Predetermined volumes of invert syrup and water are sequentially admitted to a column charged with a water-immersed bed of the alkaline earth metal salt of a cross-linked nuclearly-sulphonated polystyrene cation exchange resin. The effluent is separated into fractions: (i) sweet water I, consisting of dilute glucose-rich solution, (ii) concentrated glucose-rich solution, (iii) recycle I, consisting of concentrated glucose-rich solution highly contaminated with fructose, (iv) recycle II, consisting of concentrated fructose-rich solution highly contaminated with glucose, (v) concentrated fructose-rich solution and (vi) sweet water II, consisting of dilute fructose-rich solution. The recycle I is returned to the column, followed by a predetermined volume of syrup, followed by recycle II and a predetermined volume of water, when the effluent is collected in the same six fractions as before and the cycle may be repeated. Sweet water II may be returned to the column between recycle II and the water, and it may be collected as two fractions—dilute and very dilute fructose-rich solutions—of which only the former is returned to the column. The concentrated glucose-rich and fructose-rich solutions are evaporated, seeded and cooled, after which the crystallized sugars are separated from their mother liquors.

* * *

Clarification of sugar juices. A. E. RABE, of Port Shepstone, Natal, South Africa. **3,418,165.** 7th September 1965; 24th December 1968.—Limed juice to which phosphate has been added is treated with a polyacrylic electrolyte coagulant, e.g. "Separan AP-30", and sent to a container where it is subjected to a sub-atmospheric pressure. The coagulated muds rise to the surface of the liquor which is then clear enough to be sent direct to the evaporators and has its starch content reduced by e.g. 87·4% compared with only 35% by previously generally accepted methods of clarification. The process can be operated batch-wise with successive emptying of the clear juice from the container followed by discharge of the muds. Alternatively, the container may be designed for continuous operation with transfer of the muds to a discharge port by means of a rotating rake and weir system or removal of clear juice by outlets connected to conical extraction cups.



Trade notices

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Sugar factory process monitoring. Visi-Con, 1650 North Elston Ave., Chicago, Ill., 60622 USA.

Round-the-clock central monitoring of processes at the Hawaiian sugar factory of Kohala Sugar Co. is effected by means of two Visi-Con information and annunciator centres—a 36-point and a 30-point unit—which provide early warning of possible breakdowns by checking such process parameters as mill turbine oil and reducing gear oil pressures and temperatures, bearing temperatures, juice pump pressures, carrier functions, mill hydraulic pressures, etc. The units provide complete information on normal operation as well as immediate reports of malfunctioning. Each monitored point is identified on the central display panel by a constantly illuminated nameplate, all points being arranged in a single vertical row for ease of scanning. The condition of each point is shown by three coloured lights next to the nameplate: green, which indicates normal operation; red, showing malfunctioning (when the red light appears the entire legend panel flashes and an audible alarm sounds); and amber, which shows that the malfunction is being checked. Red plus green indicates an intermittent, self-righting malfunction. The units are easy to install and maintain, and are designed to occupy minimal space. Remote audible alarm stations are available for supplementary coverage.

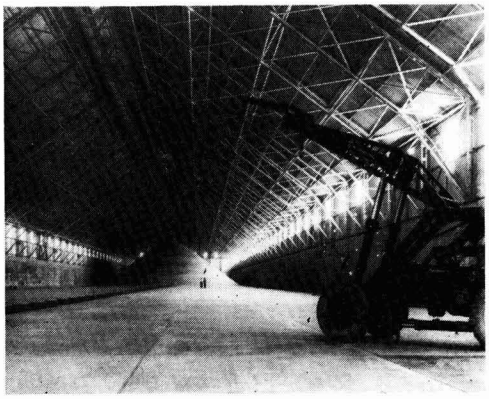
* * *

Electronic current controller. The 30–98 Co. Ltd., Gatwick House, Povey Cross Rd., Horley, Surrey, England.

The 30–98 Co. Ltd. has developed a simple electronic current controller which monitors the current of any drive motor and provides automatic on/off control, indication or both when overloading occurs. The unit, known as the "Sentry", is applicable in any automatic or semi-automatic process where motor-driven equipment is used, and has two operating levels: a high and a low current. One version has a single control with the high level fixed at 110% of the low for applications where pulse control is permitted, while a second version has two controls which permit the high level to be adjusted independently of the low level.

Protection of sugar warehouse floors. Cement Aids International, 80 O'Neill St., Leichhardt, N.S.W., 2040 Australia.

The illustration shows the vast interior of the bulk sugar terminal at Mourilyan Harbour, near Innisfail in North Queensland. Capable of storing up to 420,000 tons of raw sugar, this warehouse has a



floor area of 3½ acres (nearly 1½ ha). Because of the enormous weight of the sugar, wear-and-tear caused by front-end loaders and electric shovels, and acid attack by the sugar, the concrete floor has had to be treated with" Rokite FR", a plastic sealer which penetrates and strengthens the concrete while preventing staining and corrosion, and "Diamite" surface hardener to increase surface resistance to abrasion and "dusting". A special Cement Aids' admixture was also mixed in the base concrete. All three of these Cement Aids' products have been used for five other Queensland bulk terminals, and after five years the floors in all six are still in excellent condition.

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PUBLICATIONS RECEIVED

ROTARY LOUVRE DRYERS, ROASTERS, COOLERS. Newell Dunford Engineering Ltd., 143 Maple Rd., Surbiton, Surrey, England.

The well-known "Rotary Louvre" dryer is featured in a new Newell Dunford leaflet, which shows illustrations of a control panel for four "Rotary Louvre" dryers for refined sugar at Tate & Lyle Ltd. and a sugar dryer under construction for a Soviet sugar factory.

DEFIBRATOR NEWS. Defibrator AB, Stockholm, Sweden.

Issue No. 1, 1969, of "Defibrator News", recently received in this office, mentions, among other things, the two American Defibrator digesters used at the "Trupal" paper mill owned by W. R. Grace & Co. at Cartavio, Peru, and which started operations at the end of 1968. Each of the digesters has a capacity of about 90 tons of pulp per 24 hr and they handle bagasse from the nearby sugar factory.

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CENTRIFUGAL SIFTING MACHINES. Kek Ltd., Hulley Road, Hurdsfield Industrial Estate, Macclesfield, Cheshire, England.

Feed material delivered by a worm is discharged to a rotating helical paddle which throws it against a sieve which allows small particles to pass while oversize particles are carried through the length of the sifting chamber and are discharged at the far end. The sieves of apertures 25 to 3300 microns are made of nylon; coarser sieves are of wire mesh.

* * *

THE CJB GROUP. Constructors John Brown Ltd., CJB House, Eastbourne Terrace, Paddington, London W.C.2, England.

A well-prepared brochure details the work undertaken by the various companies in the CJB Group, covering plant and process design and supply, special development schemes, pipelines, technical consultancy work, automation and process control, corrosion control and welding, and electronic monitoring equipment.

* * *

BI-METALLIC STEAM TRAP. Miyawaki Steam Trap Mfg. Co. Ltd., 1-24-1 Chiyosaki-cho, Nishiku, Osaka, 550 Japan.

"Duplex" pop bi-metallic steam traps are described in Bulletin No. E501. Types CD, CFS, CF and CFH operate at working pressures up to 45 kg/sq.cm., depending on the type, while types CH and CUH operate at working pressures of 45–105 and 105–200 kg/sq.cm., respectively.

* * *

DAVID BROWN-BINGHAM PUMPS. David Brown Gear Industries Ltd., Pump Dept., Penistone, Nr. Sheffield, S30 6BJ, England.

The Bingham CAD heavy-duty process pump, "Priomatic" centrifugal pumps and the MSD heavy-duty multi-stage pump are described in separate leaflets obtainable from David Brown Gear Industries Ltd., who manufacture Bingham pumps under licence from the Bingham Pump Co., of the USA.

* * *

ELLIOTT TUBE CLEANING AND TUBE ROLLING EQUIPMENT. Consolidated Pneumatic Tool Co. Ltd., CP House, 97–107 Uxbridge Rd., London W.5, England.

Cat. 69C gives details of Elliott tube cleaning and expansion equipment made under licence from Elliott Overseas Corp. and Carrier Corp., of New York, USA.

* * *

SEPARATION DEVICE TABLE. Dorr-Oliver Inc., Stamford, Conn., USA.

Dorr-Oliver have recently revised a table showing useful ranges of various separation processes. It indicates the primary factor affecting separation, the ranges of sizes (in Angströms millimicrons, microns and millimetres), and the type of size range, e.g. ionic, macromolecular, fine particle, etc.

* * *

MEASURING AND CONTROL INSTRUMENTS. K. D. G. Instruments Ltd., Manor Royal, Crawley, Sussex, England.

A recent pamphlet gives information on K.D.G. flow and level control equipment, including displacement-type liquid level controls, tank flow switches, external float cage liquid level controls, the F 503 flow switch, FCV swing-check flow switch, and volume production flow switches. S1 mercury switch and M1 micro-switch mechanisms are also featured.

Philippines sugar factory order for Fletcher and Stewart. Fletcher and Stewart Ltd., of Derby, England, have received an order worth £8·1 million from the Davao Sugar Central Co. Inc. for the supply of a cane sugar factory to be erected on the island of Mindanao. The factory will have a crushing capacity of 4000 t.c.d. and will produce both raw and refined sugar. Apart from supplying the plant and supervising the factory erection, Fletcher and Stewart will also arrange the supply of agricultural equipment for cane planting and harvesting.

* * *

Goka cube sugar combines.—The Goka cube sugar combine described on p. 157 of our May 1969 issue is designed for large outputs of up to 3000 kg/hr instead of 500 kg/hr as reported. Other units of up to 500 kg/hr capacity are, however, available from Goka N.V.

* * *

Centrifugal licence.—Under the terms of an agreement with Hein, Lehmann & Co. A.G., The Mirrlees Watson Co. Ltd. is now licensed to manufacture the "Konti 6", "Konti 8" and "Konti 10" continuous centrifugals design by the German firm, and will also have exclusive rights to sell them in the UK, Canada, Ireland and most Caribbean countries.

* * *

Cane harvester testing.—Crichton Industries Pty. Ltd., an Australian subsidiary of Massey-Ferguson, has recently purchased a manufacturing facility at East Bundaberg from Fairymead Sugar Co. Ltd., of Bundaberg, Queensland, with a condition that Fairymead, which operates some of Australia's largest sugar cane plantations, will make available some of its crop for the testing of Massey-Ferguson cane harvesters. The new MF 201 "Cane Commander", released by Crichton Industries, is claimed to gave a bigger capacity than any single-row harvester previously mass-produced in Australia. It is self-propelled and has a throughput of one ton of cane per min over a wide range of crop yields and conditions. It is powered by a Perkins V-8 engine and is provided with hydrostatic transmission and six-stage cane cleaning.

* * *

Stork-Werkspoor equipment for Iran.—Stork-Werkspoor Sugar equipment to be supplied to the Haft Tappeh cane sugar factory in Iran, erected by the Dutch company in 1961, will include one set of cane knives, a 42½ × 78-in cane mill, complete with turbine and gearing and an automatic cane feed system, two juice heaters, three evaporator effects, one vacuum pan, two crystallizers, three fully-automatic centrifugals, and a continuous automatically-controlled sugar melter. This will permit expansion of the factory which already has a capacity exceeding the initially planned figure by 20%.

* * *

Buckau-Wolf beet diffuser.—Buckau-Wolf Maschinenfabrik A.G. report that a beet diffuser supplied by them to the Manteca sugar factory of Spreckels Sugar Co., in the USA, has operated to the complete satisfaction of the customer and has already achieved daily throughputs of up to 2000 short tons of beet, although the diffuser, ordered in 1967, is rated for only 1600 short tons of beet per day.

* * *

APV acquisition.—A.P.V. Holdings Ltd. has had an offer for the whole of the issued share capital of L. A. Mitchell (Holdings) Ltd. accepted. APV are manufacturers of process plant, including heat exchangers, evaporators, pressure vessels, pumps, yeast plants, etc., and the LAM Group includes a number of companies manufacturing various products, including pumps, mixers, filters (made by Sparkler Filters (G.B.) Ltd.), drying plant, etc.

* * *

Farrow & Sons Ltd. join Tate & Lyle.—Farrow & Sons Ltd., of Spalding, Lincs., England, manufacturers of irrigation equipment, have been acquired by Tate & Lyle Enterprises Ltd.

World sugar production estimates 1968-69[1]

BEET SUGAR	Campaign	Estimate 1968/69	1967/68
		(metric tons, raw value)	
EUROPE			
Belgium/Luxembourg	Sept/Jan.	589,000	579,915
France	„	2,434,785	1,766,675
Germany, West*	„	2,016,085	2,105,055
Holland	„	734,000	772,286
Italy*	July/Oct.	1,322,000	1,671,187
Total E.E.C.		*7,095,870*	*6,895,118*
Austria	Sept/Jan.	299,234	306,889
Denmark	„	347,778	329,474
Finland	„	50,056	63,740
Greece	July/Oct.	97,754	122,917
Ireland	Sept/Jan.	167,001	145,487
Spain	July/March	707,916	599,786
Sweden	Sept/Jan.	298 000	264,999
Switzerland	„	69,210	65,464
Turkey	Aug/Feb.	721,613	808,786
United Kingdom	Sept/Jan.	996,021	985,859
Yugoslavia	Aug/Jan.	397,617	508,212
Total West Europe		*11,248,070*	*11,096,731*
Albania	Aug/Jan.	16,000	15,555
Bulgaria	July/Jan.	260,000	285,000
Czechoslovakia	Sept/Jan.	878,000	840,000
Germany, East	„	505,550	566,666
Hungary	„	446,668	451,110
Poland	„	1,707,000	1,913,100
Rumania	Aug/Feb.	415,000	460,000
USSR	Sept/Jan.	9,925,000	10,665,000
Total East Europe		*14,153,218*	*15,196,431*
Total Europe		25,401,288	26,293,162
OTHER CONTINENTS			
Afghanistan	Nov/Feb.	8,500	8,339
Algeria	June/Nov†	7,000	5,936
Azores	June/Mar.	12,000	12,000
Canada	Oct/Dec.	135,326	144,523
Chile	April/June‡	186,000	191,673
China	Jan/Dec.	650,000	600,000
Iran	Oct.Mar.	455,000	419,625
Iraq	„	5,000	4,500
Israel	April/June	28,000	27,778
Japan	Oct/Feb.	321,455	295,153
Labanon	June/Nov.†	9,000	10,870
Morocco	May/Aug.‡	120,000	109,110
Pakistan	June/July	5,000	5,000
Syria	May/June	28,747	25,000
Tunisia	May/April†	7,000	6,865
United States	July/June	3,190,000	2,438,467
Uruguay	Nov/Mar.	65,000	28,000
Total Other Continents		*5,233,028*	*4,332,839*
TOTAL BEET SUGAR		30,634,316	30,626,001
CANE SUGAR			
EUROPE			
Spain	Mar/Sept.	45,000	42,862
NORTH AND CENTRAL AMERICA			
British Honduras	Dec/June	70,000	66,004
Costa Rica	„	140,000	136,000
Cuba	Nov/June	4,700,000	5,200,000
Dominican Republic	Nov/Sept.	775,000	670,000
Guadeloupe§	Jan/June	160,000	140,552
Guatemala	Dec/June	179,467	158,445
Haiti§	„	53,050	62,980
Honduras	„	55,000	54,430
Martinique§	Jan/June	45,000	45,000
Mexico	Nov/July	2,565,000	2,327,175
Nicaragua	Dec/June	127,000	108,862
Panama	„	73,000	69,406
Puerto Rico	Oct/April	439,982	685,554
Salvador	Nov/June	152,408	142,143
USA—Mainland	Oct/June	1,100,000	1,321,761
Hawaii	Jan/Dec.‡	1,088,600	1,163,170
West Indies—Antigua§	Jan/June‡	—	1,152
Barbados (incl. "fancy molasses")§	„	140,716	161,623
Jamaica§	„	401,523	451,874
St. Kitts§	„	38,608	35,389
Trinidad§	„	241,027	243,389
Total North and Central America		*12,545,381*	*13,244,909*
SOUTH AMERICA			
Argentina	June/Dec†	954,436	799,907
Bolivia	May/Sept.‡	91,000	107,332
Brazil§	June/May	4,135,000	4,215,488
Colombia	Jan/Dec.‡	700,000	663,297
Ecuador	June/Jan.	205,000	204,355
Guyana§	Oct/June	365,760	321,918
Paraguay	July/Nov.†	37,931	39,644
Peru§	Jan/Dec.‡	630,000	752,132
Surinam	Aug/May	20,000	19,500
Uruguay	July/Oct.†	6,000	3,000
Venezuela	Sept/Aug.	385,000	373,240
Total South America		*7,530,127*	*7,499,813*
AFRICA			
Angola§	July/April	70,000	72,616
Congo (Brazzaville)	Oct/April	92,400	99,000
Congo (Kinshasa)	May/Nov.†	45,000	45,000
Ethiopia	Nov/June	75,000	75,288
Ghana	April/Sept.	20,000	12,891
Kenya	July/June	117,400	69,909
Madeira	Mar/Sept.	3,000	3,000
Malagasy	July/June	115,000	112,000
Malawi	May/Nov.†	22,000	19,565
Mauritius§	July/Jan.	596,549	638,322
Mozambique§	May/Nov.	215,000	199,521
Nigeria	Nov/May	25,686	21,861
Réunion§	Aug/Jan.	252,737	229,862
Rhodesia	May/Nov.†	150,000	140,000
Somalia	Nov/June	35,000	31,335
South Africa§	May/April	1,514,377	1,822,256
Sudan	Dec/June	110,000	103,644
Swaziland§	May/Feb.	160,000	161,770
Tanzania	July/June	93,100	87,192
Uganda	„	165,000	155,691
UAR (Egypt)	Dec/June	455,000	392,045
Zambia	May/Nov.†	23,709	—
Total Africa		*4,355,958*	*4,492,768*
ASIA			
Afghanistan	Oct/April	10,000	8,339
Burma	Nov.April	85,000	82,000
Ceylon	Nov/June	10,000	7,999
China	Jan/Dec.‡	2,050,000	1,900,000
India, excl. khandsari	Oct/July	3,900,000	2,497,703
Indonesia	May/Dec.†	600,000	600,000
Iran	Oct/April	55,000	47,042
Japan & Ryukyu Islands	Nov/June	299,990	317,518
Nepal	Oct/April	10,000	10,000
Pakistan	Nov/May	437,000	382,008
Philippines§	Nov/July	1,633,000	1,595,913
Taiwan	Nov/June	784,000	865,016
Thailand§	Oct/April	339,000	209,752
Total Asia		*10,212,990*	*8,523,290*
OCEANIA			
Australia (incl. high-test molasses)	May/Dec.†	2,846,000	2,438,000
Fiji	„	422,000	313,000
Total Oceania		*3,268,000*	*2,751,000*
TOTAL CANE SUGAR		37,957,456	36,554,642
TOTAL BEET SUGAR		30,634,316	30,626,001
TOTAL SUGAR PRODUCTION		68,591,772	67,180,643

[1] F. O. Licht, *International Sugar Rpt.*, 1969 **101**, (21) 1–5.

* Including production from desugarizing of molasses.

† 1968, 1967. ‡ 1969, 1968. § tel quel.

Brevities

Cuban campaign start[1].—The 1969/70 campaign in Cuba started on the 14th July with the opening of the Antonio Guiteras mill (formerly Central Delicias) in Oriente province. Other mills in the same province were expected to start shortly after. In most regions of Cuba soil conditions during the rainy season make work in the cane fields impossible, but in Oriente it is sometimes possible—as in 1952 when the record output of 7,225,000 metric tons was reached—to continue crushing until August. This will be the first time, however, that sugar produced in July will be counted for statistical purposes in the following season's crop. It is anticipated that some mills will also open for a few weeks during October-December before the season proper begins in January. There is no doubt that Cuba is intending to make substantial efforts to reach a very large tonnage during 1969/70. The target is the well-advertised figure of ten million tons, but despite the early start there are few who anticipate that such a quantity can be attained. The unusually early start will, of course, enable Cuba to deliver sugar from the 1969/70 campaign to the world market this year and charge it within the 1969 I.S.A. quota.

* * *

Europe sugar beet area, 1969.—F. O. Licht K.G. has recently published their third estimate of beet sowings in Europe[2]. The overall total of 6,688,930 hectares is only slightly less than the second estimate of 6,717,515 hectares[3] and is the result of decreases of a few thousand hectares in a number of countries, while the two largest changes in the estimates are a decrease of 23,000 ha for Turkey, and a 14,000 ha increase for Spain.

* * *

New molasses futures contracts[4].—A new molasses futures contract has been approved by the New York Coffee and Sugar Exchange. Trading is to begin on 8th September 1969. Mr. HAROLD LEBE, President of the Exchange, said that increasing industrial uses of molasses, particularly in animal feeds, have created greater price volatility and a need for a hedging device for producers and users.

* * *

UK sugar surcharge.—In view of the fall in the world price of raw sugar on the London Market, the UK Minister of Agriculture, Fisheries and Food has increased the surcharge from 2d per lb (18s 8d per cwt) to 2¼d per lb (21s 0d per cwt) from the 7th August 1969 and to 2½d per lb (23s 4d per cwt) from the 21st August 1969.

* * *

New Philippines sugar factories.—A new sugar factory with a capacity of 5000 tons of cane per day is to be constructed at Padada, in Davao province on the island of Mindanao[5]. It will be provided with a cane diffuser and may be in operation by the end of 1970. Cultivation of high-yielding cane varieties was started some time ago to ensure that the factory will have sufficient cane when it goes into operation. Another plant costing 75 m pesos is to be built at Dinalupihan, in the province of Bataan, the equipment to be supplied by Toyo Menka Kaisha Ltd.[6]

* * *

East Germany sugar production 1968/69[7].—The sugar outturn in East Germany in 1968/69 was the lowest for 22 years, with only 455,000 metric tons of sugar. A crop of 6,000,000 tons of beet was produced from an area of 196,000 hectares, yielding 30·7 tons/ha but only 4,726,000 tons was used for sugar production and the remainder for animal fodder. The balance of the country's requirements was made up by the importation of 510,000 tons of sugar from Cuba.

* * *

Barbados sugar crop, 1969.[8]—The 1969 sugar season was concluded in Barbados with a production of 137,100 tons. This is the lowest figure for 21 years and is largely due to the increase in cane fires over the last three years and to unfavourable weather conditions.

Cuban sugar statistics[9]

	1968	1967	1966
	(metric tons, raw value)		
Initial Stocks	286,132	362,502	471,960
Production	5,315,197	6,236,000	4,866,710
	5,601,329	6,598,502	5,338,670
Exports	4,612,923	5,682,872	4,434,639
	988,406	915,630	904,031
Consumption	681,613*	629,498	541 529
Final Stocks	306,793	286,132	362,502
Exports			
Albania	17,098	4,235	10,490
Algeria	43,494	42,713	618
Bahrein	—	5,176	—
Belgium/Luxembourg	12,859	511	6,704
Bulgaria	186,431	194,671	158,051
Canada	46,739	66,175	69,378
Ceylon	68,525	—	—
China	431,108	556,079	619,731
Czechoslovakia	193,490	214,884	262,098
Finland	30,267	21,158	10,789
France	20,634	—	—
Germany, East	243,656	249,623	207,192
Greece	34,169	—	—
Guinea	3,792	—	—
Hungary	16,574	16,730	—
Iran	10,664	71,327	10,336
Iraq	53,124	42,095	—
Italy	—	58,890	45,399
Japan	555,422	542,127	359,961
Korea, North	74,910	83,346	21,335
Kuwait	—	16,115	—
Lebanon	—	753	329
Libya	—	23,417	—
Malaysia	—	118,989	—
Malta	5,482	—	—
Mongolia	5,193	5,273	—
Morocco	85,635	152,768	181,327
Netherlands	58,520	71,318	22,294
Norway	10,467	22,216	18,862
Poland	20,713	22,327	52,843
Rumania	53,552	—	—
Spain	175,678	158,581	145,343
Sudan	—	205	—
Sweden	40,893	22,223	44,741
Switzerland	3,443	51,487	48,437
Syria	64,133	63,789	53,309
USSR	1,831,727	2,473,305	1,814,930
UAR	65,599	114,278	97,038
UK	20,065	70,290	61,646
Vietnam, North	49,777	45,510	13,077
Yugoslavia	75,685	64,678	97,912
Zambia	—	10,727	—
Other Countries	3,405	4,883	469
	4,612,923	5,682,872	4,434,639

* Of which 20,052 metric tons for animal feeding.

Sudan sugar factory proposal[10].—The United Nations Development Programme reports that negotiations are under way to secure financing for five new industrial enterprises in the Sudan, costing a total of £S 71,500,000; these include a sugar factory.

[1] C. Czarnikow Ltd., *Sugar Review*, 1969, (927), 123.
[2] *International Sugar Rpt.*, 1969, **101**, (20), 1–3.
[3] *I.S.J.*, 1969, **71**, 193.
[4] *The Times*, 28th July 1969.
[5] *Sugar News* 1969, **45**, 159.
[6] *Consudel*; through *Sucr. Belge*, 1969, **88**, 348.
[7] *Zeitsch. Zuckerind.*, 1969, **94**, 357.
[8] *Barclays Overseas Review*, July 1969, p. 64.
[9] *I.S.O. Stat. Bull.*, 1969, **28**, (5), 30–31.
[10] *Barclays Overseas Review*, July 1969, p. 43.

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CRYSTAL OBSERVATION EQUIPMENT

This Portable Micro Projector is of robust construction and should find ready application for viewing crystals of sugar on the pan floor. Basically the unit consists of a metal case grey hammered finish which houses the transformer unit with tappings for 110 or 250 volts input. Illumination is provided by a 12 volt 100 W. twin pillar vertical central projection lamp used in conjunction with a specially computed condenser lens which combination give an even brilliantly illuminated field.

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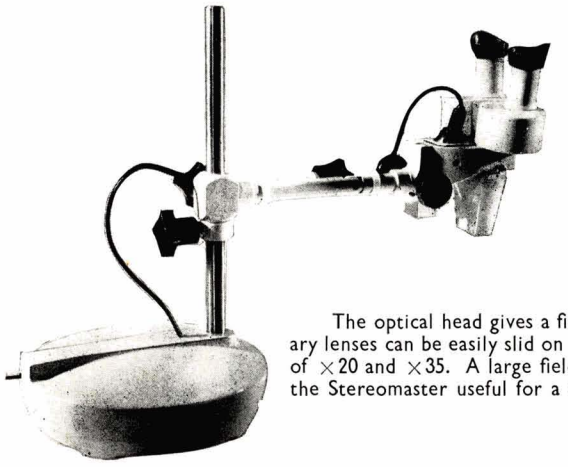

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