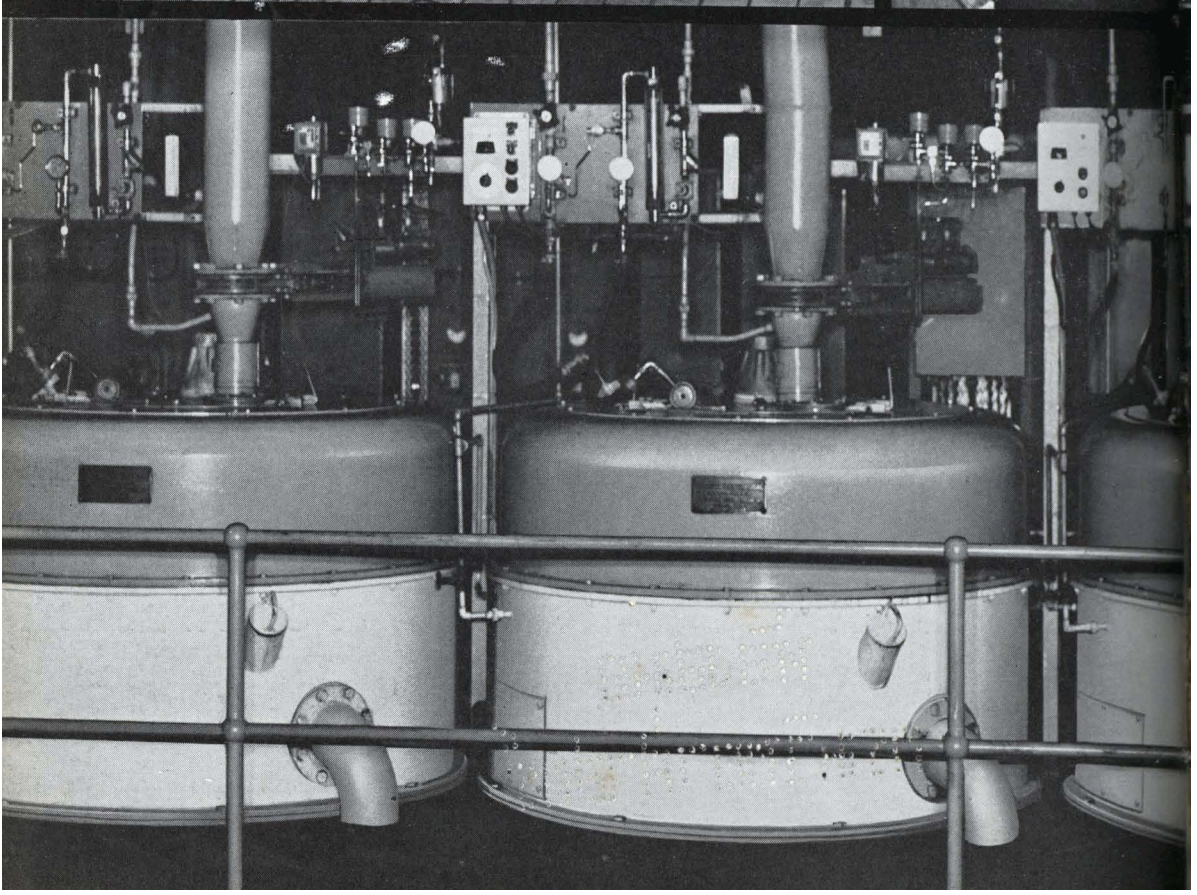
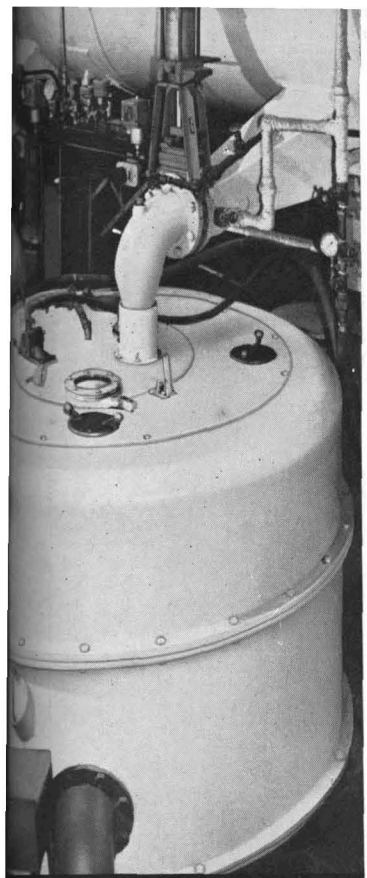
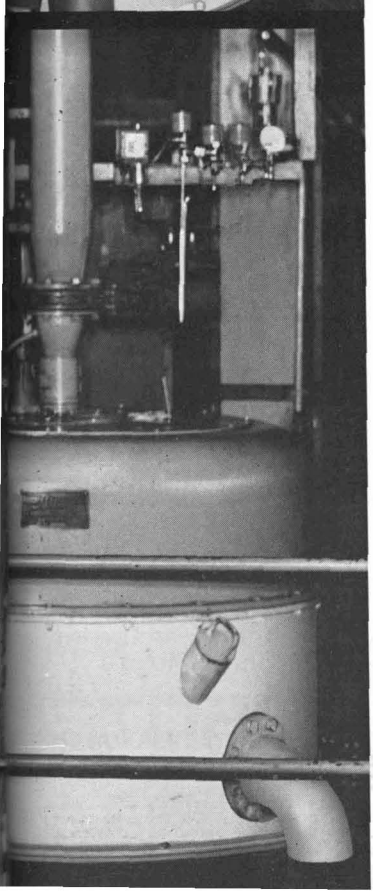
THE International Sugar Journal

NOVEMBER 1971







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for all reprocessed sugar

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Upper left—purging "B" massecuite (as well as "C" massecuite) at Malelane Sugar Factory in the Eastern Transvaal, South Africa.

Lower—repurging "C" sugar at Gledhow Sugar Company in Natal, South Africa.

The Western States staff is versatile too . . . they have the ability to consider, without bias, the size and type centrifugal best suited for you . . . since Western States manufactures both batch and continuous machines. So, whether it's cane or beet, refined or raw, consult: Mr. A. H. Stuhlreyer, Director of Sales.

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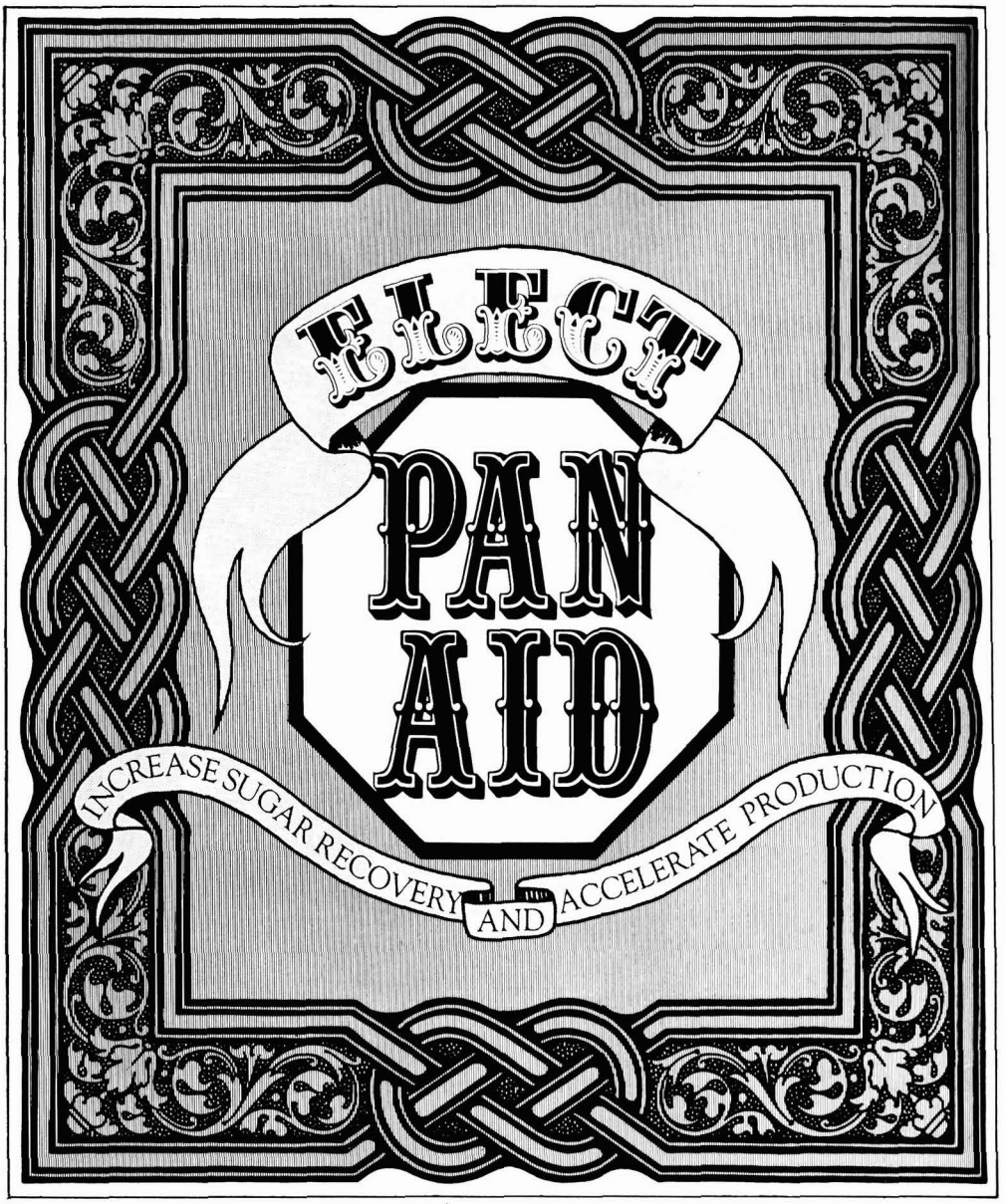

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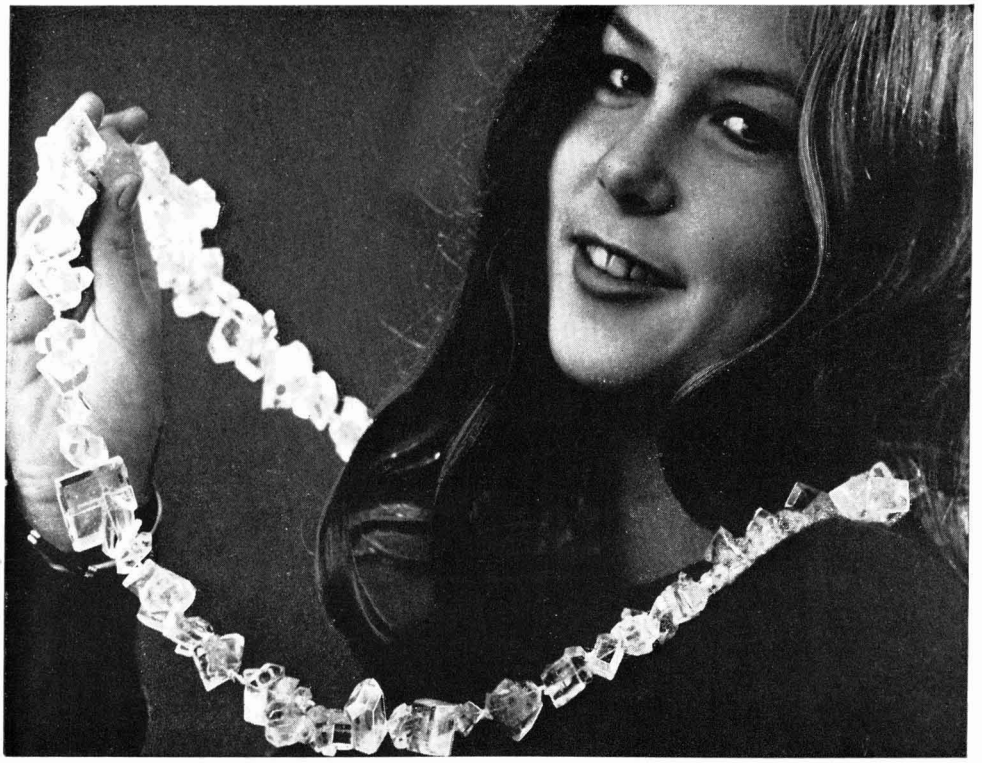

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Sparkling sugar - jewels for the youth of our world! Their health, energy and vitality depend on sugar. It is priceless for them, as jewels are. It moves their muscles and minds as they are building their fascinating future. Our world's duty is to satisfy their needs, to make sugar- one of man's most vital staple foods - available in abundance.

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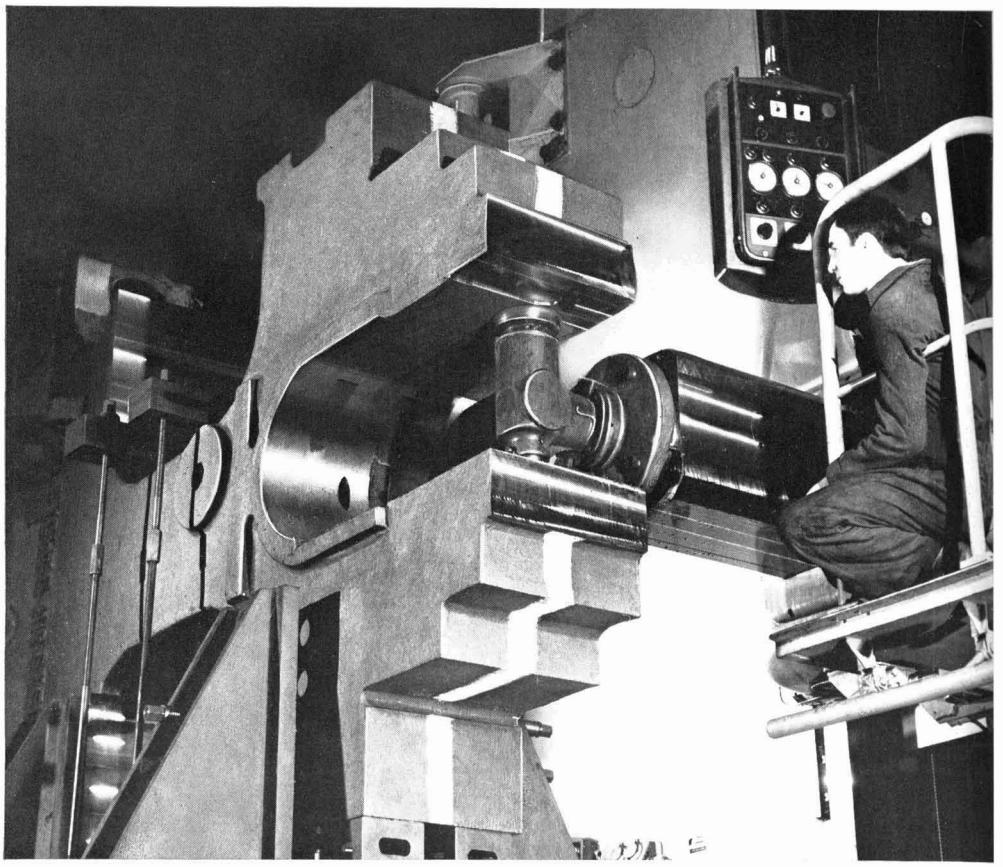

but by using the most modern and sophisticated machine tools available, this FS headstock will be drilled, bored and planed without having to be moved again until it is completed, ensuring a much greater accuracy of finish than is otherwise possible.

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Of course FS has been building sugar machinery for a very long time. Well over 130 years in fact. So they know something about it! Currently FS is building complete factories in Malaysia and the Philippines as well as unit equipment for many other sugar-producing areas.

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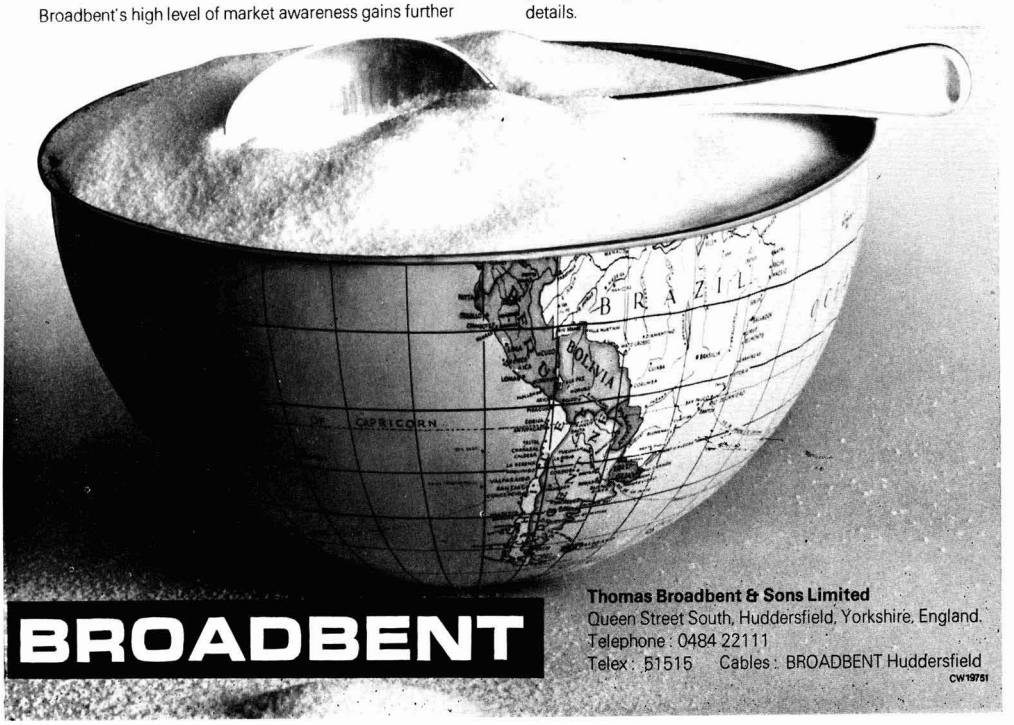

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General Tubing's 'Hydra Swaged' Full-Finished Stainless Steel Sugar Tube

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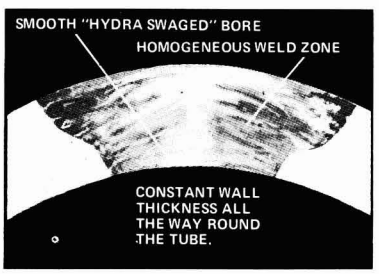
DESCRIPTION
Welded stainless steel tubing "hydra swaged" (internal bead removed) manufactured from AISI Type 304 material, annealed and passivated to Specification ASTM A269, cut to length.

TYPICAL ANALYSIS
18/8 Austenitic Chromium Nickel AISI Type 304 – Cr. 18%; Ni. 9.5%; C. .06%.

ADVANTAGES OF G.T. SUGAR TUBE

SMOOTH BORE – No internal weld bead to cause mechanical cleaning tool heads to "bounce" on weld bead. Therefore no shadows on either side of weld. Easier cleaning with stainless wire brushes or chemicals.

CONSTANT WALL THICKNESS – Weld zone is "cold worked" resulting in a refined grain structure giving increased corrosion resistance.



IMPROVED INSPECTION TECHNIQUES – With the absence of fluctuating internal weld bead mass due to "hydra swaging", the sensitivity of GT's modern eddy current electric testing equipment is set at an even higher level. This results in the most minute voids being located and rejected. You are therefore assured of a regular high quality welded tube.

EASIER END ROLLING – When expanding into tube plates, "hydra swaged" constant wall thickness and uniform ductility simplifies the operation, thus saving cost. No weld bead interference – less wear on expanders – up to 50% cold expansion is possible with "hydra swaged" tube. It is unnecessary to anneal the ends of "hydra swaged" sugar tube before expansion as the whole length is annealed and passivated.

SPEEDY DELIVERY
Normal delivery ex G.T. Works, Sydney, Australia, is 4/6 weeks – better by negotiation.

REPEAT ORDERS
G.T. "hydra swaged" will be available when next you retube – you will receive the same high quality from the same mills.

OTHER ADVANTAGES OF STAINLESS STEEL SUGAR TUBES

1. Improved erosion or abrasion resistance.
2. Good resistance to corrosion.
3. Inherent toughness of stainless steel speeds installation – longer lengths can be used – less tendency to bend.
4. Reduction in wall thickness of approximately 2 gauges due to greater strength of stainless compared with brass or copper, i.e., 16 SWG brass or copper tube can be replaced by 18 SWG stainless.
5. Initial thermal conductivity of stainless is lower than copper or brass. However, it is now recognised in the sugar industry that heat transfer in stainless steel tubes is superior when considered over a service period. This is due to resistance to scale formation both internally and externally. Less scale results in reduced fluid film turbulence, faster flow and increased heat transfer.
6. Stainless, because of high strength factors, is less subject to scoring, scratching, dents, bulging or thinning during mechanical or other methods of cleaning.
7. Extended service life. Reduced maintenance and tube replacement costs.
8. Improved overall performance and efficiency.

FOR BEST RESULTS

1. When cleaning with brushes, use only stainless steel brushes.
2. Do not use hydrochloric acid for cleaning stainless tubes.
3. Clean tubes regularly for maximum heat transfer performance.
4. During slack or off mill season, flush and dry vessels fitted with stainless steel tubes.

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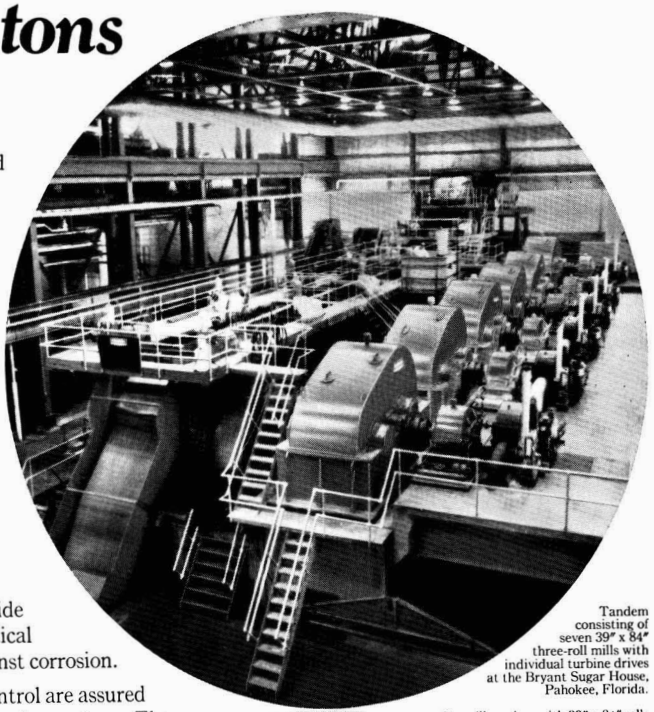
each of these Farrel tandems grinds over 11,000 short tons a day!

FARREL

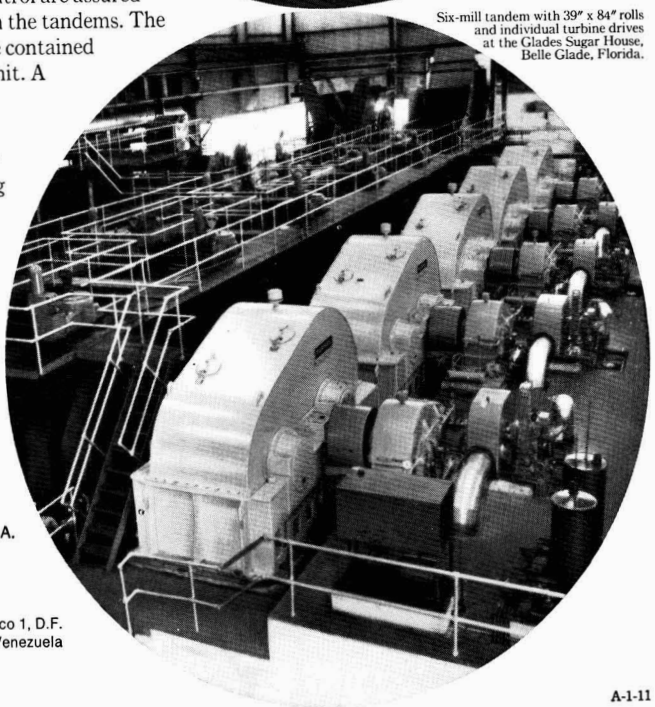
The production figures of the Glades and Bryant sugar houses in Florida prove the efficiency of modern Farrel grinding equipment. Each facility grinds over 11,000 short tons a day using Farrel equipment exclusively – both in the original installations and recent expansions. These 7-foot tandems have set production records and have significantly contributed to the growth of Florida's sugar industry.



Tandem consisting of seven 39″ x 84″ three-roll mills with individual turbine drives at the Bryant Sugar House, Pahokee, Florida.

Both tandems incorporate many refinements developed by Farrel in recent years. Included are: hydraulic-ram mechanisms and ladder roller bearings that maintain uniform roll pressure and free float for the top rolls; automatic lubrication of roll journals; side and top cap designs that allow fast, vertical removal of all rolls, and safeguards against corrosion.

Independent alignment and speed control are assured by self-contained gearing for each mill in the tandems. The first two reductions from the turbine are contained in a high-speed double-reduction gear unit. A second unit contains the two low-speed reductions.



Six-mill tandem with 39″ x 84″ rolls and individual turbine drives at the Glades Sugar House, Belle Glade, Florida.

Put Farrel experience to work in your sugar factory. Whether you are planning a new installation, expansion or modernization, let Farrel grinding equipment be the standard against which you make your buying decision. Write for bulletin 312A today.

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KASTEL C 300 P	porous strongly acidic exchanger with sulphonic active groups
KASTEL C 300 AGR	porous highly crosslinked exchanger with sulphonic active groups
KASTEL C 300 AGR/P	porous highly crosslinked exchanger with sulphonic active groups
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KASTEL A 300	strongly basic exchanger (type II) with dialkyl-alkanol amine active groups
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KASTEL A 510	highly absorbent resin with strongly porous matrix and strongly basic active groups: specially recommended as scavenger

KASTEL

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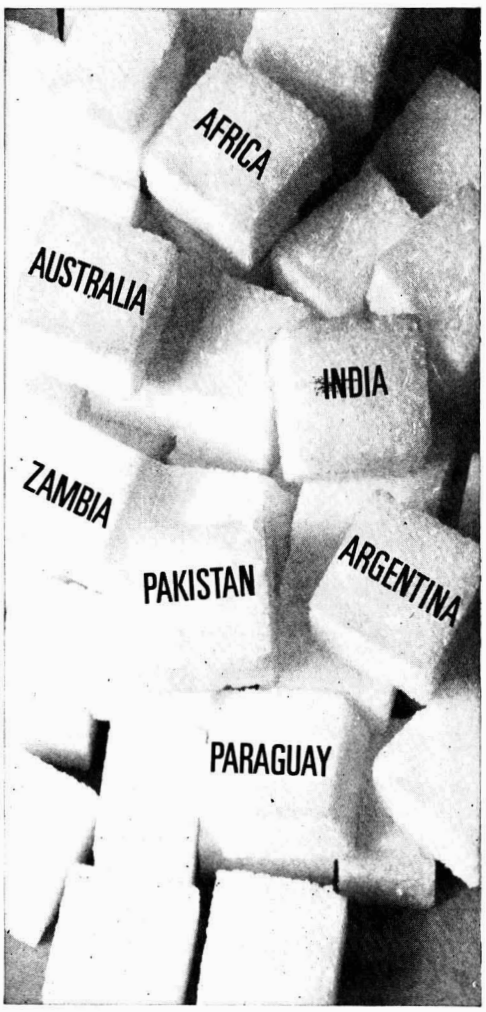
Sweet success for Brotherhood steam turbines



When the big names in sugar mill plant specify Brotherhood turbines, we count it as success. Not that it is unfamiliar, because we have been making turbines for over 60 years, but success is no less sweet.

Throughout the sugar producing world Brotherhood turbines are at work. The illustration shows part of a recent contract for horizontal, multi-stage steam turbines developing 2,500 kW on test prior to despatch to the Caribbean.

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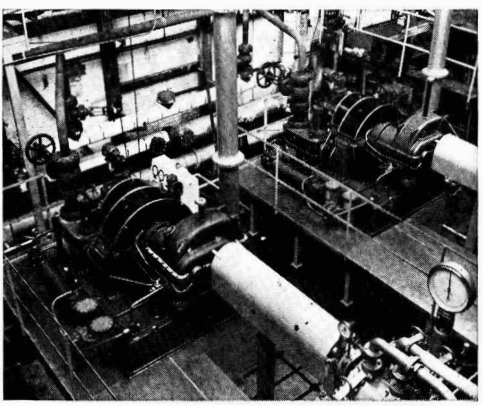

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- **Constant opening ratio during operation.**
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- **Improved extraction.**
- **Increased capacity.**
- **Reduction of power peaks.**

The originality of this system lies in the fact that the top roller does not move in a vertical slide, as in all the conventional mills, but is supported by a hinged upper half housing forming a lever arm. The result of it is, on the one hand, a constancy in the ratio of the feed and discharge openings and, on the other hand, a very easy lift of the top roller, involving an improved efficiency.

already more than 50 mills of this type in the world

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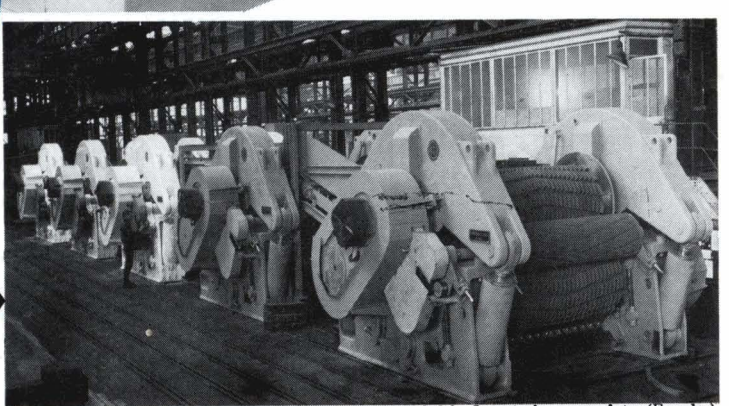

Tandem of five 2 300 x 1 150 mm self-setting cane mills intended for Ingenio Azucarero Aztra (Ecuador)

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International Sugar Journal

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Published by
The International Sugar Journal Ltd.
23a Easton Street, High Wycombe,
Bucks., England.
Telephone: High Wycombe 29408
Cable: Sugaphilos, High Wycombe

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Annual Subscription: £3.00 or $10.00 post free

Single Copies: 40p or $1 post free

November 1971

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Calibrage de sucre en poudre. F. H. C. KELLY et M. F. KENG. *p.* 323–325

On rapporte des expériences effectuées sur la mesure de la distribution de la grosseur des particules de sucres en poudre. On a trouvé qu'une méthode faisant appel à un Analyseur de Dimensions de Particules Hitachi employant une technique de balayage de la lumière et utilisé pour balayer une dispersion de sucre en poudre dans du *n*-butanol, donne des résultats satisfaisants.

* * *

Recherche des conditions optimales de stockage à partir d'études sur les taux de respiration de la betterave. Ire partie. J. F. T. OLDFIELD, J. V. DUTTON et B. J. HOUGHTON. *p.* 326–330

On a déterminé les pertes en sucre dans des betteraves stockées par la mesure du dioxyde de carbone produit par la respiration. On donne des détails sur la méthode et l'appareil utilisé pour mesurer les taux de respiration pendant 30 jours entre 0 et 33°C. On a aussi pris en considération les effets de la température et de la déshydratation sur les taux de respiration.

* * *

Purification des produits de sucrerie par le procédé d'exclusion d'ions. IIe partie. D. GROSS. *p.* 330–334

On donne des détails sur des tests effectués au moyen d'une technique de recyclage élaborée pour l'application du traitement d'exclusion d'ions à du sirup de raffinerie et aux mélasses. Les résultats indiquent la possibilité d'obtenir par ce moyen un degré élevé de purification. On considère les avantages et les inconvénients de la technique de recyclage et on discute de la possibilité d'un procédé en continu.

Korngrössenbestimmung bei Pudersucker. F. H. C. KELLY und M. F. KENG. *S.* 323–325

Es wird über Versuche zur Messung der Korngrössenverteilung bei Puderzucker berichtet. Bei diesen Versuchen, bei denen ein Korngrössenbestimmungsgerät von Hitachi verwendet wurde, das nach dem Lichtabtastverfahren arbeitet, wurde festgestellt, dass beim Abtasten einer Dispersion pulverförmiger Saccharose in *n*–Butanol zufriedenstellende Ergebnisse erhalten werden.

* * *

Ableitung optimaler Lagerungsbedingungen aus Untersuchungen über die Atmungsgeschwindigkeit von Rüben. Teil I. J. F. T. OLDFIELD, J. V. DUTTON und B. J. HOUGHTON. *S.* 326–330

Es wurde die Bestimmung der Zuckerverluste in gelagerten Rüben durch Messung des bei der Atmung entstehenden Kohlendioxids untersucht. Einzelheiten über die Methode und die zur Messung der Atmungsgeschwindigkeit bis zu 30 Tagen bei 0 bis 33 C verwendete Apparatur werden angegeben. Ausserdem wird der Einfluss von Temperatur und Austrocknung auf die Atmungsgeschwindigkeit diskutiert.

* * *

Reinigung von Zuckerprodukten mit Hilfe des Ionenausschlussprozesses. Teil II. D. GROSS. *S.* 330–334

Es werden Einzelheiten über Versuche mit einem für die Ionenausschlussbehandlung von Raffinadekläre und Melass eentwickelten Rücknahmeverfahren angegeben. Die Ergebnisse sprechen dafür, dass es möglich ist, mit dieser Methode einen hohen Reinigungsgrad zu erzielen. Die Vor- und Nachteile des Rücknahmeverfahrens werden aufgezeigt. Ausserdem wird die Möglichkeit einer kontinuierlichen Arbeitsweise diskutiert.

Clasificación de azúcar en polvo. F. H. C. KELLY y M. F. KENG. *Pág.* 323–325

Se hace un informe acerca de experimentos sobre medición del repartimiento de tamaño de particulas de azúcares en polvo. Los autores han demostrado que resultados satisfactorios estan dado por un método en que un Analizador de Tamaño de Particulas, marca Hitachi, que usa una técnica de escudriñación por luz, se utiliza para examinar un dispersión en *n*-butanol de azúcar en polvo.

* * *

Deducción de las condiciones optimales de amalcenaje de estudios de las velocidades de respiración de remolacha. Parte I. J. F. T. OLDFIELD, J. V. DUTTON y B. J. HOUGHTON. *Pág.* 326–330

Determinación de perdidas de azúcar en remolacha almacenada se ha investigado por medición del anhidrido carbónico que se produce por respiración. Se presentan detalles del método y del equipo usado para medir las velocidades de respiración hasta 30 dias a 0–33°C. Se consideran también los efectos de temperatura y deshidratación sobre velocidades de respiración.

* * *

Purificación de produtos azucarados por el proceso de exclusión de iones. Parte II. D. GROSS. *Pág.* 330–334

Se presentan detalles de experimentos con un técnica de devolución proyectado por aplicación al tratamiento de licor y melaza de la refinería por exclusión de iones. Los resultados indican la posibilidad de obtenir de esta manera un alto grado de purificación. Los ventajes y desventajes de la técnica de devolución se considera y se discute la posibilidad de un proceso continuo.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXIII NOVEMBER 1971 No. 875

Notes & Comments

World sugar supply position, 1971/72

Very good growing conditions in Europe have indicated a high outturn of sugar, particularly in Western Europe in the coming campaign. Owing to the operation of the International Sugar Agreement on a calendar year basis, there is also a volume of sugar which must be marketed under quota before the end of the year. As a consequence there is an adequate supply of sugar assured for the remainder of 1971 although, considering the crop year to the end of August 1972, there is likely to be an overall shortage. As C. Czarnikow Ltd. point out[1], "this contrast . . . makes an analysis difficult and the establishment of the turning point between sufficiency and shortage rather vague.

"With its dependence upon weather and the incidence of disease, world production at this stage cannot be accurately estimated. Several generalizations can be made, however, and the first tentative forecasts for Europe are expecting an increase over the previous season of around one million tons. In an exercise of this nature it would be well to allow for the maximum foreseeable expansion and we feel that a rise of 1·5 million tons over last season's output should be allowed for. Of the beet producers outside Europe the most important is the United States, where a slight reduction is anticipated and we therefore assume that an increase in world beet output of 1·5 million tons is likely for 1971/72. The major cane sugar producer is, of course, Cuba where the Prime Minister has already stated that the last crop is unlikely to be exceeded next year and hopes for any increase in prospects are not expected until the 1973 season. While improvements in production levels can be expected in many countries throughout the world it is difficult to pin-point any single area where a significant and sizeable expansion will take place during the coming season and we would therefore expect total world output to rise by no more than three million tons.

"World consumption is a factor which tends to grow at a fairly even rate and provided sugar is available, a growth of approximately 3·5% has been the normal pattern for many years. An increase of this order over Licht's 1970/71 estimate of 75,505,000 tons would indicate a level higher than 78 million tons during the next twelve months.

"It is extremely difficult to predict actual stock levels at a particular time. Nevertheless provided that from one year to the next the same criteria are applied when seeking the information, the relative movement of stocks does assume a meaningful pattern. In view of the acknowledged standing of the Licht organization and the many years during which these statistics have been published, it would be reasonable to take Licht's figure of 18,267,000 metric tons, raw value, as a starting point for 1971/72.

"Bearing these points in mind, we anticipate that the possible rise in world production is likely to be matched by a similar rise in world consumption, both totalling around 2·5–3·0 million tons. This would lead to a second consecutive year with a substantial deficit between the two. During 1970/71 Licht estimates this difference at 2·76 million tons which during 1971/72 we feel could again be around the same level. As with last year the deficit will be made up from surplus stocks but a reduction of this order would lead to carry-over stocks at the end of August 1972 of around 15·5 million tons. This of course would be a dangerously low level to service the following year's consumption of over 80 million tons. It is possible that before stocks decline to this level the free market price mechanism will intervene and, by rising, will curtail consumption temporarily until production can be enlarged to cope. It is probably worth remembering that the only previous occasion since the war when production fell short of consumption on this scale for two consecutive seasons was 1961/62 and 1962/63. Although the price reaction on that occasion was dramatic there was then no International Sugar Agreement controlling supplies. The present ISA has provided considerable stability to the market and any reaction to a tight supply position could well be more controlled and gradual. As it is, there has been discussion for many months concerning the possibility of insufficient supplies during next year. It remains to be seen whether this anticipation of the event has occurred early enough for producers to make sufficient changes in their

[1] *Sugar Review*, 1971, (1038), 147.

programmes to alter the expected availability of sugar for next year and beyond."

* * *

International Sugar Agreement

As mentioned earlier[1], the ISA spot price fell below 4 cents on the 8th September and remained below that level for sufficient time to prevent the necessity of a reallocation of export quotas because of a prevailing price of over 4 cents. In fact, by the 30th September the prevailing price had fallen below 4 cents and the provisions of Article 48(2)(g) came into effect. These call for a reduction of individual quotas in effect of the exporting members by 5% of their respective basic export tonnages "unless the Council decides otherwise". The cuts were applied on the 1st October.

The Executive Committee, meeting on the 5th October, reviewed the market situation and decided on the immediate distribution of 250,000 tons of the declared shortfalls. Peru received 5000 tons under the provisions of Article 47(1); having relinquished her quota previously she had advised the Committee that she could after all accept 5000 tons of quota redistributions. The remaining 245,000 tons were redistributed under Article 47(5)(b), with 20% going to developing countries and 80% being shared by all exporting members able to accept the additional amounts. Thailand did not participate, of course, since she was due to withdraw from the Agreement on the 28th October.

Reallocations and the original and amended quotas are as follows:

Member	*Original quotas*	*Redistribution*	*Amended quotas*
	(metric tons, raw value)		
Argentina	53,345	0	53,345
Australia	1,120,376	40,511	1,160,887
Bolivia	0	0	0
Brazil	513,924	25,304	539,228
British Honduras	22,811	1,113	23,924
Colombia	100,000	0	100,000
Congo (Brazzaville)	42,512	2,075	44,587
Cuba	2,226,112	108,807	2,334,919
Czechoslovakia	135,000	0	135,000
Denmark	41,595	1,510	43,105
Dominican Republic	187,302	9,413	196,715
Fiji	160,340	7,844	168,184
Guatemala	11,405	557	11,962
Honduras	11,405	557	11,962
Hungary	0	0	0
India	259,215	12,652	271,867
Malagasy Republic	2,300	0	2,300
Mauritius	179,292	8,856	188,148
Mexico	0	0	0
Peru	0	5,000	5,000
Poland	47,000	0	47,000
South Africa	636,207	23,018	659,225
Swaziland	56,361	2,783	59,144
Taiwan	503,000	0	503,000
Thailand	37,327	0	37,327
Uganda	0	0	0
West Indies	10,000	0	10,000
Total	6,356,829	250,000	6,606,829*

European beet sugar production estimates for 1971/72

F. O. Licht K.G. recently published their first estimates of European sugar production[2] and these reflect the reports of high root yields and sugar contents as well as the small increase in beet area. The total crop is estimated at 26,556,600 metric tons, raw value, 1·8 million tons more than in the 1970/71 campaign and a new record. Of course, since the estimates were made at a time when the campaigns were starting in many countries, they are vulnerable to the effects of bad weather, etc., between the start and the end. However, this is offset by the prospect of further improvements with the continuation of good growing and harvesting conditions.

Little change from 1970/71 is expected in Albania, Finland and the UK, while drought and a smaller area are expected to reduce production in Austria. Greece also has a smaller area and is expected to have a reduced sugar output. Bad conditions are expected to reduce production in Czechoslovakia, East Germany and Poland, while all other areas are indicated as expecting higher sugar crops compared with last campaign. Details of the estimates are as follows:

	1971/72	1970/71
	metric tons, raw value	
West Europe		
Belgium/Luxembourg	790,000	606,200
France	3,200,000	2,755,553
Germany, West	2,210,000	2,100,000
Holland	800,000	729,626
Italy	1,260,000	1,228,000
Total EEC	8,260,000	7,419,379
Austria	300,000	330,979
Denmark	340,000	297,777
Finland	61,000	61,067
Greece	167,000	192,208
Ireland	171,000	153,128
Spain	840,000	767,980
Sweden	289,000	224,555
Switzerland	70,000	59,477
Turkey	873,000	657,376
United Kingdom	1,039,000	1,029,096
Yugoslavia	444,000	351,627
Total West Europe	12,854,000	11,544,649
East Europe		
Albania	17,000	17,000
Bulgaria	250,000	235,000
Czechoslovakia	750,000	780,000
Germany, East	450,000	500,000
Hungary	305,600	258,344
Poland	1,450,000	1,504,900
Rumania	480,000	380,000
USSR	10,000,000	9,500,000
Total East Europe	13,702,600	13,175,244
TOTAL EUROPE	26,556,600	24,719,893

[1] *I.S.J.*, 1971, **73**, 289.

* Excluding hardship allocations of 102,000 tons and temporary relief of 34,508 tons.

[2] *International Sugar Rpt.*, 1971, **103**, (26), 1.

Powdered sugar sizing

By F. H. C. KELLY* and Miss MAK FONG KENG†

NUMEROUS attempts have been made over the years to measure the particle size distribution of powdered sugars for the purpose of specifying this property either for commercial usage of icing sugar or as seed nuclei in sugar boiling procedures. Because of the nature of the difficulties encountered in these experiments, results have generally been unsatisfactory and often of questionable real value. This paper reports the culmination of a long series of experiments in this field which is believed now to have achieved a useful measure of success.

In 1942 a result was reported by one of us[1] using a microscope counting—measuring technique carried out during the course of an intensive series of studies on sugar boiling and for which powdered sugar was being used for crystal nucleation. For that sample a mean average size value of 14·5 μm on a particle number basis and a C.V. of 0·41 was observed which when converted to a weight basis gave values of 0·41 μm for M.A. and 0·79 for C.V. The procedure was extraordinarily tedious and has never been repeated by this worker. Other studies of this problem have included air or liquid dispersion sedimentation with manual or recording balance, differential centrifuging of a liquid dispersion, electrical conductivity differentials in liquid dispersion, differential air or liquid velocity separations and related techniques. Surface area studies have also been attempted both with B.E.T. and gas permeability measurements. No success was achieved with the B.E.T. technique owing to inability to remove the last mono-layer of water without thermal decomposition although other thermally stable powders gave satisfactory results with this particular equipment. Values for effective surface area have been obtained with air permeability cells[2] but equivalent mean particle size values calculated from these data have been only of limited use.

In all experiments employing dispersion in either liquid or gas phases, substantial difficulties were experienced with clustering of particles and it was recognised that until this could be effectively resolved a satisfactory size distribution analysis could not be achieved. Even sieving of particles in the range below 100 μm is obviously difficult to perform effectively because of this clustering behaviour.

A systematic study of clustering was carried out before the current series of tests and it is believed that we are now able to obtain complete dispersion as and when desired. The clustering was identified as associated with electric charges on the surface of the particles which were not dispersed in atmospheres of high humidity. The technique adopted for the tests reported here has been to disperse the powdered sucrose (or other sugars as the case may be) in *n*-butanol and if necessary also with the aid of a short period (10–20 sec) touch with an ultrasonic probe operating at about 12 kHz. The size measuring equipment successfully used has been a Hitachi Particle Size Analyser (H.P.S.A.) employing a light scanning technique with a beam of light scanning a glass cell holding a dispersion of the sucrose powder. The 1942 micro-counting test was carried out using glycerol as dispersing medium but this was not suitable for the current H.P.S.A. tests.

It is believed, however, that, with the effective dispersion techniques we have developed, it should be possible to obtain equivalent information with a recording liquid phase sedimentation-balance.

Procedural technique

The analytical procedure for the H.P.S.A. unit involves suspending in a liquid the particles to be studied. The suspension is contained in a glass cell in which it is stirred just before observation in order to obtain initial uniform distribution. The concentration of particles is low enough for sedimentation to be mutually unhindered and Stokes law behaviour is assumed. A gradient of concentrations is immediately developed which corresponds to differences in diameter of the particles. The actual analytical system involves measurement of this concentration gradient after the commencement of sedimentation. It is also a valuable feature that this analysis can be repeated at almost any selected time after initiation of the sedimentation process, provided that there is a concentration gradient great enough to allow the analytical study.

The analysis involves photo-electric scanning of the suspension which must also be sufficiently dilute for individual particles to be able to "see" the scanning beam. It is assumed that the particle is "black" in colour and of a spherical shape to calculate a "Stokes diameter".

Theoretical aspects of the technique are set out in detail in the instrument manual provided with the instrument[3] together with interpretations of abnormalities in the shape of chart records for which causes have been identified during the development of the instrument. The application is a development of work by ROSE[4] on the relationship between extinction coefficient and particle size relationships for spherical materials following theoretical analyses of STRATTON and HOUGHTON[5] and of BRILLOUIN[6].

Light from a tungsten source is developed to a rectangularly shaped beam and by means of cam and mirror control scans the cell from bottom to top with a beam always parallel to the meniscus and with the timed position a function of the square root of the height. A complete scan requires 7 seconds and is commenced after a stop watch-timed interval of 30 sec. The information is recorded on 14 cm of chart of a slave micro-voltmeter. The analysis of the chart record is substantially facilitated by the supply of a suitably engraved transparent ruler to transform

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[1] *Proc. Queensland Soc. Sugar Cane Tech.*, 1942, 32.
[2] *I.S.J.*, 1957, **59**, 304.
[3] "Instruction Manual for the Model PSA-2 Particle Size Analyser" (Hitachi Ltd., Tokyo, Japan).
[4] *Nature*, 1951, **168**, 784; *J. Applied Chem.*, 1952, **2**, 80.
[5] *Phys. Rev.*,1931, **38**, 159.
[6] *J. Appl. Physics*, 1949, **20**, 1110.

data for preparation of a histogram. No doubt it could be arranged for primary information to be fed directly into a computer through a suitable interface with results printed out and suitably graphed in terms of actual particle size distribution. The technique has been well studied by the manufacturers in relation to size determination as recorded by other techniques and the effect of non-spherical shapes, translucency or transparency in particles. From a study of these data as well as examination of our own records it is confidently believed that this technique provides the desired information as far as powdered sucrose particles are concerned.

Experimental observations

Although the manufacturers indicated 200 μm as an upper limit for the range of size measurement, a series of tests was successfully carried out on a sample of commercial crystal sugar, hand shaken between 30 and 50 mesh B.S.S. screens and for which the nominal average size would be given as 400 μm. It was found that a satisfactory measurement could be obtained with this sample by mechanically dispersing in ethylene glycol using a laboratory wrist-action flask shaker. Sonic treatment actually generated clustering in the medium and similar behaviour was observed when attempting to disperse in carbon tetrachloride. The H.P.S.A. chart data indicated a value of 291 μm for M.A. with a C.V. of 0·31. It was evident from the shape of the histogram that the crystals of the main size fraction must have had their surfaces fairly well covered with powder-sized particles. Not only are the fine particles themselves retained on the surface of the larger crystals but in so doing they inflate the sizes to retain many crystals which would otherwise pass through the mesh. This type of behaviour has been well recognized over the years by workers in this field but has not been easy to evaluate. We believe that this technique offers a means for doing this with both speed and precision.

Improvements can be effected in standard screening techniques by using such dispersants as *n*-butanol, ethylene glycol or one of the "Cellosolve" solvents (glycol monomethyl or -ethyl ether) but, because of their relatively low volatility, it is necessary to wash well the screened fractions with more volatile solvents before a suitable dry-weight value can be obtained. This substantially adds to the time and effort required for a screen analysis.

Two commercial samples of icing sugar purchased from a supermarket but originating from different countries were analysed by dispersion in *n*-butanol but without the need for sonic assistance. One of these samples had had 3% of starch added during its commercial preparation and the other is believed to have been phosphate-treated. In neither case was the effect of this treatment noticed in any way as far as the H.P.S.A. was concerned. A commercially prepared untreated powdered sample similar in every other respect to the starch-treated sample was also analysed and likewise did not require sonic assistance for dispersion in *n*-butanol. Use of *n*-butanol as a dispersing agent for powdered sucrose is also suggested

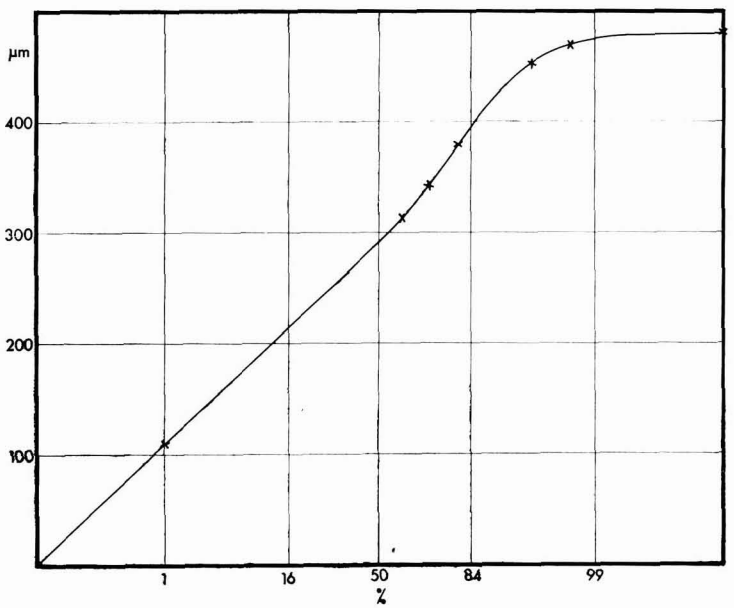

Fig. 1. Cumulative size analysis (nominal crystal size, μm, *vs.* cumulative percentage by weight) of sieved crystal sucrose (sample dispersed in ethylene glycol for p.s.a.; M.A. = 291 μm, C.V. = 0·31, specific surface = 133·5 cm^2/g).

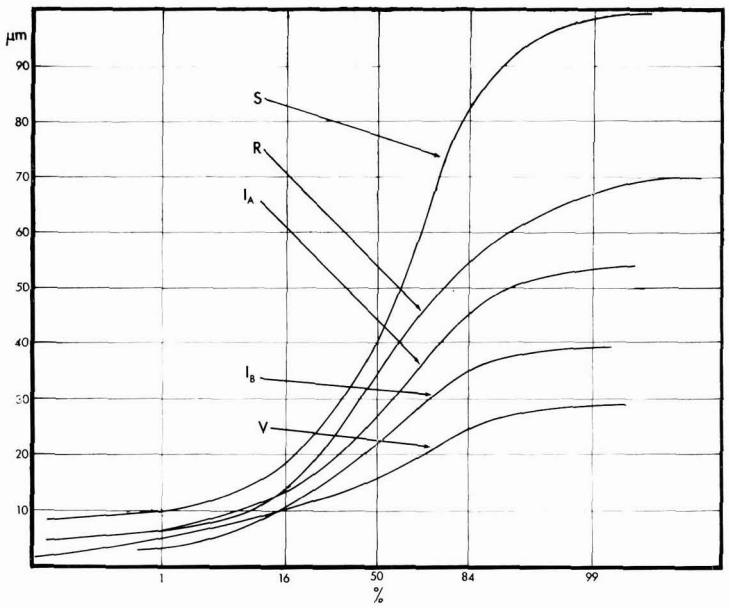

Fig. 2. Cumulative size analyses (particle size, μm, *vs.* cumulative percentage by weight) of powdered sucrose samples. *S*—1942 micro-count sample (M.A. = 0·41 μm, C.V. = 0·79); *R*—Rolling ball mill powdered crystal (M.A. = 35 μm, C.V. = 0·55); I_A—Icing sugar market sample A (M.A. = 27 μm, C.V. = 0·59, specific surface = 1786 cm²/g); I_B—Icing sugar market sample B (M.A. = 22 μm, C.V. = 0·57); *V*—Vibrating ball mill powdered crystal (M.A. = 16 μm, C.V. = 0·44).

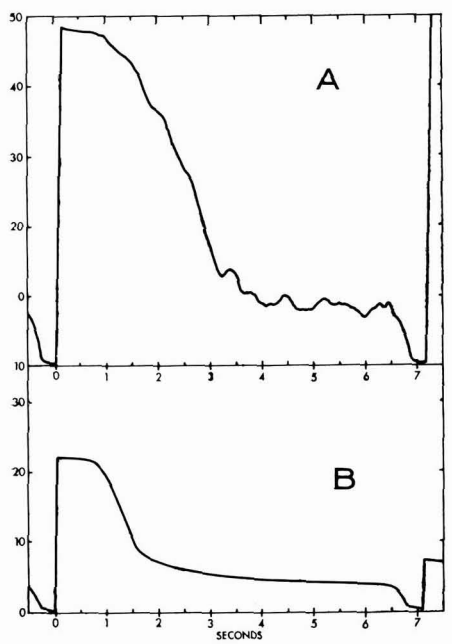

Fig. 3. H.P.S.A. chart records: (A) Unsatisfactory dispersion of suspension; (B) Satisfactory dispersion of suspension.

in the instruction manual for the instrument. Two samples of pulverized powder were prepared in our own laboratory from standard commercial granular crystals by dry milling in a porcelain jar with porcelain balls. In one case a rolling action was employed, in the other case a vibrating action. With each of these samples it was found necessary to employ sonic assistance for effective dispersion.

The results of these tests are illustrated in Figs. 1 and 2 using linear-probability co-ordinates for plotting the cumulative size analysis. A straight line would be expected for a "normal" distribution size relationship. The sigmoid shape of these curves is not unusual in this type of system but it is not the purpose of the present paper to discuss their significance. Intermediate between the cumulative plot and the instrument chart record we prepared size distribution histograms which were integrated in small steps for the calculation of apparent specific surface. It seems evident from the results obtained from the sieved crystals that the H.P.S.A. result provides a satisfactory size distribution analysis. With this instrument it is also immediately obvious from the shape of the chart record as to whether complete and satisfactory dispersion has been achieved. Two such chart records are provided by way of illustration in Fig. 3.

Acknowledgement

Financial assistance for this project by Tate and Lyle Refineries Ltd. (London) has been appreciated and is gratefully acknowledged.

Deduction of the optimum conditions of storage from studies of the respiration rates of beet

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Paper presented to the 14th General Assembly, Commission Internationale Technique de Sucrerie, Brussels, May 1971

PART I

Introduction

THE economic importance of good beet storage has been reflected over the years by numerous investigations and publications[1–9].

Different systems of storage are employed throughout the beet-growing countries to suit individual circumstances but, whatever the system used, the same general principles affecting sugar loss apply.

In Britain, most beet are stored at some period of the campaign in farm clamps. General advice on the storage of beet in such clamps has been published[10]. This advice was derived in part from full-scale clamping experiments and partly from laboratory investigations.

Direct determination of sugar loss in full-scale clamping experiments is best undertaken using weighed netted samples of beet. To obtain an estimate of the sugar content and dirt tare at the time of clamping, a duplicate sample should be analysed for each netted sample placed in the clamp. For each net the difference between the calculated sugar entering the clamp and the measured sugar leaving the clamp can be calculated and, by statistical analysis of the individual loss estimates, it is possible to calculate the precision of the mean estimated loss.

The precision is improved by use of more and larger netted samples but, in comparing two clamps, at least 100 nets per clamp are generally required in order to detect a difference of 1% in the total sugar loss. These field experiments are therefore expensive and they also suffer from disadvantages due to uncontrolled variables such as the weather and the condition of the beet.

Small-scale laboratory experiments, on the other hand, permit a greater degree of control over the variables and it is such experiments which are described in the present work.

Direct measurement of sugar loss on small samples in the laboratory by measurement of polarization and weight changes is not easy, because of large variations in the sugar content of individual beet. Measurement of respired carbon dioxide does, however, provide an excellent means of determining sugar loss and, in particular, the change in rates of sugar loss with time and conditions.

EXPERIMENTAL METHODS

The basis of the method

Respiration of stored beet results overall in a loss of sugar to produce carbon dioxide and water. In normal storage there is an adequate supply of oxygen so that respiration occurs aerobically and the conversion may be represented by the formula:

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + 12\,\underset{\text{Oxygen}}{O_2} = 12\,\underset{\text{Carbon dioxide}}{CO_2} + 11\,\underset{\text{Water}}{H_2O} \quad \ldots.(1)$$

342 parts of sucrose yield 528 parts of carbon dioxide, so that measurement of carbon dioxide provides a simple means of measuring loss of sucrose.

This principle is not new and the review by VAJNA[6] refers to its use at the end of the last century; but in practice there are difficulties and one of the major obstacles that has been overcome in the present work was the development of a relatively simple and flexible system for carrying out the experiments.

Beet preparation

In all experiments except those in which varieties were compared, the diploid variety Sharpes Klein E was used. The beet were lifted, topped just below the level of the lowest leaf bud and washed carefully by hand to remove the adhering soil. Any remaining buds around the edge of the cut surface were removed to prevent sprouting during the experiment. The beet were allowed to drain dry, any surplus water being removed with absorbent paper.

The weight, circumference at the widest part and length of each beet were measured before placing in the respiration vessel and collection of carbon dioxide commenced within 3 hours of lifting the beet.

Procedure for the respiration experiments

Approximately 10 kg of beet was taken for each experiment. The beet were placed in a 30-litre cylindrical vessel. A base plate covered the 9-inch

[1] BARR *et al.*: *Proc. Amer. Soc. Sugar Beet Tech.*, 1940, (1), 52.
[2] STOUT and SMITH: *ibid.*, 1950, 670.
[3] STOUT: *ibid.*, 1954, **8**, (2), 404.
[4] *idem: J. Amer. Soc. Sugar Beet Tech.*, 1957, **9**, 350.
[5] STOUT and SPIKES: *ibid.*, 1957, **9**, (6), 469.
[6] VAJNA: "Zuckerrüben Lagerung" (Verlag Dr. Albert Bartens, Berlin) 1962.
[7] *idem: Zeitsch. Zuckerind.*, 1966, **91**, 71.
[8] DEVILLERS: *Sucr. Franc.*, 1969, **110**, 379.
[9] DILLEY *et al.*: *J. Amer. Soc. Sugar Beet Tech.*, 1970, **15**, 671.
[10] OLDFIELD and DUTTON: *Brit. Sugar Beet Review*, 1969, **38**, 15.

diameter opening and was firmly held in position by a flange fitting made air-tight with a rubber gasket. Two tubes for the passage of air were inserted through the narrow neck of the vessel.

For constant temperature experiments the vessel containing the beet was submerged in a thermostatically controlled tank of water and for experiments conducted at or below 0°C, ethylene glycol was added to the water. Temperature variations within the tank were not greater than $\pm$ 0·25°C.

Air was drawn through the vessel using a "Hy-flo" Model C twin-piston pump normally at a rate of 1000 cm^3 per minute, although when required the rate could be varied between 0 and 1500 cm^3 per minute.

Before entry into the vessel the air was drawn through a flowmeter, followed by a gas washing bottle containing a grade 0 sinter (150–250 μm maximum pore size) immersed in approximately 300 ml of 2N sodium hydroxide solution. A preliminary experiment showed that this removed at least 95% of the carbon dioxide from the air which was then passed through a further gas washing bottle containing approximately 0·1N sodium hydroxide which reduced the level of sodium hydroxide spray in the air flow.

The solutions in both bottles were changed at frequent intervals.

In constant temperature experiments the bottles were immersed in the thermostatic tank and the air flowing from the second bottle was passed through a stainless steel coil also immersed in the tank to ensure that the air entering the vessel was at the same temperature as the beet.

The air was well dispersed throughout the vessel by passage through a perforated tube.

The respired carbon dioxide contained in the air withdrawn from the vessel was collected by passage through three gas washing bottles, the first of which was normally fitted with a grade 2 porosity sinter (40–60 μm maximum pore size) and the remaining two with grade O porosity sinters.

These bottles contained 2N or N sodium hydroxide solution in the ratio 2:1:1, the precise volumes used depending on the expected respiration rate.

To give a visual indication that these solutions had effectively absorbed the carbon dioxide, the air was then passed through a bottle containing dilute barium hydroxide solution before being pumped to the atmosphere.

The bottles were generally replaced daily and the collected carbon dioxide determined by titration with standard hydrochloric acid using a pH meter to detect the equivalence points at pH 8·30 and pH 4·20.

Respiration pattern and reproducibility of the method

Even at constant temperature, beet do not respire at constant rate. In all experiments with sound beet, a relatively high respiration rate was observed immediately after harvesting and the rate decreased regularly during the first days after harvesting to reach a comparatively steady state of about half of the initial value during the second and subsequent weeks after harvest. The post-harvest treatment must

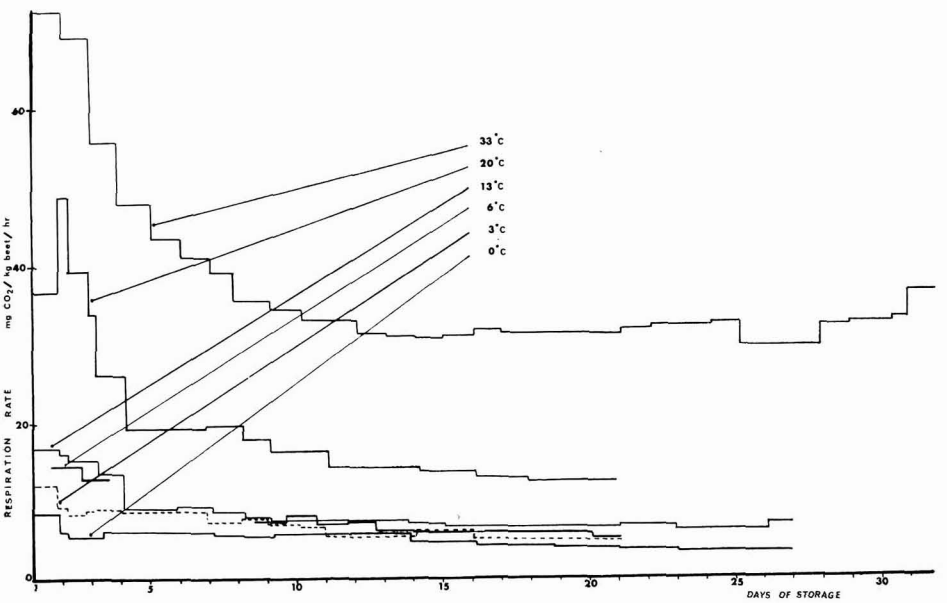

Fig. 1. Variations in respiration rate with temperature and time of storage

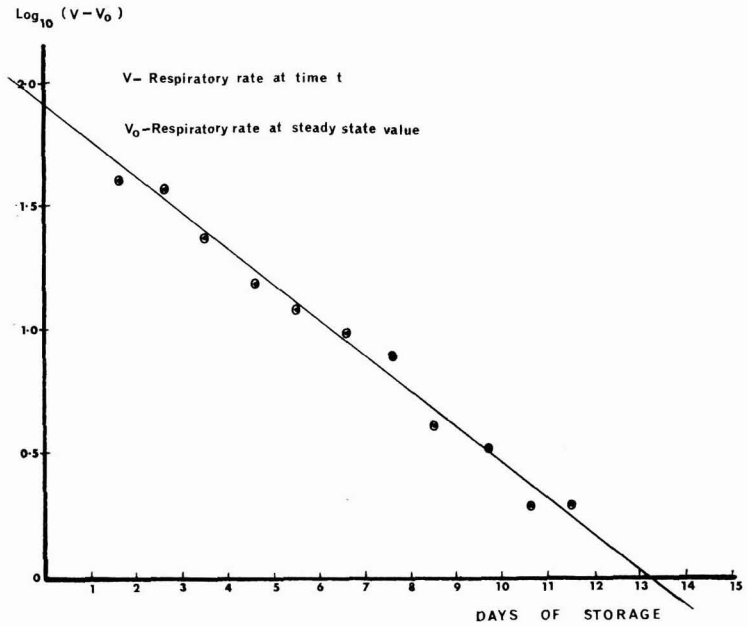

Fig. 2. Respiratory decay at 33°C

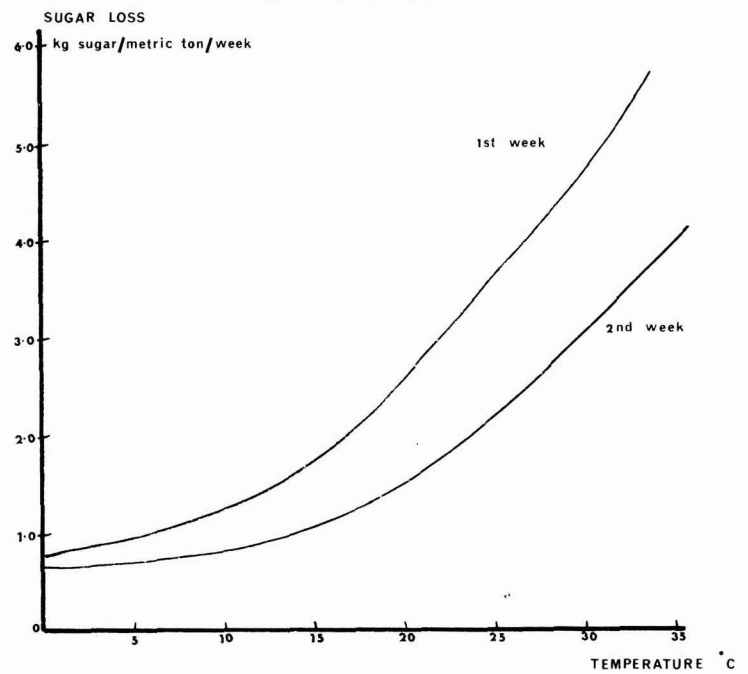

Fig. 3. Relationship between respiratory sugar loss and temperature

therefore be standardized for investigation of effects of other factors.

Initial experiments showed appreciable variations between the respiration rates of individual beet and to obtain reproducible results some 10 to 20 beet were required.

A comparison of the respiration rates at room temperature, which averaged 10°C, of two 19 kg samples of the same variety of beet, harvested at the same time, is shown in Table I. The measured respiration rates differed by only 1·6 to 2·7 mg CO_2 per kg beet per hour, showing that 10 kg samples can give adequate reproducibility for most investigations.

Experiments were undertaken with beet harvested at different dates in the period October to January and, to assess whether effects of maturity of the beet would interfere with comparison of results over this period, a control experiment was run at 20°C for each harvesting date in the main series of experiments comparing effect of temperature on respiration rate.

The results of these experiments are shown in Table II.

These results show satisfactory reproducibility and that within this harvesting period the rates at 20°C do not appear to be greatly affected by the maturity of the beet.

Factors Influencing the Respiration Rates of Beet

Temperature

Apart from frost damage, high storage temperatures are the main

cause of excessive sugar losses. The primary objective of the present work has been to determine the effects of temperature on the respiratory rates of beet.

Typical results showing the variations in respiration rate with time after harvesting of beet held at six different temperatures are recorded in Fig. 1.

It is apparent that the respiratory sugar loss increases rapidly with increasing temperature and that quantitatively, the higher respiration rate immediately after harvesting is of far more concern at the higher temperatures. The initial high respiration rate at 33°C is shown to decay exponentially when the data from Fig. 1 are plotted logarithmically in Fig. 2.

The rates of carbon dioxide production during the first week and during the subsequent week were averaged and converted to sugar losses using the relationship shown in equation 1 above. The data, recorded in Fig. 3, show that storage losses are minimized at temperatures below 10°C but the losses increase rapidly in the temperature range 10° to 33°C.

At even higher temperatures it appears that the cell structure of the beet is destroyed. In an experiment at 46°C, as recorded in Fig. 4, the evolution of carbon dioxide increased enormously over the first few days to reach a value about 8 times greater than the maximum measured at 33°C. Measurable amounts of ethanol were also detected by condensing the vapour leaving the respiration vessel. The experiment was stopped after 7 days because the beet had almost completely disintegrated.

Effect of dehydration

In all of the experiments, the loss of weight of the beet was appreciably greater than the calculated sugar loss, showing that some dehydration occurred even though the air was passed through dilute sodium hydroxide solution before entering the respiration vessel.

To determine whether such a dehydration influenced the respiration rates, a modified experi-

Table I. Comparison of the average respiration rates of two similar samples of beet

Respiration Rate
mg CO_2/kg beet/hour

Sample	*Days* 1–8	*Days* 8–15	*Days* 15–22	*Days* 22–29	*Days* 29–37
A	25·8	10·8	9·4	8·3	7·9
B	27·8	13·5	11·6	10·6	9·5

Table II. Comparison of respiration rates at 20°C of beet harvested on different dates

Respiration Rate
(mg CO_2/kg beet/hour)

Harvest date	*Days* 1–8	*Days* 8–15	*Days* 15–22
21st October	22·2	12·7	Not detmd.
20th November	21·7	13·1	Not detmd.
2nd December	26·0	15·5	13·2
22nd December	Not detmd.	14·6	13·0

Table III. Comparison of respiration rates and weight losses of beet stored in a dry and a water-saturated atmosphere

Relative Respiration Rate
(Rate in water saturated air = 100)

Storage Atmosphere	*Weight Loss (%)*	*Days* 1–8	*Days* 8–12	*Days* 19–22
Dry	13·2	101	98	103
Water-saturated	2·4	100	100	100

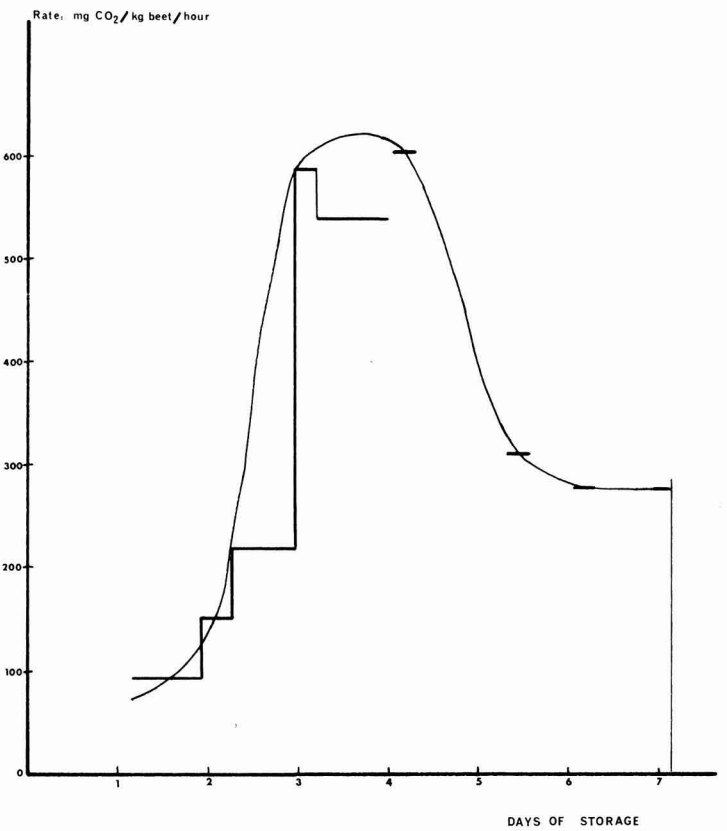

Fig. 4. Rate of carbon dioxide production from beet at 46°C

ment was carried out in which the air was deliberately dried by passage through a tube of anhydrous calcium chloride before entering the respiration vessel. The respiration rate was compared at room temperature with that of a similar sample of beet under the normal conditions. The relative respiration rates and weight losses for the two experiments are reported in Table III.

At no stage was a significant difference in respiration rates noted although there was a 13% weight loss in the sample stored in dry air compared with a 2% weight loss in the sample stored under the standard conditions. In addition, analysis and examination of the beet showed there was no difference in the invert levels or visible signs of deterioration.

It is concluded that the relatively slow loss of moisture in the respiration experiments did not affect the respiration rate of the beet. More rapid dehydration leading to wilting can give rise to increased sugar losses and VAJNA[7] has reported high sugar losses due to anaerobic respiration following rapid dehydration of the exterior cells of beet.

(To be continued)

Purification of sugar products by the ion exclusion process

By D. GROSS (Tate & Lyle Ltd., Research Centre, Keston, Kent, England)

Paper presented to the 14th General Assembly, C.I.T.S., Brussels, 1971

PART II

EXPERIMENTAL

Two columns were used. The first column was a small "converter" column, 45 cm long × 3 cm dia., containing a bed volume of 220 cm^3 of "Zeo-Karb 225.X-8" in the Na^+-form. The capacity of the volumn was 400 meq/B.V. (bed volume). For convenience of regeneration, two columns in parallel were found useful. Further details are given above under "Regeneration of resin".

The second column, the exclusion column, 180 cm long × 3 cm dia., 8·04 cm^2 cross section, had a B.V. of 1200 cm^3. Both columns had water jackets and were operated at 80°C, with the temperature thermostatically controlled. Feed liquor and rinse water were kept at 80°C; the recycled fractions, however, were allowed to cool down and were not reheated before being fed back. A flow rate of 15 cm^3/min was chosen. Conductivity, density and refractometric Brix of the effluent were continuously monitored. The fractionation was based on these readings and the resulting elution curves (see Fig. 3).

RESULTS

Although most of the experiments were carried out before 1965, only few and minor improvements could be suggested since then.

Affination syrup

The system first adopted for the purification of affination syrup is given in Table I. The analyses of the products are shown in Table II.

Table I. Volume and solids balance per cycle

Material	*Volume*		*Density,*	*Solids*	
	cm^3	*B.V.*	*°Bx*	*g*	*%*
Affination syrup	150	0·13	50·4	93·2	100
Product	135	0·11	47·8	78·5	84·2
Waste	450	0·37	2·1	9·45	10·15
Water	500	0·42	—	—	—
Left in pool and spillage	—	—	—	5·25	5·65

Since the volume balance proved not quite satisfactory, a system, as set out in Table III, was applied successfully.

The reduction of ash from 4·29% to 0·05%, i.e. an elimination of 99%, is outstandingly good, and were it not for the high invert content, the final product could go straight into the melter.

1st Crop Syrup

The undefecated syrup was very turbid and therefore not easy to purify. The system chosen was as given in Table IV, and the analyses are shown in Table V.

A reduction of ash to below 0·2% would have been feasible, but would have meant restricting the volume of feed liquor, which was not thought advisable.

Table II. Analyses of products (% on solids)

Material	*Brix*	*Sucrose*	*Invert*	*Total sugars*	*Ash*	*Organic matter*	*Colour (Lovibond 1-in cell)*	*pH*
Affination syrup (Feed liquor)	50·4	84·4	4·58	88·98	4·29	6·73	900	6·22
Product	47·8	94·56	3·64	98·20	0·05	1·75	32	7·68
Waste	2·1	14·0	2·5	16·5	47·5	36·0	—	—

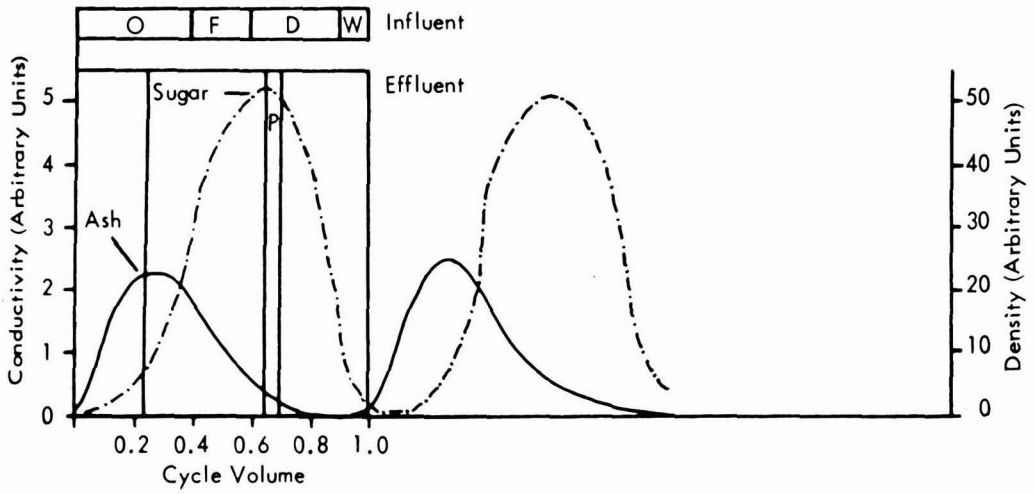

Fig. 3. Recycling system for affination syrup

Table III. Volume balance for affination syrup—Improved system

	B.V. (bed volume)
Feed	0·13
Water	0·31
Product	0·15
Waste	0·29
Recycled fractions	1·05

Table IV. Volume and solids balance per cycle

Material	*Volume*		*Density,*	*Solids*	
	cm³	*B.V.*	*°Bx*	*g*	*%*
1st crop syrup	150	0·13	51·5	95·62	100
Product	160	0·135	40·4	76·40	79·89
Waste	375	0·31	3·6	13·65	14·27
Water	400	0·33	—	—	—
Left in pool and spillage	—	—	—	5·57	5·84

Table VI. Volume balance for 2nd crop syrup

Material	*B.V.*
Feed	0·046
Water	0·34
Product	0·063
Invert product	0·033
Waste	0·29
Recycled fractions	1·0

Table VII. Solids balance per cycle

Material	*Volume*		*Density,*	*Solids*	
	cm³	*B.V.*	*°Bx*	*g*	*%*
2nd crop syrup	55	0·046	52·0	35·5	100
Product	75	0·062	30·0	23·66	66·64
Invert product	40	0·033	3·5	1·42	3·99
Waste	350	0·29	2·8	9·9	27·88
Left in pool and spillage	—	—	—	0·52	1·49

2nd Crop Syrup

The feed liquor was an undefecated syrup at 52°Bx. The system chosen is set out in Tables VI and VII. The flow rate was increased from 15 cm³/min to 17 cm³/min, and the cycle thereby shortened to 100 min. Altogether, 140 cycles were run (see Fig. 4).

The analyses are shown in Table VIII. The purification efficiency was fairly high, but, owing to the relatively small feed volume, the average density of the product was only 30°Bx.

Refinery Cane Molasses

This experiment was meant to be the acid test for the ion exclusion technique. A molasses of very high ash and organic matter was deliberately chosen to tax the system to its utmost. It was of interest to find out what level of purity of the end product could be achieved under these unfavourable conditions. No prior defecation was applied.

The system designed for this purpose is given in Tables IX and X. The time of cycle was 93 min. The analyses are shown in Table XI.

Table V. Analyses of products (% on solids)

Material	*Brix*	*Sucrose*	*Invert*	*Total sugars*	*Ash*	*Organic matter*	*Colour (Lovibond 1-in cell, 1:20 dil.)*	*pH*
1st crop syrup	51·5	78·38	9·55	87·93	4·49	7·58	1340 (41°Bx)	5·75
Product	40·5	90·32	7·05	97·37	0·22	2·41	140	6·93
Waste	3·6	13·33	37·22	50·55	23·92	25·53	—	—

Table VIII. Analyses of products (% on solids)

Material	*Brix*	*Sucrose*	*Invert*	*Total sugars*	*Ash*	*Organic matter*
2nd crop syrup	52·0	59·4	15·7	75·1	10·57	14·33
Product	30·00	85·06	10·94	96·0	0·32	3·68
Invert product	3·5	3·5	84·3	86·56	0·71	12·73
Waste	2·8	17·15	6·08	23·23	34·4	42·37

Table IX. Volume balance for cane molasses

Material	*B.V.*
Feed	0·038
Water	0·29
Product	0·038
Invert product	0·042
Waste	0·25
Recycled fractions	0·92

Table X. Solids balance per cycle

Material	*Volume*		*Density,*	*Solids*	
	cm³	*B.V.*	*°Bx*	*g*	*%*
Refinery molasses	46	0·038	45	24·94	100
Product	45	0·038	29	14·67	58·82
Invert product	50	0·042	6·2	3·16	12·68
Waste	300	0·25	2·1	6·7	26·83
Left in pool and spillage	—	—	—	0·65	1·67

The solids balance must be considered with a certain degree of caution, as it was difficult to attain anything but a rough and tentative balance.

The high invert content of the molasses lent itself to a recovery of a substantial invert fraction. The relatively high organic matter content is somewhat puzzling and may be due in some way to the unsuitability of standard analytical methods to these novel products.

The invert fraction arises, as in the experiment with 2nd crop syrups, from the fact that the exclusion resin has a certain separating effect on mixtures of sugars, related to their molecular weights. This kind of molecular sieving is the reason for invert sugars to accumulate in the later fractions during the elution, an effect which is enhanced by recycling. A French patent[16] exists concerning the separation of sugars, such as sucrose, glucose and/or fructose, based on the K^+-form of an ion exclusion resin. A US patent[17] claims the feasibility of a separation not only of sucrose from invert sugars, but also the separation of glucose from fructose, using the Sr^{++} or Ba^{++}-form of a similar resin. SAUNDERS[18] described basic laboratory experiments, using "Dowex 50W.X-4" resin in the K^+, Li^+ or Ba^{++}-form, for the separation of sugars, ranging from tetrasaccharides to monosaccharides.

[16] RUBICON GMBH: French Patent 1,425,816.
[17] DOW CHEMICAL CO.: US Patent 3,044,905.
[18] *Carbohydrate Res.*, 1968, **7**, 76.

Table XI. Analyses of products (% on solids)

Material	*Brix*	*Sucrose*	*Invert*	*Total sugars*	*Ash*	*Organic matter*
Refinery molasses	45	47·73	15·17	62·90	16·00	21·10
Product	29	77·12	15·56	92·68	1·59	5·73
Invert product	6·2	5·8	83·44	89·24	0·82	9·88
Waste	2·1	2·85	6·66	9·51	49·05	41·44

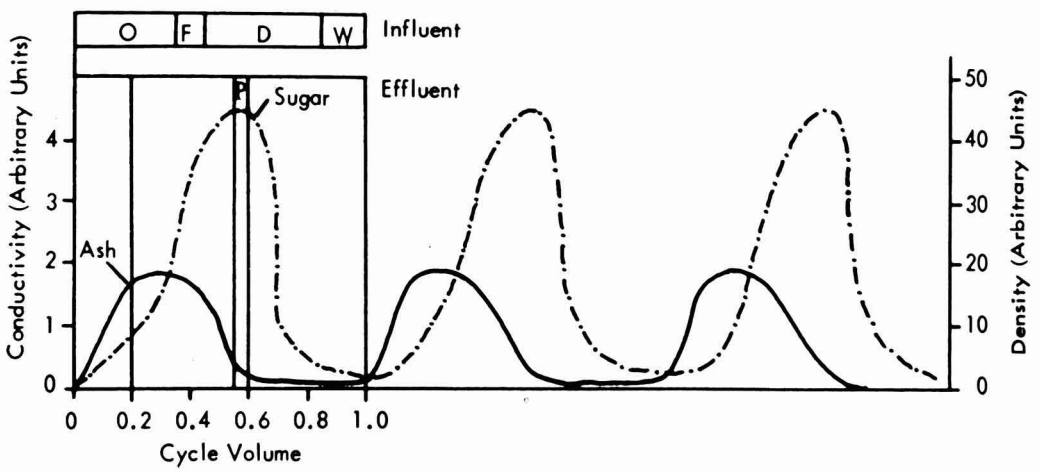

Fig. 4. Improved recycling technique for 2nd crop syrup

Beet Molasses

A sample of undefecated beet molasses of a relatively high sucrose and ash content was selected for the experiment. The volume balance chosen is given in Table XII. A relatively low feed volume was suggested by the high ash content. The solids balance is given in Table XIII and the analyses are shown in Table XIV.

Table XII. Volume balance for beet molasses

Material	*Density, °Bx*	*B.V.*
Feed	48·0	0·05
Water	—	0·325
Product	37·0	0·042
Waste	3·0	0·33

Table XIII. Solids balance per cycle

	Solids	
Material	*g*	*%*
Beet molasses	35·1	100
Product	21·2	60·39
Waste	12·12	34·54
Left in pool and spillage	1·78	5·07

The molasses was easier to run than cane raw materials of similar low-grade composition. The absence of coarse colloidal and suspensoid organic impurities was helpful in maintaining the cycle equilibrium and a relatively clean state of the resin. The low feed rate helped to produce a high-sugar and low-ash product of interesting quality, viz. 96·5% total sugar and only 0·16% ash. If lower purity of product were acceptable, then load and productivity could be significantly increased.

Discussion

The ion exclusion technique is economically attractive because, in contrast to ion exchange processes, theoretically no chemical regeneration should be required. In practice, the feed liquor has to be pre-treated by an ordinary ion exchange resin in the Na^+-form, so as to convert Ca^{++} and Mg^{++} ions to Na^+ ions. The necessity for this has been particularly stressed by Reents and Keller[19]. This means regeneration of the converter column will be required periodically, since some of the divalent and multivalent ions that escape conversion tend to be exchanged by the ion exclusion resin, thus impairing its performance.

It is not possible to achieve a complete separation of sugar and ash in one pass through the column. Usually, one pass will lead to a reduction of ash to about one-half of the original concentration and to a great dilution of the sugar fraction, say from 50°Bx to 15°Bx. This renders the process unrealistic for practical purposes. If, however, a recycling technique is devised, whereby the poorly purified or dilute fractions are fed back to the column in a definite sequence, then a high degree of purification, with little or tolerable dilution, may be attained.

The obvious drawbacks of the recycling technique are the volumes and great number of fractions. The greater the number of fractions the better the purification. On the other hand, the cycle becomes more sensitive to changes of conditions, and the storage of many individual fractions may present a great technical problem. The best practical solution would seem to be the adoption of a system that restricts the number of fractions for recycling to not more than six.

Better still would be a continuous process, such as the one based on the Higgins Contactor, as tried in Australia and America. However, the degree of purification and productivity appeared to be not equal to that achieved by the fixed-bed technique. The process is also technically more difficult to operate, as extremely careful control of resin movement in the contactor as well as of liquid flow is essential, in order to maintain steady-state conditions.

Hill[20] suggests a system whereby the influent requirements for overlaps and diluate occur just as these fractions appear in the effluent, so that they can be pumped straight back. This would only happen if the volumes of product and waste were equal respectively to the volumes of feed and water. This condition could be satisfied for 2nd crop syrups with some adjustment to the volume balance, as per Table VI, so that feed = product = 0·10 B.V., water = waste = 0·29 B.V. (1 B.V. = 0·72 cycle volume.)

Adopting a two-column scheme, indicated in Figs. 5 and 6, in which the progress of time, or volume flow, is represented by movement of the line XX to the right, the system would operate as follows:

After starting to feed the overlap to the top of the first column, one void volume must be displaced before the ash appears in the effluent. This is approximately equal to 0·4 B.V. or 0·29 cycle volume. 0·21 cycle later the effluent is acceptable as overlap so the total phase difference between influent and effluent is, fortuitously, exactly half a cycle. Overlap and diluate fractions from each column are thus available at the precise times at which they are required for feeding to the other column. The scheme could be operated by an automatic control system operating the valves.

[19] US Patent 2,937,959.
[20] Private communication

Table XIV. Analyses of products (% on solids)

Material	*Brix*	*Sucrose*	*Invert*	*Total sugars*	*Ash*	*Organic matter*
Beet molasses	48·0	65·36	0·96	66·32	13·75	19·93
Product	36·6	95·82	0·74	96·56	0·16	3·28
Waste	3·0	12·06	4·82	16·88	35·52	47·60

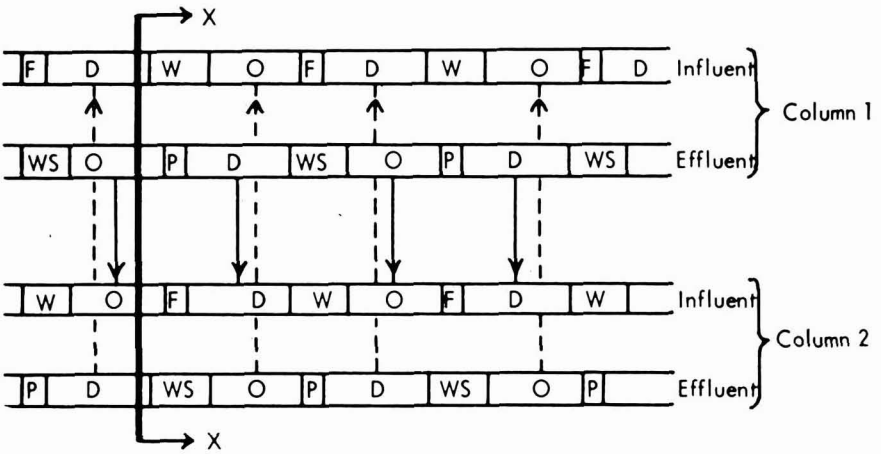

Fig. 5. Schematic feed arrangement for two-column system

Swelling and contraction of the resin may present a problem to control.

In general the ion exclusion technique is limited chiefly by the capacity of the resin, which is relatively low, one cu.ft. (28,300 cm^3) being able to separate satisfactorily about 0·1 kg of ash and 2·4 kg of sugar. The maximum amount of feed is thus determined by the volume of resin. If the feed is increased above the limit, the ion exclusion mechanism breaks down, the separating efficiency deteriorates quickly, more sugar will be lost in the waste, and the degree of purification will be low. Improvement in capacity by increasing the porosity of the resin might be one of the answers.

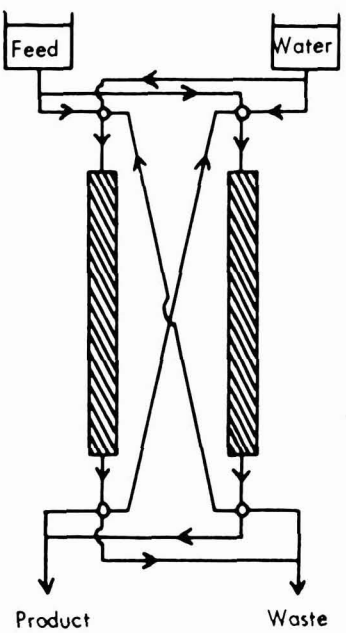

Fig. 6. Two-column system for continuous operation

ACKNOWLEDGEMENTS

Thanks are due to R. W. BUTTERS and J. E. RUDLAND for valuable technical assistance.

SUMMARY

The ion exclusion process is based on the phenomenon that certain types of ion exchange resins possess a significantly different absorptive capacity for non-ionizable compounds, such as sugar, than for ionizable compounds, such as inorganic salts. On elution from an ion exclusion column, ash and certain other impurities will emerge first, followed by sugar, which can be collected as a separate fraction.

Since no chemical reaction between resin and sugar or salts occurs, no chemical regeneration is theoretically required. This makes the process economically attractive.

A recycling technique has been devised and extensively tried out, which affords a high degree of purification of sugar products of greatly varying composition, ranging from affination syrup to both cane and beet molasses.

Theory and technique of semi-continuous and continuous systems are discussed in detail. The tabulated experimental results are critically examined.

Sugar cane agriculture

Passi Mill revolutionizes cane transport with (Tate & Lyle) Technical Services (Ltd.). ANON. *Sugarland* (Philippines), 1970, **7,** (7), 7–18.—In this illustrated article, with 19 photographs, a description is given of a new and completely up-to-date system installed for the loading of cane on new haulage units or road trailers of 12–16 ton capacity, transport of the cane to the mill, and unloading.

* * *

Rat control in cane. R. D. GUERRERO. *Sugarland*, (Philippines), 1970, **7,** (7), 20, 35.—In the Philippines the total tonnage of cane lost to rats every year is not known. However, it is considered that in some plantations in Negros, Tarlac and Pampanga loss may be as high as 40%. Studies have shown that rats prefer sugar cane varieties with soft rinds and high sucrose content. Some general recommendations are given for reducing the rat population.

* * *

Effect of soil moisture stress on tasselling of sugar cane. K. M. NAIDU. *Indian Sugar*, 1970, **20,** 343–344.—Field and pot culture experiments were carried out with two varieties of sugar cane, Co 285 and Co 312. With pot culture soil moisture stress reduced flowering to a very low level, 4·4% and zero. Under normal watering conditions flowering was 97·1% and 52·7%, respectively. Similar results were obtained with the field experiments.

* * *

Isotima javensis—**a potential parasite of sugar cane borers in India and Pakistan—a résumé.** D. K. BUTANI. *Indian Sugar*, 1970, **20,** 349–355.—The confused nomenclature that has existed regarding this insect in the past is explained. It was first recorded in Java in 1918 (on *Scirpophaga nivella*).

* * *

Cane breeding, a new project in Uttar Pradesh. B. SINGH and B. R. RAO. *Indian Sugar*, 1970, **20,** 357–359.—Previously, live seedlings or "fluff" (seeds) were obtained from Coimbatore and tested at the Sugarcane Research Institute, Shahjahanpur. When BO varieties were produced by Pusa (Bihar) they were also introduced. Some of these became important canes such as BO 17, BO 32, BO 47 and others. Breeding was found to be possible in the humid Terai belt of eastern Uttar Pradesh. In 1963 a cane breeding programme was started at the Sugarcane Research Station, Gorakhpur. Investigations carried out so far are described.

Co 1148—a promising sugar cane variety for the eastern tract of Uttar Pradesh. S. S. KHANNA, B. K. MATHUR and A. SINGH. *Indian Sugar*, 1970, **20,** 361–363.—The promising performance of this variety, now released as a mid-late variety for the eastern tract of Uttar Pradesh, is described. It should take the place of the present varieties grown, now showing signs of deterioration. Co 1148 is a cross between Co 301 and XP 4383. A description of the variety and its agronomic behaviour is given.

* * *

Rat infestations at Meringa. T. D. REDHEAD. *Cane Growers' Quarterly Bull.*, 1970, **34,** 40–42.—Two species of rat do serious damage to cane in Queensland, viz. the climbing rat and the ground rat. Work is at present being concentrated on the climbing rat since less is known about it. For better control it is essential to acquire more knowledge about the rats in question. The value of "live trapping" in this work is explained, i.e. rats are trapped, given identity marks, usually ear-tags, and then released. The same rats may be captured again, in the same or in a different area. Before cane reaches about 4 feet in height the climbing rat breeds in grass. It should be attacked then. A mature female has up to four (average 2½) young every five weeks. A young female can become pregnant at 80 days of age.

* * *

Sugar cane needs nitrogen. K. C. LEVERINGTON. *Cane Growers' Quarterly Bull.*, 1970, **34,** 43–44.—The rôle of nitrogen in the life of the cane plant is discussed. The characteristics of the 4 kinds of nitrogen fertilizer available to cane growers in Queensland are discussed, i.e. urea (cover with soil as soon as possible after application); "aqua ammonia" (good soil tilth desirable); ammonium nitrate (not recommended in very sandy soils in high rainfall areas); ammonium sulphate (may be left on the surface but is taken up more rapidly if covered with some soil).

* * *

Notes on nitrogen fertilizing from the cane growing areas. C. M. MCALEESE *et al. Cane Growers' Quarterly Bull.*, 1970, **34,** 45–49.—Eight different cane growing areas in Queensland are dealt with in turn. Notable points discussed are the changes that are taking place in the kind of nitrogen fertilizer used, depending on price and availability. Excessive use of nitrogen in a few areas has resulted in lower sugar content and an increased tendency to lodge.

Leaf-scald disease in the Maryborough district. D. R. L. STEINDL. *Cane Growers' Quarterly Bull.*, 1970, **34**, 49–50.—What is probably the first record of the disease in the Maryborough areas is described. It was on the variety Q 71, known to be very susceptible, and was restricted to one farm. This variety is being dropped and now represents only 4% of the area under cane.

* * *

Fibre in cane. P. G. ATHERTON. *Cane Growers' Quarterly Bull.*, 1970, **34**, 57–58.—Technically fibre in cane is defined as the dry, water-insoluble matter in cane, i.e. what later becomes bagasse. The proportion of fibre varies greatly with different varieties of cane and with the conditions under which the cane is grown. The significance of fibre to the grower and to the cane miller is discussed in all its aspects. The rôle of bagasse as fuel at the cane mill and in industry is also discussed.

* * *

Fiji disease. C. G. HUGHES. *Cane Growers' Quarterly Bull.*, 1970, **34**, 59–61.—What is known of the origin of Fiji disease and its present distribution in the cane growing countries of the world is discussed. It has been shown in Queensland in the past that the disease can be controlled or eradicated.

* * *

Cultivation practices and productivity (at Caroni Limited, Trinidad) 1890-1967. D. M. HANSCHELL. *Proc. 1st Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1967, 8–13.—Developments and changes in cane agriculture at Caroni Ltd. since 1890 are reviewed and an attempt made to trace the effect of the changes on trends in productivity. One subject mentioned which has received considerable attention is froghopper control.

* * *

Froghopper blight of sugar cane—an insect toxemia? E. A. C. HAGLEY. *Proc. 1st Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1967, 14–22.—Data obtained from studies of the physiological mechanisms involved in cane blight production by the froghopper (*Aeneolamia* var. *saccharina*) are presented. From analysis of the adult salivary secretion it is suggested that the amino-acid and lipase components injected into the leaf by the insect during feeding may be of importance in blight initiation.

* * *

Aerial applications of chemicals for control of sugar cane froghopper (*Homoptera: Cercopidae*) infestations in Trinidad. D. A. BUXO and D. W. FEWKES. *Proc. 1st Sugar Tech. Assoc. Trinidad and Tobago*, 1967, 23–40.—Trials on froghopper control by aerial application of various insecticides are reported, and the economics discussed. Satisfactory results were achieved with "Imidan", "Malathion" and "Sevin" as reflected in the low incidence of blight within the test area. However, timing of the spraying is highly important, and the froghoppers should be controlled in the first brood in order to avoid heavy second and third brood infestations, which could lead to considerable rises in costs. The need to allow the natural insect enemies of the froghopper to exert their influence is also stressed.

* * *

The use of aircraft in sugar cane areas with particular reference to Caroni Limited. P. C. MACINTYRE and W. KEIR. *Proc. 1st Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1967, 41–43.—The advantages of the aircraft in application of materials for control of weeds, insect pests (particularly froghoppers) and fires are discussed.

* * *

"Paraquat" as a post-emergence herbicide. P. D. MANNING. *Proc. 1st Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1967, 44–53.—"Paraquat" at 0·5 lb/acre in 27 gal of water/acre gave as good interrow weed control as, and often better than, did herbicidal oil at 27 gal/acre, with considerable saving in costs per acre. It controlled the main weeds in cane except some broad-leaved weeds and a sedge, *Fimbrystylis miliacea*, and nutgrass (*Cyperus rotundus*) in the early growth stages. "Paraquat" at 0·37 lb/acre plus "Diuron" at 1·2 lb/acre effectively controlled *Fimbrystylis miliacea*, a species of increasing importance, while addition of 2,4-D amine controlled the resistant broad-leaved weeds as well as extending the control period. Addition of "Paraquat" to "Diuron" "Atrazine" and a TBA/MCPA mixture, respectively allowed greater flexibility in the application of these residual herbicides, while 0·37 lb "Paraquat" + 0·9 lb 2,4-D amine/acre is recommended as a standard mixture for post-emergence weed control in Trinidad cane. Although "Paraquat" was more phytotoxic to cane than herbicidal oil, visual cane damage rapidly disappeared and yields were not affected.

* * *

Mechanical harvesters for sugar cane. R. G. HARKNESS *Proc. 1st Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1967, 59–63.—The mechanical harvesting systems used in Hawaii, Louisiana, Australia and Trinidad are briefly described and desiderata of a harvester listed.

* * *

The use of self-loading trailers. L. P. DONAWA. *Proc. 1st Conf. Sugar Tech. Assoc. Trinidad and Tobago* 1967, 64–65.—The method of operation of self-loading cane trailers and the types used in Trinidad by Caroni Ltd. are described.

* * *

Research in sugar cane growing. F. HAWORTH. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago* 1968, 19–24.—On the basis of his visit to a number of major sugar-producing countries on his way to the ISSCT Congress in 1968, the author puts forward several suggestions for fields of investigation in Trinidad, covering planting material and method of planting, water control and drainage, cane varieties, fertilizer use and harvesting methods.

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Variety testing. T. P. OGIER. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 25–32.—Cane breeding and testing in Barbados for the West Indies Sugar Association countries is mentioned and the variety breeding and testing programme in Trinidad described.

* * *

Experimental precision. J. M. BRAY. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 33–38. Although there is need for an experimental precision to detect increases in cane yield of the order of 5–10%, the standard of field experimentation in Trinidad and Tobago does not allow yield increases of less than 20% to be detected with reasonable certainty. Methods used to increase the accuracy in other fields of agricultural research are described and suggestions given for changes in the methods used in cane experiments in Trinidad.

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Herbicide use in sugar cane. L. C. GOBERDHAN. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 39–44.—The major factors affecting the use of herbicides in cane are discussed, including herbicide chemical structure and source, mode of action, time and method of application, and the potential hazards of continued use of herbicides (cane damage and changes in weed flora).

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Aerial control of froghopper 1967. D. A. BUXO. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 45–51.—Aerial spraying of first and second brood froghoppers with 3 lb "Carbaryl" (85% sprayable "Sevin") in 3 US gal/acre plus 1 pint of 96% "Malathion LVC"/acre gave good control in Trinidad in 1967. Of the 37,200 acres sprayed, only 170 showed blight damage at the end of the year. However, it is possible that a severe outbreak of yellow aphid was caused by the spraying upsetting the host-parasite relationship.

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Insecticides and moth borer damage. D. A. BUXO. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 52–56.—Spraying fields of ratoon and plant cane with various chemicals to control froghoppers reduced the incidence of joint and stem damage by large and small moth borers, generally considered to be relatively minor pests in Trinidad. The probable mode of action of the insecticides on moth borers is described.

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Recent laboratory trials with exotic parasites on *Diatraea* spp. in Trinidad. F. D. BENNETT and K. CARL. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 57–62.—Results of laboratory tests on control of small moth borers (*Diatraea* spp.) with *Apanteles flavipes* and with *Palopzenillia* sp. nec. *palpalis* (Ald.) and of field tests with *A. flavipes* were sufficiently encouraging to recommend that both parasites be considered for release in areas where *Diatraea* spp. are major pests.

Outbreaks and natural enemies of some minor pests of sugar cane in Trinidad. F. D. BENNETT. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 63–66.—The natural enemies of four minor pests are listed. The pests are: *Sipha flava* (yellow aphis), *Saccharosydne saccharivora* (West Indian canefly), *Pulvinaria elongata* (red-striped sugar cane scale insect) and *Elasmopalpus lignosellus* (jumping borer).

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Cane transport vehicle maintenance. P. D. BAYNES, L. G. WINTER and H. RAGHUNANAN. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 82–86. The article covers servicing and factors contributing to the need for frequent checks on cane transport. Particular attention is drawn to engine oil condition and consumption as well as fuel consumption.

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Maintenance programmes for mechanical field equipment. R. G. HARKNESS. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 87–96.—Maintenance systems are discussed generally and the maintenance of crawler tractors and mobile cranes using a high-cost system, involving the stripping of machinery for inspection and replacement of worn or doubtful parts on an annual routine basis, compared with a low-cost maintenance scheme based on maintenance history, fuel and oil consumption records and prior inspection of each machine. Use of the latter system is warranted provided there is no under-maintenance.

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The use of the computer in the sugar industry. P. A. ASHLEY. *Proc. 2nd Conf. Sugar Tech. Assoc. Trinidad and Tobago*, 1968, 97–104.—Information is given on the computerized system at Caroni Ltd. used for payroll accounting, materials accounting and payments to cane farmers. Future possible uses of the system are also discussed, particularly in the field of agricultural research.

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Fiji disease—the campaign at Bundaberg. J. ANDERSON. *Cane Growers' Quarterly Bull.*, 1970, **34**, 61–64. The progress of the eradication campaign launched in Queensland immediately after the discovery of the disease in April 1969 is discussed. Later the disease was found to be present on 17 farms, and further outbreaks followed. The importance of roguing with this disease is emphasized.

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A new sugar experiment station—Tully. I. J. V. STEWART. *Cane Growers' Quarterly Bull.*, 1970, **34**, 65.—Four sugar experiment stations have served the Queensland sugar industry in the past but there has been no experiment station in the high rainfall tropical areas of the north. This is now remedied with a new station near Tully on a 100-acre block where the average rainfall is about 150 in per annum and there are somewhat unusual varietal, agronomic and disease problems.

Squamulata grubs—a serious pest in sandy soils. J. A. CURRIE. *Cane Growers' Quarterly Bull.*, 1970, **34,** 66–67.—Since 1963 a comparatively new grub pest (*Lepidiota squamulata*) has damaged cane in various parts of Queensland, always on sandy soils. A description of this grub, which is very like the greyback grub, is given as well as details of its habits. Control measures (BHC dust at 90 and 100 lb/acre) are discussed.

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The use of pre-harvest fire in sugar cane areas. R. P. HEALY. *Producers' Rev.*, 1970, **60,** (9), 7–8.—Problems discussed at a Rural Fire Board Inspectors' conference at Brisbane are referred to. Cane burning was one of the topics discussed. There was little complaint about the normal cane or trash burning by farmers. Farmers along electric transmission lines are asked to exercise special care to avoid interruptions in electricity supply to towns as has happened recently. Fires allowed to run up hills adjoining cane lands can lead to soil erosion and land slips.

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Leaf scald disease identified at Maryborough. C. G. HUGHES. *Producers' Review*, 1970, **60,** (9), 9.—An account is given of this bacterial disease and illustrations provided of its effect on an individual stalk and on a block of cane with comparisons with healthy cane.

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Sugar cane ripening compounds—comparison of chemical, biochemical and biological properties. L. G. NICKELL and A. MARETZKI. *Hawaiian Planters' Record*, 1970, **58,** (5), 71–79.—Ripening is considered to be one of the most important aspects of sucrose production in sugar cane. A statement made some years ago, "To say that the phenomenon of cane ripening is complex would be, at best, a gross under-statement," still holds with great emphasis today, and is the basis for this report where ten selected chemicals, all "ripeners", are involved. It is now thought that with different compounds different modes of action in ripening may be involved and that further study is needed in this connexion.

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Red stripe disease of sugar cane. N. E. V. DE RAMALLO. *Rev. Ind. y Agric. Tucumán*, 1970, **47,** (1), 13–18. This bacterial disease (*Xanthomonas rubrilineans*) is known to have been present in Tucumán since 1895 when it was known as "polvillo", a name possibly used for other diseases. Symptoms of red stripe are described and illustrated with photographs. The desirability of substituting susceptible varieties by resistant ones is discussed.

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Foliar diagnosis and sugar cane fertilization. III. Ambiental influences on the production and concentration of nutrients in the leaves. F. A. FOGLIATA and R. A. DIP. *Rev. Ind. y Agric. Tucumán*, 1970, **47,** (1), 19–34.—Studies carried out over five years and examined statistically showed that low rainfall greatly affected foliar N and K, especially where no fertilizer was applied. Cane production was correlated with rainfall and with N application, the response to N being greater when rainfall was better.

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Selection studies at the individual stools stage with sugar cane. O. GIMÉNEZ LASCANO and J. A. MARIOTTI. *Rev. Ind. y Agric. Tucumán*, 1970, **47,** (1), 35–45.—It is hoped to reduce selection time with new varieties by the methods described. Field and laboratory tests relate to the number of stalks, stalk diameter, commercial height, average weight of stalk, Brix, juice purity and estimated weight per stool

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Results of fertilization and irrigation with sugar cane at Ingenio San Pablo, Province of Tucumán, 1963-69. M. REICHART and J. TOLL J. *Rev. Ind. y Agric. Tucumán*, 1970, **47,** (1), 47–55.—Optimum nitrogen rate was found to be 80–120 kg/ha, urea and ammonium nitro-sulphate giving better results than sodium nitrate and ammonium sulphate. With identical nitrogen application, irrigated plots yielded 13·7 tons/ha more cane and 1·7 tons/ha more sugar.

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The nematode *Meloidogyne javanica* Chitwood in sugar cane seedlings. M. A. COSTILLA. *Rev. Ind. y Agric. Tucumán*, 1970, **47,** (1), 77.—Yellowing of seedlings in greenhouses at the Tucumán Experiment Station has been found to be due to attack by the nematode named.

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A new implement for sugar cane cultivation. F. A. FOGLIATA and D. M. MORÍN. *Rev. Ind. y Agric. Tucumán*, 1970, **47,** (1), 79–83.—A cultivator is described which uses small ploughshares and tines for inter-row weed control, the rows to be treated with herbicide. The working depth is 5–8 cm.

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Rôle of ammonium chloride on sugar cane as a substitute for ammonium sulphate. A. SINGH and B. K. MATHUR. *Indian Sugar*, 1970, **20,** 407–409.—It is pointed out that the supply position of ammonium sulphate for sugar cane in India is less easy than in many countries because of the limited supplies of gypsum and sulphur. Trials were carried out with ammonium chloride as an alternative source of N for sugar cane, ammonium chloride being a relatively cheap by-product of the soda ash industry. Details of the trials are given. Ammonium chloride proved to be equally efficient as a source of N and could safely be used as a substitute in cane cultivation.

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Fertilizer experiments carried out in the Argentine Republic. F. A. FOGLIATA. *La Ind. Azuc.*, 1970, **75,** 87–95, 117–124, 181–187.—A history of fertilizer experiments in Argentina is presented with detailed reference to recent work carried out by the Tucumán Experiment Station.

Sugar beet agriculture

Quality and "physiological ripeness" of sugar beet. M. NITZSCHE and C. WINNER. *Zucker*, 1970, **23,** 531–537, 572–576.—While quality of sugar beet in the traditional sense (percentage of sugar and non-sugars, etc.) may be expressed in chemical terms it is not possible to define very clearly what is meant by "physiological ripeness". Two indices, root-top ratio and sucrose:sodium ratio, have been used for describing the physiological state of the sugar beet in the autumn. From the observations made it is apparent that sugar beet may attain a fair degree of processing quality before full physiological ripeness is attained.

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Effect of increasing the nitrogen supply to sugar beets grown in plant populations of different densities. A. VON MÜLLER and C. WINNER. *Zucker*, 1970, **23,** 599–602.—With N increased up to 160 kg/ha, sugar beet responded with increased yields. Above this level (220 kg/ha) there was little increase except in beet populations of low density. Fertilizing with more than 100 kg/ha of N had an unfavourable effect on beet quality, especially in plant populations of less than 60,000 plants per ha. With populations of 60,000 the optimum N dressing was considered to be 160 kg N/ha. The practice, common among sugar beet farmers, of stimulating incomplete plant populations by giving extra N fertilizers, turns out to be undesirable, having a detrimental effect on sugar production and reducing net profit.

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Army worm (*Spodoptera exigua*) on sugar beet. J. S. SANDHU and Y. P. MADAN. *Indian Sugar*, 1970, **20,** 283–284.—Severe attacks of the army worm on sugar beet in India are reported, notably at the Sugarcane Research Station, Jullundur Cantt. Leaves were eaten down to the midrib but growing points were usually untouched. Spraying the crop with "Endrin" emulsion effectively checked the pest. This army worm is known to attack other economic plants, e.g. jute, citrus and tomatoes, and to move readily from one food plant to another.

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Prospect of sugar beet cultivation in Madras as a supplement to sugar cane. C. EKAMBARAM. *Proc. Third Joint Conv. All India Sugar Tech.*, 1969, A-12.1–A-12.5.—It is believed that sugar beet was first grown in India in 1917 and again in 1959 as a winter crop. In Pakistan, three sugar mills are currently working with sugar beet[1]. Prospects in Madras are encouraging. Preliminary trials conducted at the Sugar Cane Research Stations in Madras indicate that sugar beet can be successfully grown from September, October or November to April–May in soils with good irrigation and drainage facilities and that well developed roots containing a high sugar content (16–18%) could be obtained during April–May with a fairly good yield of 50–60 tons of sugar beet and 7–8 tons of sugar per hectare.

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Influence of different seed spacing and population density on yield and quality with "sugar beet growing without singling". E. BORNSCHEUER. *Zucker*, 1970, **23,** 657–662.—Sugar beet growing without singling, or "drilling to a stand", was studied in field trials over a period of several years. When seed was spaced at 15 cm apart, final plant stands of 70,000 to 75,000 were required to avoid losses of yield. An increasing population density did not cause any decline in yield or only slight losses. With a spacing of 12 cm or more than 90,000 plants per ha there was a decline in root yield.

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Growth of sugar beet (cultivar Polyrave) in relation to petiole nitrate content. N. ALBASAL, Z. DOR, R. CARMELI and U. KAFKAFI. *Exp. Agr.*, 1970, **6,** (2), 151–155; through *Biol. Abs.*, 1970, **51,** 10228.—Nitrate content in the petiole reaches its maximum 3 months after emergence of the seedling. There is a linear correlation between the final yields and the nitrate content of the petiole at the maximum stage. N fertilizer should be given in the first 3 months of growth.

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Production and multiplication of seed of sugar beet varieties. G. K. G. CAMPBELL. *Nat. Agric. Advisory Service Quart. Rev.*, 1969, **86,** 55–58; through *Biol. Abs.*, 1970, **51,** 10228.—The history of the sugar beet industry is presented, with particular emphasis on the earlier problems of obtaining suitable seed material and useful polyploidy. The practicality of mechanical production of monogerm seed from multigerm stocks is discussed.

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The outlook for sugar beet in India. R. R. PANJE. *Indian Farming*, 1969, **19,** (2), 7–10; through *Field Crop Abs.*, 1970, **23,** 517.—Results of trials in different parts of India are reviewed. The highest average beet yields (41·5 tons/ha) were in the N.W. region, as against 29·4 for the S. region. Nineteen different varieties were tested in all.

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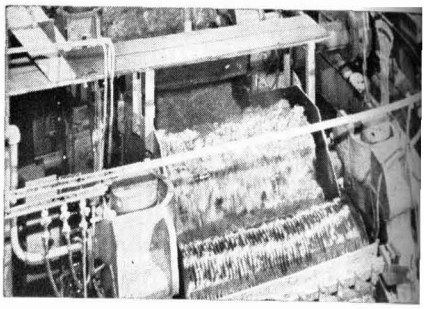
[1] See *I.S.J.* 1971, **73,** 202.

Cane sugar manufacture



The performance of (Mauritius) sugar factories in 1969. J. DUPONT DE R. DE ST. ANTOINE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1969, 133–141. Results from the 1969 season are summarized and compared in some cases with results from previous seasons. The importance of maintaining high dilution ratios is emphasized and the significance of this factor explained. Generally, no clarification problems were encountered. The use of saccharate liming at a number of factories has permitted lower clarified juice turbidities and higher raw sugar filtrabilities. It is recommended to use a sugar solution of low reducing sugar:sucrose ratio for preparation of the saccharate solution, since most of the reducing sugars are destroyed during the sucrose-lime reaction. Only a slight excess of sucrose should be used compared with that theoretically required for soluble Ca monosaccharate formation, and high temperatures should be avoided, in order to prevent precipitation of insoluble trisaccharate. While bagasse losses were low (4·02% sucrose in cane), filter cake and undetermined losses were normal (0·43% and 1·06%, respectively), with final molasses losses being the highest. To reduce these, the minimum theoretical or target purity applicable to a particular product must be known, and to this end actual and target true purities of molasses monthly samples from all Mauritius factories are calculated and circulated. Processes leading to well-exhausted molasses are described, reference being made to the advantages of the Queensland practice of heavier boiling with greater exhaustion taking place in the pans, and dropping the massecuite at a higher Brix. The massecuite is generally cooled only to about 45°C and is then reheated to 55–60°C to reduce the viscosity before curing. Curtailing massecuite retention in the crystallizer is also recommended. The use of enzymatic starch removal has raised affined sugar filtrability.

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The use of bacterial amylase for reducing the starch content of sugar products. E. C. VIGNES, M. ABEL and L. LE GUEN. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1969, 141–145.—Trials in which bacterial amylase was added to clarified juice and evaporator thick juice are reported. Addition of 10 p.p.m. amylase to mixed juice which had been boiled to solubilize the starch and then cooled to 73°C permitted 82–92% starch removal after 15 minutes; 75% of the starch was removed after 15 minutes from clarified juice cooled to 75°C when 5 p.p.m. amylase was added, the percentage removal being raised to 86% after 30 min and to 93% with 10 p.p.m. amylase. However, elimination of starch from cooled clarified juice is considered technologically unpractical. From determination of reducing sugars in pressed juice, it is concluded that amylase does not cause inversion. The ideal point at which to add amylase to thick juice was found to be the 3rd effect; addition of 10 p.p.m. caused an average 63% reduction in the starch content after 5 min at 85°C and 32°Bx. The reduction in starch was greater at lower Brix, although temperature had no effect in the range 64–84°C. Best results were obtained at a higher temperature and a lower Brix, so that the starch hydrolysis rate in the 3rd effect would be double that in the last effect.

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Notes on slurry preparation and pan seeding. J. DUPONT DE R. DE ST. ANTOINE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1969, 145–150.—A survey of pan seeding methods used in Mauritius showed that 15 factories use slurry and 7 use icing sugar. Those using slurry employ Ditmar ball mills or locally-made equipment, while one uses an "Atomicer". Details are tabulated of the equipment and slurries produced, showing that the imported equipment does not necessarily give better quality slurry, but some of the results obtained with the locally-made equipment were very poor. The main difference between imported and Mauritius equipment lies in the greater proportion of volume occupied by the balls and higher speed of rotation of the former. However, sufficient seed of small and regular dimensions such as is required for good slurries may be obtained by careful application of data from studies with a microscope of the seed nuclei and examination of size analysis data. The amount of seed required for true pan seeding cannot be calculated, since the quantity is always much greater than that obtained by calculation, so that only a trial-and-error method will give the requisite figure.

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Sugar in Thailand. H. HIRSCHMÜLLER and H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1970, **95**, 576–579. A survey is presented of the Thailand cane sugar industry. While rapid development has taken place over the 15-year period up to 1969, when 300,000 tons of sugar were produced, further expansion has been stopped by the Government because of the inability to increase exports beyond the present level. Of the 45 factories, only two-thirds produce white sugar, while the other third produces a crude product, so-called "red sugar"; some sugar factories are at present

inoperative. There are also many small mills which turn out red sugar or syrup, part of which is processed to low-grade white sugar for local consumption. Average sugar consumption in Thailand is only about 10 kg per caput.

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Simulation study of a vacuum pan sugar crystallizer. I. L. B. EVANS, G. P. TREARCHIS and C. JONES. *Sugar y Azúcar*, 1970, **65**, (10), 19–22, 37.—As part of a study towards improving batch pan boiling control, a mathematical model was first developed to describe the dynamics of the process and was then used as a basis for simulation experiments using a digital computer to evaluate control schemes. One such scheme is set out in tabular form and is based on massecuite level, mechanical stirrer power requirement and supersaturation as variables and the vapour condensing temperature as constant. For each step the criteria for terminating the step and proceeding to the next phase of the cycle and for varying syrup feed, steam condensing temperature and vapour condensing temperature (where required) must be defined.

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The "Saturne"—complete maceration cane diffuser. ANON. *Sugar y Azúcar*, 1970, **65**, (10), 24–25.—Some performance data are given for the "Saturne" cane diffuser[1] installed at Azucarera Hispania, Málaga, Spain. Over a 2-month period of operation the 2000 t.c.d. diffuser gave an extraction corresponding to 35% juice weight on weight of bagasse; the 1st carbonatation juice had a filtration coefficient about half the previous value obtained without the diffuser. A number of teething troubles were encountered, including inadequate cane preparation, irregular feeding of cane to the two-roller crusher, poor dewatering mill performance, and frequent drops in steam pressure, resulting in falls in diffusion temperature to below 55°C. The diffuser operates in parallel with a mill tandem, so that a switch from conventional milling to milling-cum-diffusion and *vice versa* can be made in less than 1 hour.

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Reverse cycle to establish footing for commercial sugar. G. F. FUNDORA. *Sugar y Azúcar*, 1970, **65**, (10), 28. To minimize impurities inclusion in sugar crystals as a result of using *C*-sugar as footing for commercial sugar boilings, reverse-cycle processing is recommended in which (i) a high-purity medium is grained and the mother liquor purity reduced by feeding low-grade molasses, or (ii) a low-purity medium is grained and used as footing; the latter is preferred, since (i) increases the risk of imperfect crystal formation and promotes syn-crystallization. At Central Okeelanta *C*-massecuite is made from *A*-molasses, and the *C*-sugar is remelted in clarified juice. While the steam consumption is increased because of the remelting of all of the *C*-sugar, crystal formation is improved and the commercial sugar ash and colour are lower than when *C*-sugar is used as footing in a 2-boiling scheme.

Centrifugals design, construction and operation. M. ANAND. *Sugar News* (India), 1970, **2**, (4), 13–17. A general survey is presented of trends in centrifugal design, operation and construction, with reference to massecuite handling and brief mention of continuous machines.

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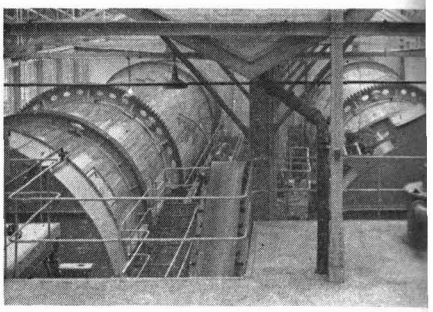
Division of Mill Technology. P. G. ATHERTON, P. N. STEWART and A. D. DOOLAN. *Ann. Rpt. Bur. Sugar Expt. Sta.*, 1970, (70), 55–67.—Work carried out by the Division of Mill Technology of the Bureau of Sugar Experiment Stations in Queensland is reported, including information on new equipment installed in sugar factories and advisory and investigation work conducted on behalf of factories. Among the more important items discussed are: fluidized bed drying tests with a laboratory model and with a pilot-scale three-stage unit installed at Millaquin, in which the three beds fluidized readily with Brand 1 sugar but handled the sugar more rapidly than did the transfer chutes which therefore became blocked. Mechanical feeders are considered a possible answer and are to be incorporated. A sugar throughput of 2 tons/hr was achieved. Direct cane analysis has been investigated at Mossman, but snags have arisen as a result of the large amount of sample to be handled, so that modifications are to be made to the system, which comprises a Rietz pre-breaker and a rotating sub-sampling table. In tests to determine whether or not the c.c.s. formula used in conjunction with wet disintegrator analyses was valid for the Babinda region, good agreement was found between first expressed juice c.c.s. and wet disintegrator c.c.s. during the mid-season tests, but appreciable differences occurred between the two sets of values in late-season tests. No significant loss of moisture was observed with a Jeffco cutter-grinder provided the cutter blades were sharp and the machine maintained in good condition. A number of flocculation aids were tested; of these, LT 25 proved to be very promising and was better in some respects than "Separan AP 273" and much cheaper. Another, A 130, costing about the same as LT 25 and giving results comparable to those obtained with "Separan AP 273", was to be tested in 1970. Investigations into the performance of BMA K 850 continuous centrifugals showed that massecuite feed into the basket was very uneven as a result of erosion and tracking in the feeding bell. The unevenness had caused severe wear to portions of the lower edge of the gauze screen in the machines at Gin Gin. BMA have designed modifications to overcome the problem of heavy massecuite feeding and recommendations have been made for modifications to existing machines, the performance of which was to be studied in 1970. Bagasse utilization and its prospects in Queensland have been studied. Sodium metasilicate has proved an effective preservative for clarified juice but not for unlimed juice. A survey of the 1969 mill performances and cane and sugar yields in Queensland is included in the report.

[1] *I.S.J.*, 1970, **72**, 147; 1971, **73**, 61.

Beet sugar manufacture



Juice purification. II. The stages of juice purification. H. GELEN. *Seker*, 1970, **19,** (76), 2–11.—The individual process stages and equipment used in juice purification, viz. pre- and main liming and 1st and 2nd carbonatation, are described, showing how problems arising during the processes are overcome.

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New developments with RT continuous diffusers. G. DUCHATEAU. *Sucr. Belge*, 1970, **89,** 597–608.—See *I.S.J.*, 1971, **73,** 125–126.

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The sugar industry in Israel. L. BEAUDUIN. *Sucr. Belge*, 1971, **90,** 3–11.—A survey is presented of the Israel sugar industry, the bulk of the article being devoted to beet agriculture. (See also *I.S.J.*, 1970, **72,** 374.)

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Fluidized calcination of carbonatation mud on a pilot-plant scale. W. STANKIEWICZ. *Sucr. Belge*, 1971, **90,** 15–24.—Details are given of tests in which carbonatation mud was subjected to calcination in an experimental fluidized bed kiln at Lódz Technical University in Poland. Although the thermal efficiency of the kiln was low at 27·7% (compared with 25–72% for other fluidized bed kilns as reported in the literature and with 66% for a vertical kiln as used in the sugar industry), CaO output, at 5·3 tons/m³/day, was much higher than the 0·5 tons/m³/day achieved by a vertical kiln. The CO_2 content of the waste gas varied between 20 and 60%, averaging 32·4%, depending on the quantities of fluidizing air and mud feed. The particles of pre-dried mud measured 0·3–0·5 mm. Average power consumption was 2·48 kW during one hour in which 1·5 kg of mud was processed.

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Sugar beet storage in unilaterally controlled atmosphere. H. SCHMIDT, H. KLAUSHOFER and L. WIENINGER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 92–93.—Reference is made to tests, which are being continued, on the storage of beet in a CO_2-rich atmosphere. The beet (30 kg) were stored at 8°C in sealed containers fed with CO_2 gas. Measurements were made at intervals of the container atmosphere.

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Non-sugar behaviour during beet processing. The behaviour of beet non-sugars in diffusion. N. KUBADINOW and L. WIENINGER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 105–107.—Investigations using a laboratory diffuser, in which distilled water was used as extraction liquid at 70°C, showed that at least 95–97% of the sugar in the beet was to be found in the raw juice, while 85% of the original sodium and potassium was extracted but only 10% of the original calcium and 50% of the original magnesium were present, suggesting that Ca and Mg are in the form of compounds which are only slightly water-soluble; 85–90% of the original amido-, ammonia- and α-amino-N compounds were extracted, whereas total N extraction was of the same order as the Ca and Mg. Considerable variations were found in the total N contents in beet and raw juice for two campaigns, the place of origin, beet variety and fertilizer application being the same.

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Investigations on a thin juice softening unit. L. WIENINGER and N. KUBADINOW. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 107–109.—Thin juice was analysed before and after passage through an ion exchange unit and the pH of the resulting thick juice and of thick juice from untreated thin juice investigated. From the corrosion prevention viewpoint, the optimum filtration time through the resin was 90 min, giving a thick juice pH of 8·6 compared with 9·3 where the thin juice was untreated. After 30 min the pH of the thick juice from the treated juice was higher at 9·5 than from the untreated juice (9·0).

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Charging of footing during standard crystal boiling. W. SZOKOL. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 109–110.—Descriptions are given of the boiling procedures carried out at two Austrian sugar factories where a minimum of footing is boiled in the pan before the greater volume of syrup is introduced. In both cases difficulties occurred, these being more significant at one factory than at the other, the latter obtaining good crystal quality and final sugar colour.

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Investigations on a low-grade vacuum pan with stirrer. W. SZOKOL. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 111–112.—Tests on low-grade boiling showed that the average evaporation rate for 92–94°Bx massecuite was 1·0–1·2 tons of water/hr with and only 0·5–0·7 tons/hr without the mechanical stirrer, which in one case raised the rate from 0·5 to 1·4 tons/hr with a massecuite of 94°Bx. However, when throttled 2nd vapour was used the risk of foaming arose; this may lead to evaporation of more water per unit time than the quantity of sucrose crystallizable on the existing crystal surface at a corresponding syrup concentration.

Adsorption purification of beet sugar factory products by granular active carbon in a continuous stream. YA. O. KRAVETS, A. K. KARTASHOV, YU. D. GOLOVNYAK and A. A. IVANYUK. *Sakhar. Prom.*, 1971, **45**, (1), 6–11.—Tests are reported in which a thick juice-remelt liquor mixture was passed through a counter-current adsorption column and decolorized with AG-3 granular carbon. Initial colour of the 53–57°Bx solution varied in the range 27–112°St and was reduced to 16–31°St, i.e. 41–73% colour removal. Other advantages of the treatment included higher purity and better molasses exhaustion as well as shorter boiling times.

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pH change in sugar solutions during evaporation. M. A. GEISHTOVT, L. P. MAIOROVA and V. V. MAIOROV. *Sakhar. Prom.*, 1971, **45**, (1), 14–16.—Tests are reported in which sugar solution was treated in a single-tube evaporator provided with means for both natural and forced circulation. Samples taken every 5 min during 30–60 min were cooled to 20°C and the pH measured. The pattern of fall in pH as a function of evaporation time and temperature is indicated in graph form, showing that the higher the constant temperature the more quickly will the point be reached at which the fall will change from gradual to abrupt. A formula is given for calculation of the maximum retention time in the evaporator as a function of temperature.

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Improving DDS diffuser operation. M. I. YANITSKII. *Sakhar. Prom.*, 1971, **45**, (1), 33–34.—As an alternative to the recommendation by the Polish licensed manufacturers of the DDS diffuser to have a tank available to hold the juice flowing down the trough when the diffuser stops working for more than 10 minutes, the author suggests raising the height of the wall section carrying the 1st and 2nd sight glasses near the feed end and thus increasing the level carrying capacity of the idle diffuser. This would also help in restarting the diffuser, it is pointed out.

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Sulphitation under vacuum. ANON. *Sakhar. Prom.*, 1971, **45**, (1), 34–35.—Brief mention is made of the system at one Soviet sugar factory where the three sulphitation towers operate under vacuum, each being provided with its own small condenser.

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Automatic unit for counting the finished product. M. KRETOV. *Sakhar. Prom.*, 1971, **45**, (1), 35–37.—Details are given of the automatic system at a Soviet factory for counting up to 2500 50-kg bags of sugar per hour.

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Differences in the extraction of beet from humid and continental regions. K. VUKOV. *Zucker*, 1971, **24**, 43–48.—The physical properties and chemical composition of beets grown in western and north-western Europe are shown to be so vastly different from those of beets grown in central and eastern Europe as to create differences in diffusion. The former beets, grown under cold, moist conditions, are fragile but have a higher permeability and a lower marc and non-sugar content than beets grown under continental conditions in warm summers which, in the second half, are characterized by drought. Cossettes from beets grown in the humid regions should be thicker, which necessitates a longer diffusion time than with continental beets, although the juice purities are higher than with the latter.

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Pitting corrosion of stainless steel evaporator tubes used in the British Sugar Corporation Limited. M. E. GILES and N. REED. *Sucr. Belge*, 1971, **90**, 57–70. See *I.S.J.*, 1971, **73**, 22.

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Utilization of liquid and gaseous fuels in sugar factory lime kilns. P. DUPONT. *Sucr. Belge*, 1971, **90**, 73–78. The use of various oils and of butane, propane and natural gas as fuels for lime kilns is discussed, and kiln designs for operation with these fuels are examined as well as the various methods of operation where the usual vertical kiln is converted. As regards the effects of the fuels on sugar factory processing, the main drawback in the use of liquid fuels is considered to be inflexibility in CO_2 production which is smaller than with coke, ranging from 36·1% with heavy oil to 29·9% with natural gas compared with 38·2% with coke, as indicated in a table of representative values. However, on the cost side, it is shown for a Moroccan sugar factory that a new oil-fired kiln would be paid for in 10 years and a converted kiln in 4 years. It is emphasized that installation of a new kiln in a sugar factory is never without teething troubles.

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Enzymatic hydrolysis of pectin. II. Hydrolysis of pectin in raw juice. R. BRETSCHNEIDER, J. ČOPÍKOVÁ and B. KALIKOVÁ. *Listy Cukr.*, 1971, **87**, 18–21.—Tests with raw juice samples and a model solution were carried out to determine the effect of pectin hydrolysis on carbonatation juice. After 15 minutes' hydrolysis with "Sparkl-L" preparation and a pectinase preparation, respectively, the pectin content fell to a satisfactory level, there was no rise in the dextran content and foaming during carbonatation was reduced. The pol and colour of the thin juice remained unchanged, while the physical properties of 1st carbonatation juice were improved. The pectinase preparation proved better than the "Sparkl-L". Although the preparations would be of benefit for low quality juice treatment, their high cost must be considered.

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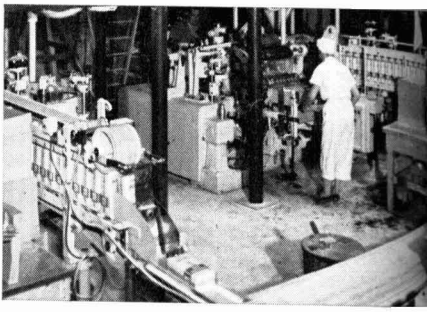
Practical examples of tabular calculation of optimization and planning. B. PAULI. *Zucker*, 1971, **24**, 67–73. A method of calculating the economically optimum use of power plant is explained with the aid of two examples, the second of which concerns application of three back-pressure turbines of varying capacity in a sugar factory. The best possible load distribution on the turbines to give maximum power output at any given total throughput is calculated. The advantages of the method are discussed.

Sugar refining



Improvement in a sugar refining scheme based on ion exchange purification of syrups. M. B. YARMOLINSKII *et al.* *Sakhar. Prom.*, 1971, **45**, (1), 20–26. Details are given of a scheme, tested on a pilot and factory scale, in which the syrup for refined sugar O-massecuite (made exclusively from white sugar and hence of very high purity) was treated with bone char and then with decolorizing resin. The result was a syrup colour averaging 0·19°St instead of 0·85°St with the conventional scheme, plus subsequent improvements in colour of the massecuites, run-offs and final sugar. It was also possible to boil refined sugar 1st massecuite from syrup of much higher Brix (71° instead of 63°). Flow sheets and tabulated data are given.

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Processing cane raw sugar at Latvian sugar factories. YU. A. SEMENTSOV, I. B. KALVISH, I. Z. GERCHIKOV and N. G. SAL'NIKOV. *Sakhar. Prom.*, 1971, **45**, (1), 26–29.—Reference is made to the excellent performance of Latvian sugar factories in refining imported raws, and the measured adopted to reduce the bacterial content of raw and white sugar as well as process water are discussed. The counts of various types of micro-organisms in sugar and water during February–June are tabulated.

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Optimum conditions for thermal activation of bauxites used as colour adsorbents in the sugar industry. J. I. VAVRA and L. M. PETROV. *Glas. Khem. Drushtva*, 1970, **35**, 32.—Five kinds of Yugoslavian bauxite were tested for their optimum thermal activation conditions with a view to their use as adsorbents in the sugar industry. Granulated samples in beds of varying thicknesses were heated for various periods at a temperature in the range 200–900°C and their activity then determined in terms of the extent of adsorption of colouring matter from model molasses and sugar solutions. All the samples displayed optimum adsorption after heating in the range 450–500°C. Up to this temperature a correlation was found between adsorption capacity and loss due to ignition. Red bauxite was found to have greater adsorptive capacity than white bauxite.

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Graphical atlas for the treatment of refinery syrups. A. PASETTI. *Ind. Sacc. Ital.*, 1970, **43**, 203–208.—The results of a series of tests are indicated in graph form which demonstrate the effect on % decolorization of variations in the amount of active carbon, time of contact, temperature, syrup Brix, pH and initial colour, as well as the effect of time and initial colour and of pH and purity on the increase in syrup colour, and the effect of Brix and temperature on syrup filtration rate. Other aspects of syrup decolorization are discussed, including the treatment of turbid syrups compared with clear syrups, etc.

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Combining defeco-saturation and sulphitation in purification of raw sugar remelts. M. I. DAISHEV, V. T. SHI and T. P. TRIFONOVA. *Sakhar. Prom.*, 1971, **45**, (2), 10–12.—Preliminary tests indicated that in simultaneous treatment of raw sugar remelt liquor with lime and SO_2, the latter was responsible for only some two-thirds of the overall decolorization. In subsequent experiments, 55°Bx remelt liquor was simultaneously limed with 0·2–0·8% CaO on solids weight and gassed with CO_2 to a pre-set pH range. After filtration, the liquor was sulphited to pH 7·2–7·5. While the decolorizing efficiency rose slightly with increase in CaO and was greater with increase in the pH range, best results were achieved by gassing with CO_2 to pH 8·4–8·6, filtering, and simultaneously treating with SO_2 and 0·1% CaO on solids weight; the maximum decolorizing efficiency (70·1%) was achieved where only 0·4% CaO was added in the preceding defeco-saturation, after which decolorization fell with increase in the CaO addition in defeco-saturation. The maximum decolorization contrasted with 46–54·9% where no lime was added with the SO_2, although with increase in the quantity of lime added in the preceding defeco-saturation, the maximum (65·8%) obtained with defeco-sulphitation had to be compared with 54·1–64·0% using only sulphitation after defeco-saturation.

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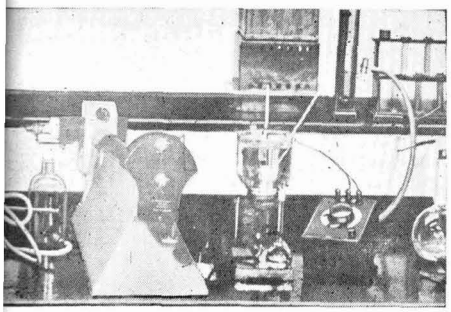
Hong Kong refinery buying new equipment and diversifying. R. J. LEFFINGWELL. *Sugar y Azúcar*, 1971, **66**, (1), 46, 50.—Following the establishment of sugar production facilities in other countries of the Far East, the markets for refined sugar from the Taikoo Sugar Refining Co. Ltd. of Hong Kong have been reduced from nearly 70,000 tons to 41,000 tons/year, and it is anticipated that they will become steady at about 35,000 tons/year. New centrifugals, clarification and filtration plant, silos and packing equipment are being installed on the advice of Tate & Lyle Technical Services Ltd., and diversification planned into liquid sugars, yeast, and possibly candy manufacture. Advantage is being taken of the refinery's assets—a wharf, water reservoirs, buildings and land—to improve the company's position.



Laboratory methods & Chemical reports

The effect of temperature and concentration on pH measurement of beet sugar factory products. S. SUBAYGIL. *Seker*, 1970, **19**, (76), 36–44.—Tabulated data for products from four Turkish sugar factories demonstrate the fall in the measured pH value with rise in temperature over the range 20–90°C, the difference in measured pH per 10°C deviation from 20°C being given for each product. Data for white sugar and molasses showed that although the general trend was for the measured pH to fall with decrease in Brix, in some cases the measured pH at 40°Bx was higher than at 70°Bx. In all cases the measured pH fell with increase in molasses dilution up to 1:4, the effects of temperature and dilution being additive.

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Differentiation of hyperthermophilic *Bacillus* strains from sugar factory diffusion units by means of numerical taxonomy methods. F. HOLLAUS and H. KLAUSHOFER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 85–86.—See KLAUSHOFER & HOLLAUS: *I.S.J.*, 1971, **73**, 184.

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Collection of hyperthermophilic bacteria at the Microbiological Department. F. HOLLAUS and H. KLAUSHOFER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 88.—Means used to preserve more than 100 bacterial isolates taken from Austrian sugar factory diffusers over the last 4 campaigns are described. The aim is to maintain the properties constant and at the same time make the samples available for rapid culture.

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Determination of sucrose, invert sugar and lactic acid in cultures of *Bacillus stearothermophilus*. H. KLAUSHOFER, G. POLLACH and H. HABÖCK. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 88–89.—Of various methods examined for determination of sucrose and invert sugar in *B. stearothermophilus* cultures, the most suitable was found to be one involving the use of Müller's solution; for lactic acid determination a thin-layer chromatographic method was selected.

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Biochemistry of beet invertase. R. KLEMEN and H. KLAUSHOFER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 90–92.—Tests with brei from deep-frozen and stale beet to which water had been added showed that within a day considerable quantities of invert sugar had formed. When toluene was added, the quantities were smaller than with water alone or with "Tego" (a disinfectant). Similar tests with fresh beet made available during the summer growth period showed that the invert sugar formation was most marked with the youngest beet and fell with age. Tests in which whole slices of beet were shaken in water with air feed showed that invertase formation was considerable. It is suggested that toluene inhibits synthesis of the enzyme but does not affect the action of invertase already present. "Tego" evidently does not inhibit the synthesis. Reference is made to the findings of BACON *et al.*[1] concerning beet invertase and invertase inhibition.

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Development and checking of analytical methods. Determination of iron with "Ferron". W. WRUSS. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 93–95.—Full details are given of the method, briefly reported earlier[2], for determination of iron in thin and thick juice and molasses. The method is claimed to be highly suitable for routine analysis, since it takes only a maximum of 15 min, is simple and has good reproducibility.

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Determination of iron in sugar factory juices by means of atomic absorption. W. BRAUNSTEINER, G. FORSTER and P. HORIL. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 95–97.—The use of atomic absorption spectroscopy to determine iron[3] was extended to sucrose solutions of 15, 30, 45 and 60% concentration containing 1–10 ppm of iron. The addition of methanol reduced the fall in extinction with increase in sucrose concentration which was most marked without methanol. Addition of 40 cm^3 methanol to 10 g of sucrose solution caused the absorption to remain constant (within the limits of measuring accuracy) at the same iron content, irrespective of sugar content. The nature of the effect of the methanol was studied by determining the viscosities and surface tensions of the solutions. The viscosities were established according to the time taken for 10 cm^3 of solution to pass under suction into an atomizer, whereby the methanol was found to increase the viscosity slightly. Tensiometric measurements showed that methanol considerably reduced surface tension, so that under otherwise equal conditions the solutions were atomized more finely and a greater quantity of sample passed through the flame to give a greater absorption.

[1] *Biochem. J.*, 1965, **94**, 175–182.
[2] *I.S.J.*, 1970, **72**, 314.
[3] *ibid.*, 313.

Lactic acid determination in raw juices by means of thin-layer chromatography. H. POLLERES. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 97–99.—See PREY & POLLERES: *I.S.J.*, 1970, **72**, 184.

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Improvement of thin-layer chromatographic determination of raffinose. W. BRAUNSTEINER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 99–100.—Of various coats and solvents tested for suitability in thin-layer chromatographic determination of raffinose, "Kieselgel G" and 9:1 acetone:water proved the best despite their susceptibility to interferences and inadequate reproducibility. To overcome these problems it was found best to lay the plates for a short time in the open air between activation at a given temperature and development of the spots. Reproducibility can be improved by adding small amounts of acetic or formic acid, although even with these measures the method still lacks the desired accuracy. Thymol-sulphuric acid proved successful as a spray reagent and there was no marked fading of the spots. Accuracy of beet brei raffinose determination is still poor at 20–30% in the range 0·3–0·5 μg.

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Determination of the phosphorus content in sugar beet samples. W. BRAUNSTEINER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 101.—The method described is based on colorimetric determination of the yellow phosphovanadomolybdic acid formed by reaction of phosphate ions with a reagent containing vanadate and molybdate ions. Beet brei samples were dissolved in a perchloric and nitric acid mixture and the solution then diluted with water and boiled for a brief period to hydrolyse any pyrophosphate ions present. Treatment with sulphuric acid in the presence of selenium, as described in the literature, gives the same results as with the mixture used above, but is considerably more time-consuming. Turbid solutions made up of 26 g beet + 177 cm^3 water were easily clarified with 10% trichloroacetic acid, after which the phosphate ions were easily determined. From the results it is concluded that the greatest part of the phosphorus in beet is present as phosphate, the remainder being organically bound.

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Spectroscopic determination of betaine in sugar factory products. S. PIEH. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 101–104.—Infra-red spectroscopic determination of betaine in beet molasses by the attenuated total reflection method with a Perkin-Elmer instrument using a germanium crystal was carried out in the spectrum range 1400–1320 cm^{-1}. The optimum sample comprised 7·2 g of molasses diluted with 2 cm^3 of water. The betaine contents found by reference to a calibration curve for four factories had a mean varation of ±2%. The method takes only a few minutes, and the lower determination limit is about 0·25% betaine by weight.

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Investigations on factory molasses. L. WIENINGER, W. SZOKOL and W. BRAUNSTEINER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 112–113.—Beet molasses from the 1969/70 campaign were analysed and the results compared with data from previous campaigns. Measurements of viscosity at 45–65°C showed that it fell considerably with increase in the degree of exhaustion, since sucrose in supersaturated solution raises the viscosity to a far greater extent than the corresponding non-sugars concentration.

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Sulphitation of sugar factory juices. H. POLLERES. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 113–114.—Previous experiments were continued[1], in which invert sugar was decomposed in alkaline medium and sodium sulphite added at the temperature of a boiling water bath. A slight reduction in extinction of the sugar solution occurred in both visible and u.v. light, the reduction increasing with increase in the amount of sulphite added at the same colour concentration. Further tests with glucose solution, varying the ratio of glucose to sodium sulphite, reaction time and reaction temperature, revealed a maximum in the extinction curve in the u.v. range between 250 and 300 nm in the presence of sulphite, but, as was found with sucrose solution, the value was higher than in the case of a purely alkaline decomposition under identical conditions. Considerable difference was found between colour formation in the presence and absence of sulphite ions.

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Determination of peptide nitrogen (reactive nitrogen) in beet and sugar factory juices. G. PETERSHOFER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 115.—See PREY & PETERSHOFER: *I.S.J.*, 1970, **72**, 152.

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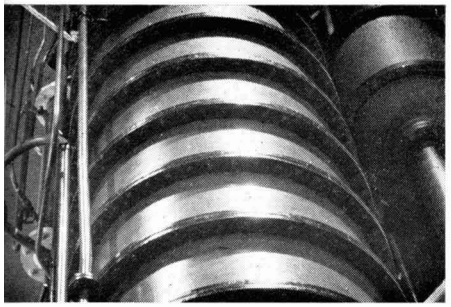
Investigation on "Sephadex" gels. H. ANDRES. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1969/70, 120–124.—Gel filtration on columns of "Sephadex" G 24, G 50 and G 75 was used to fractionate browning reaction colorants formed by alkaline decomposition of sucrose and to determine their molecular weights. It was found that the course of the decomposition under otherwise identical conditions is strongly dependent on the alkali cation. Varying concentrations of acid amino-acids were also added to sucrose undergoing alkaline decomposition; the use of invert sugar instead of sucrose permitted an end-point of the browning reaction to be reached more quickly. The zoning in the columns was facilitated by use of a 1:1 diluted molasses solution; this was also used, in its capacity as a N-containing alkaline sugar decomposition product, as a contrast to the pure alkaline sucrose decomposition process. The addition of increasing amounts of sodium chloride (0·5–10%) to the 0·02M borate buffer solution used for elution enabled certain fractions to be isolated in very pure state, although distilled water used for elution had optimum properties for molecular weight determination of the molasses fractions. The extinction curves for the fractionation were considerably different in u.v. light than in visible light. Fifteen fractions were isolated on "Sephadex G-25"; these had molecular weights in the range 50–5000.

[1] *I.S.J.*, 1970, **72**, 310.



By-products

Continuous fermentation of forage yeast in Cuban cane molasses. K. BERAN and O. ALMAZÁN. *Sobre los derivados de la caña de azúcar*, 1968, **2,** (1), 5–20. Experiments have been made to determine the effects of a number of factors on the yield of yeast and its activity as measured manometrically. The rate of dilution affects yield with a slight increase followed by a sharp decrease. Yield was greater at pH 4·5 than at 3·5 or 5·5. When the P_2O_5 content of the yeast was greatest the yield was also highest, but the P_2O_5 content was always at least 1·7%. The effect of temperature was as described in the literature, i.e. above 35°C there was a drop in yield.

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Study on the structure of Cuban dextran. L. C. BROSSARD. *Sobre los derivados de la caña de azúcar*, 1968, **2,** (1), 41–47.—The structure of dextran produced at Central España is found to include 6·1% of alpha 1:3 bonds, 1·1% of alpha 1:4 bonds and about 93% of alpha 1:6 bonds. It is concluded that this dextran is similar to NRRL B-512 dextran.

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The use of furfuryl alcohol as a binding agent in the preparation of pressed boards from bagasse particles. I. M. A. YOUNG. *Sobre los derivados de la caña de azúcar*, 1968, **2,** (1), 48–54.—Particle board has been prepared from furfuryl alcohol and bagasse using maleic or toluene sulphonic acid as catalyst. The material has a superior resistance to water to that made from urea-formaldehyde resins at the same density.

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Study on the properties of dextran. A. BELL, X. ALVAREZ and M. AGUILERA. *Sobre los derivados de la caña de azúcar*, 1968, (**2**), 47–55.—Details are given of analytical techniques employed for determining the characteristics of dextrans and data tabulated which were obtained for ten samples produced in Cuba. The characteristics included moisture, sulphated ash, reducing substances, nitrogen, phosphorus, and pH, density and viscosity in 2% solution.

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Possibility of obtaining furfural from trash, pith and bagasse. Obtaining furfural in semi-industrial equipment. A. MILOVANOV, Y. OLGUÍN and E. CORONA. *Sobre los derivados de la caña de azúcar*, 1969, **3,** (1), 2–10.—Laboratory yields of furfural from bagasse, trash and pith were 10·9%, 11·6% and 9·7%, respectively, the furfural quality being practically the same in all cases. The possibility of obtaining furfural from bagasse was confirmed by pilot plant experiments using 6–7 atm. pressure and H_2SO_4 as catalyst, the yield being 11–12% on bone-dry bagasse. The crude furfural condensate is acid and is rectified with or without prior neutralization; the slight differences in the characteristics of the furfural are tabulated.

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Acetylation of α-cellulose from bagasse in the presence of urea and ammonium sulphate. J. LODOS and Y. LINES. *Sobre los derivados de la caña de azúcar*, 1969, **3,** (1), 34–41.—The formation of cellulose acetate from bagasse in the presence of ammonium sulphate and urea has been studied with varying proportions of each of the reaction components. The optimal variant was considered to be the reaction of 25 g of comminuted cellulose with 90 cm^3 acetic acid, 150 cm^3 acetic anhydride, 5 g urea and 1 g $(NH_4)_2SO_4$ at reflux temperature for 25 min from the start of heating. The hydrolysis is carried out at 40°C with the addition of 250 cm^3 acetic acid, 115 cm^3 water and 15 cm^3 conc. H_2SO_4 for 150 min. The characteristics of the product are within the range of commercial products as regards yield, degree of acetylation and degree of polymerization. Comparative data are given for acetate obtained from wood cellulose in similar conditions.

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Utilization of furfural-urea resins in the manufacture of bagasse boards. M. CHERKASOV and J. LODOS. *Sobre los derivados de la caña de azúcar*, 1969, **3,** (2), 13–17.—Synthetic furfural-urea resin can be used as a binding agent in bagasse particle board manufacture, but it is viscous and requires a rather high consumption of solvent alcohol and of furfural; consequently it is prepared as a "liquid resin" which can be stabilized with triethanolamine and stored, and which can be used without a solvent to prepare a board of properties similar to commercial "Miratex" board [density 0·76 g/cm^3, water absorption 27–30% after 24 hr, 10–15% deformation, modulus of rupture 130–184 kg/cm^2 (dry) and 45–70 kg/cm^2 (wet)]. The resin is normally prepared by heating 1 mol of urea with 2 mol of freshly distilled furfural and sufficient 3% aqueous NaOH to give a pH of 7·5–8·0. After heating to the boil (125–127°C) for 3 hr, sufficient 5% HCl is added to reduce the pH to 5·5 and heating continued for 2 hr, after which the mixture is cooled, the unreacted urea filtered off and the resin precipitated by adding to 5–10 volumes of water. The "liquid resin" is prepared by adjusting the pH with acid after only 1 hour, and eliminating the precipitation in water.

Patents

UNITED STATES

Bagasse board. C. C. CAMPBELL, J. W. SCHICK and J. H. STOCKINGER, of Cherry Hill, N.J., USA, *assrs.* MOBIL OIL CO. **3,410,813.** 30th March 1966; 12th November 1968.—Pretreated whole un-depithed bagasse is combined with a thermosetting resin (comprising the product of reaction of a ketone having an α-H atom, an aldehyde and a phenolic compound in the presence of a base), moulded and the resin cured. The bagasse is pretreated with a water-repellent substance (a water-insoluble wax) which is either a silicone oil, petroleum oil or water-insoluble wax and heated at an elevated temperature below about 250°F for between 10 minutes and 24 hours to flux and distribute the substance uniformly.

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Bagasse board. J. F. RAKSZAWSKI and H. F. SCHROEDER, *assrs.* ESSO RESEARCH & ENGINEERING CO. **3,493,528.** 23rd October 1967; 3rd February 1970. Bagasse is milled to give pith-and-fines and fibre fractions; the former is adjusted to between 15 and 30% (20–25%) w/w, and at least 6% (7–15%) of a resin [of 10–1000 (10–600) (600–1000) cp viscosity measured on a 38% aqueous solution] added to the mixed fractions and these separated and formed into a laminar structured board having at least a fibrous layer and a pith and fines layer, and the resin cured to give rigidity. The ratio of resin concentrations in the two fractions ranges from about 1·8 to about 3·5 (below 2·5) (below 3·5).

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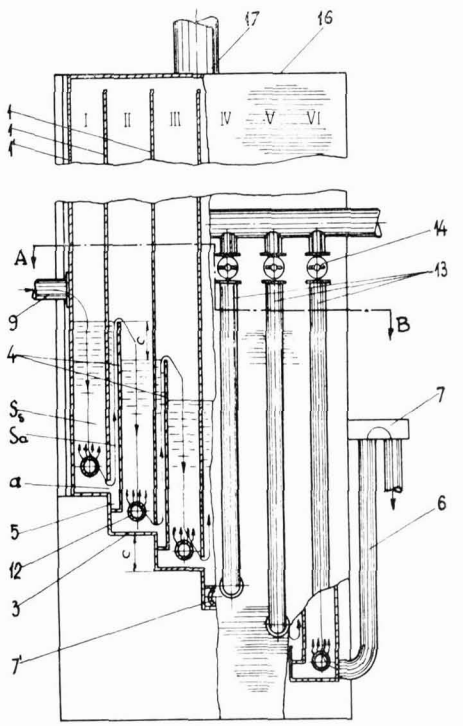
Animal fodder. H. E. BODE, or Cleveland, Ohio, USA. **3,505,073.** 1st March 1965; 7th April 1970. Molasses is diluted and fermented with suitable micro-organisms until > 95% of its sugars are converted to lactic acid and the latter neutralized with lime; the product is dehydrated and may then be blended with not more than one third of its weight of a dry comminuted animal feed product. Before dehydration the product may be treated with di-ammonium phosphate to precipitate the Ca as calcium phosphate, and to convert the fermentate to ammonium lactate. Residual dextrose after the lactic acid fermentation may be converted to gluconic acid by glucose oxidase.

Continuous carbonatation. F. N. DOMSA, of Bucharest, Rumania. **3,506,484.** 23rd June 1966; 14th April 1970.

The carbonatation tank comprises a series of compartments I–VI formed between the side walls by vertical lateral walls 1, and horizontal lateral floors 3 which are stepped. Across the full width of the walls 1 is a gap *a* which connects the saturation space S_s with an auxiliary space S_a formed by weir 4 and its foot 5. Juice enters the first compartment I by way of pipe 9 in the end wall 1′, fills spaces S_s and S_a, and overflows into compartment II. After compartment III part of the juice overflows onwards through



compartments IV, V and VI, overflowing up pipe 6 and being emptied through pipe 7. The bulk of the juice from compartment III is withdrawn from the bottom of compartment IV through port 7′ and

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pumped to the feed pipe 9 so that the ratio of recycled juice to fresh juice is say 8:1.

Carbon dioxide gas is admitted under the control of valves 14 through pipes 13 to the bottom of each compartment through the distributors 12, reacting with the lime content of the juice; unreacted gas passes upwards to the space in each compartment above the liquid level and is withdrawn through vent pipe 17 in the lid 16.

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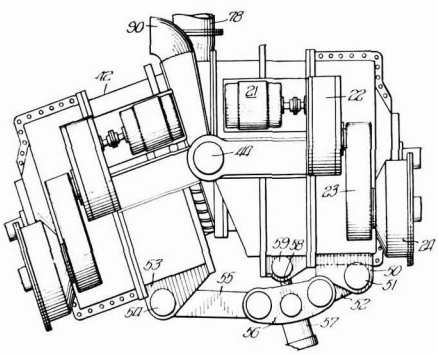
Beet thinner. B. A. SHADER, of Denver, Colo., USA, *assr.* EVERSMAN MANUFACTURING CO. **3,512,587.** 9th October 1967; 19th May 1970.

* * *

Bagasse press. H. F. SILVER and F. B. PRICE, of Denver, Colo., USA, *assrs.* C F & I ENGINEERS INC. **3,513,770.** 15th May 1968; 26th May 1970.

The bagasse press is of the cone type[1] in which rotation of cones set at an angle to each other compresses bagasse fed at the side of greatest distance between their edges as it passes round to where the distance between these edges is at a minimum. The cones, being perforated, permit the passage of juice which is recovered while the compressed bagasse is of lower moisture content. One cone is stationary while the other 42 pivots about upper and lower hinge pivots 44 under the influence of a hydraulic cylinder 57 carrying the strap 56 which is pivotally connected by links 52, 55 to lugs 50, 53 on the housings of the two cones. The cylinder acts on piston 58, thus drawing the two housings and cones together on the pressure side.



Rotation of the cones is brought about by motors 21 acting through gearing 22, 23, 24, and the bagasse feed is by way of pipe 78, the dried bagasse leaving through chute 90.

Cane heaper. H. M. MARTIN and P. J. POCHE. **3,515,256.** 4th November 1968; 2nd June 1970.

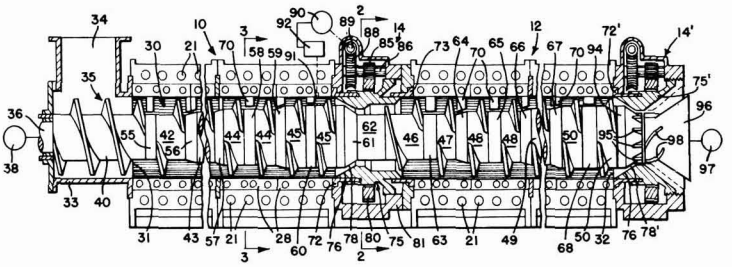
* * *

Laboratory system for automatically analysing mashed sugar beet samples. L. H. WESTESSON, of Arlöv, Sweden. *assr.* INGENIÖRSFIRMAN NILS WEIBULL A.B. **3,517,709.** 29th February 1968; 30th June 1970.—The laboratory system involves the movement of the samples along a conveyor which includes a number of stations where weighing and various steps in the analysis of the samples take place. The samples are held in open-topped containers which are moved by grippers and associated arms for transverse movement off the conveyor to a stationary base and back again; after the sequence of analytical steps is completed the sample container is inverted, washed out and carried by a return conveyor to the start position.

* * *

Mechanical screw press. D. K. BREDESON, of Piqua Ohio, USA, *assr.* THE FRENCH OIL MILL MACHINERY, CO. **3,518,936.** 9th September 1968; 7th July 1970.

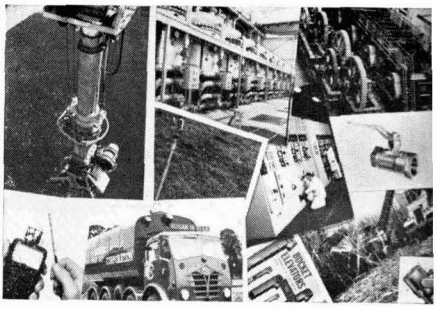
The press is a two-stage unit with a first section 10 and a second section 12. A common shaft 36 rotates within both sections carrying material for pressing from the feed 34 to the discharge 78'. The shaft is provided with scroll sections 42, 44, 45, 46, 47, 48, 50, while the housing has internal axial ribs between which are apertures for expressed liquid.



In the middle of the press is an annular housing 14 with bearings 72, 73 supporting a choke 75 which has a tapered inner surface 76; a helical external thread on the choke is engaged by the ring gear 80 and this is driven by gear 85 on shaft 86 through the linkage 89, 85 from a motor 90 which is automatically controlled by the unit 92 in response to the pressure and/or temperature sensing device 91. The operation of motor 90 causes the choke 75 to move axially along the shaft, so increasing or decreasing the aperture 78 between it and collar 61. The once-pressed material leaving this gap expands in the open ring surrounding sleeve 62 and then is picked up by the second worm and taken along to the second choke 75' which is controlled similarly to the first.

[1] See U.K. Patent 1,095,108; *I.S.J.*, 1968, **70**, 220.

Trade notices



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Cane loader. Salopian-Kenneth Hudson Ltd., Prees, Whitchurch, Shropshire, England.

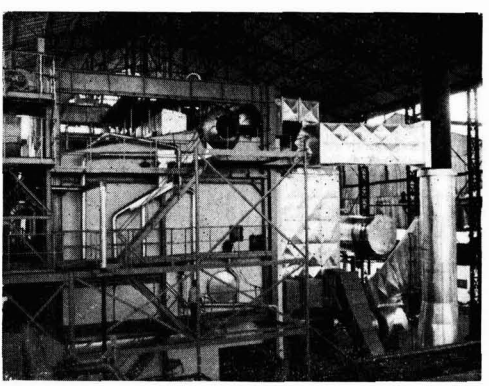
The "Project 300" cane loader, developed from the Funkey-Bell machine, is mounted on a tricycle chassis with two independently-powered front driving wheels and a rear castor wheel. The front wheels

are individually driven by hydraulic motors, the speed, direction of travel and braking of each wheel being controlled separately by a foot pedal. With such manoeuvrability there is no need for a slew boom, and a fixed boom fitted immediately over the front wheels provides maximum stability and traction under all loading conditions. The operator's hands are completely free to work the boom controls, and

the same grab forks are able to push, pile and grab in one operation. The absence of a separate push piling manoeuvre increases the speed of operation and almost eliminates the rolling of stones into the cane during collection. The total weight of the loader is 5700 lb (2600 kg), its forward speed in the field is 6 mph (10 kph), its maximum overall width is 8½ ft (259 cm) and its turning circle 10 ft (305 cm). Clearance height is 7½ ft and it has a 9½ ft (290 cm) lift under the grab. Capacity normally averages 25 tons/hr but can reach 40 tons/hr. The method of operation of the loader is demonstrated in the two illustrations, and full details of the machine are obtainable in a brochure obtainable from the above address. Also available is a costing exercise in which the economics of installing five loaders (one per estate and one spare) on a group of four estates functioning as one unit were compared with the costs of hand stacking of cane. This report was compiled by a customer who had already installed the loader on some of his estates.

* * *

Stork-Werkspoor boilers for Indonesia.—Stork-Werkspoor Sugar N.V., of Hengelo, Holland, have received an order for three Stork-Babcock "Bi-drum" boilers fired by bagasse or oil for supply to Tjukir, Ngadiredo and Tasikmadu sugar



factories in Indonesia. The boilers for the first two factories will have a rated output of 20 tons of steam/hr, while that for Tasikmadu will have an output of 40 tons/hr. Steam pressure will be 20 atm (gauge) and the temperature 350°C. This order will bring to 10 the total of SWS boilers ordered and partly completed for the Indonesian sugar industry since 1969. The other sugar factories involved are Djatiroto, Rendeng and Tersana Baru (supplied with 40 tons/hr boilers, two of these being orders for Djatiroto), and Gempolkrep, Pandji and Modjopanggung (20 tons/hr). The illustration shows part of the new boiler installation at Djatiroto.

ISJ Panel of Referees

MR. OLOF WIKLUND, who has been a member of our Panel of Referees since its inception in 1955, has announced his retirement from the Swedish Sugar Corporation and from active participation in the sugar industry, including membership of the Panel.

During the past sixteen years Mr. WIKLUND has given us the benefit of his experience and judgement in assessing the value of technical papers submitted for publication, and we, our readers and the authors are in his debt for the exercise of this expertise which has helped to maintain the high standard of editorial quality in our pages. We gratefully wish Mr. WIKLUND a long and happy retirement.

We are happy to announce that Mr. THOMAS RODGERS, B.Sc., A.R.C.S.T., C.E., M.I.Chem.E., F.I.F.S.T., has kindly agreed to serve on our Panel of Referees. Born in Greenock in 1923, Mr. RODGERS was educated at Gourock and Greenock High Schools and later at the Royal Technical College, Glasgow (now the University of Strathclyde). He graduated with Honours in Chemical Engineering in 1943, obtaining the Diploma with Distinction in Chemical Engineering of the Royal Technical College, and served an abbreviated engineering apprenticeship with the well-known sugar machinery manufacturing company, Mirrlees Watson Co. Ltd., of Glasgow. After two years working on petroleum research he joined the British Sugar Corporation Ltd. at their Technical Headquarters in Peterborough and was for two years personal assistant to J. CAMPBELL MACDONALD, later the first Technical Director of the Corporation and one of our Referees until his death.

After a further two years as assistant to N. M. ADAMS, also later Technical Director of the Corporation, Mr. RODGERS moved in 1949 to the Bury St. Edmunds sugar factory where he was a Shift Superintendent until 1952, and subsequently to Newark as a Shift Superintendent for a further year. He became Assistant Works Manager at Ipswich factory in 1953 and five years later became Works Manager at King's Lynn. In 1963 he returned to the Central Offices at Peterborough as Planning and Development Engineer of the Corporation. In 1968 Mr. RODGERS succeeded Mr. ADAMS as Senior Technologist and on Mr. ADAMS' retirement in 1970 Mr. RODGERS became Production Director of the British Sugar Corporation Ltd.

Mr. RODGERS joined the Institution of Chemical Engineers in 1943 and was elected Member in 1965. He is also a founder member and Fellow of the Institute of Food Science and Technology.

Brevities

Hawaiian difficulties through US Mainland strike[1].—Emergency storage of sugar began in Hawaii in September with the continuation of strikes which had shut down the ports on the West Coast of the US Mainland. By the end of the month nearly 29,000 tons of sugar was to be stored under cover while another 1000 tons was to be stored outside, protected by plastic coverings. Storage costs are increased for this sugar and even more for sugar put into emergency storage subsequently, which may have reached 70,000 tons under roofs and 50,000 tons outside by the end of October. This is the third blow to the Hawaiian industry as a result of the strike; the C & H refinery near San Francisco (cooperatively owned and supplied by the Hawaiian raw sugar producers) was closed for lack of sugar in early August and was only able to resume limited operations in early September with raw sugar transshipped by rail from Vancouver. In addition, the Hawaiian industry is having to pay more for its fertilizers and other supplies because of the greater distances they must be shipped.

New Greek sugar factory[2].—The foundation stone of the fourth sugar factory in Greece has been laid by the Minister of Agriculture in Toxotai, near Xanthi, in Thracia. It will have a production of 45,000 tons of sugar per year and will be supplied with beets from an area of 8000 hectares. Construction of the factory is to be completed within 17 months by the Polish Foreign Trade Company CEKOP.

* * *

US beet sugar factory expansion[3].—The Utah-Idaho Sugar Co. is to undertake a major extension of its Moses Lake, Washington, factory which will enlarge the plant capacity to 11,500 tons of beets per day, making it the biggest beet sugar factory in the US. An earlier extension has raised its capacity to 8500 tons for the 1971/72 campaign.

[1] *Willett & Gray*, 1971, **95**, 327.
[2] F. O. Licht, *International Sugar Rpt.*, 1971, **103**, (20), 6.
[3] *Willett & Gray*, 1971, **95**, 249.

Brevities

The late R. R. Follet-Smith.—The late Robert Redvers Follett-Smith, C.B.E., who died in September, was born in 1901 and, after graduating from the Royal College of Science in London in 1923, undertook a post-graduate course in sugar technology at the Imperial College of Tropical Agriculture in Trinidad, becoming assistant chemist at Usine Ste. Madeleine in 1925. From 1925 to 1929 he served as assistant to the chairman of the Froghopper Investigation Committee in Trinidad, and then entered Government service as chemist in the British Guiana Department of Agriculture where he served until 1937. In that year he joined Booker Bros. McConnell & Co. Ltd. as a consulting chemist and he was appointed a local director in 1946, becoming chairman of Bookers Sugar Estates Ltd. in 1951. In 1961 he was appointed to the London board of Bookers, retiring in 1967. In 1959 he was honoured with the C.B.E. for public service in Guyana. He was active in international affairs concerning the sugar industry and in 1948 was a member of the Economic Commission to Mauritius. Since 1959 he was the U.K. regional vice-chairman of the I.S.S.C.T. and has been active in promotion of membership of the 14th Congress currently in progress in New Orleans. In addition he was a founder member of the panel of judges for the C. W. Murray Award.

* * *

Sugar derivative for tooth decay reduction.—The Colonial Sugar Refining Co. Ltd. is to manufacture calcium sucrose phosphate at a new plant and to market it under the name "Anticay". This material, a white, neutral tasting, free-flowing amorphous powder, has no noticeable effect on the taste, texture or appearance of foods to which it is added and it has been approved by the National Health and Medical Research Council of Australia for use as a food additive. It has been found to strengthen teeth and to reduce caries, and applications for its use in foods have been filed in the UK and USA. A booklet describing "Anticay" is available from The Manager, Colonial Sugar Refining Co. Ltd., 1–7 O'Connell St., Sydney, N.S.W. 2000, Australia.

* * *

New Venezuelan sugar journal.—*Azúcar y Productividad* is a new sugar periodical published by C.V.F. Centrales Azucareros C.A. in Venezuela, the first issue being dated September 1971. It includes as principal articles the first part of a study on the development of sugar production in the dry savanna area of Ureña, a paper (reprinted from the *International Sugar Journal*) on the effects of mechanical cane loading on factory yields, analysis of sugar cane productivity (reprinted from *Turrialba*), and a comparative survey of some of the principal cane diffusion systems.

* * *

Cane payment in Trinidad[1].—A new formula for payment for cane is to be introduced in 1972 and will affect 10,000 farmers. The formula has been agreed between the farmers' association (T.I.C.F.A.) and the Sugar Manufacturers' Association and will be based on a percentage split in revenue, the farmers being paid according to the sucrose content of their cane. Transport costing is to be organized according to specified factory or two-factory areas, and there is entrenched provision for periodical reviews (in contrast to the previous formula which had not been changed since 1946).

* * *

New Thailand sugar factories.—Two new sugar factories are to be in operation for the 1971/72 crop in Thailand. The first, with a capacity of 6000 t.c.d., is the New Krung Thai factory of the Kwang Soon Lee Sugar Group and its equipment will include five 1000-kg Buckau-Wolf centrifugals. The second factory, Karnchanaburi sugar factory, will crush 4000 tons of cane per day and belongs to the Thai Roong Ruang Sugar Group.

Pakistan ban on sugar exports[3].—According to a US Dept. of Agriculture report, the Government of Pakistan has banned export of sugar during the fiscal year 1972 in an effort to counter the abnormal rise in prices of the past few weeks. Sugar was exported in 1970 and 1971 fiscal years and enquiries were made as to the possibility of an allotment to Pakistan under the US Sugar Act. Production in 1971 has been estimated at 511,000 metric tons, compared with 612,000 tons in 1970; 100,000 tons of the 1970 sugar was exported, the last in December 1970. Production in 1971 should be sufficient to cover domestic requirements and to build up the required stocks of about 70,000 tons.

* * *

British Honduras sugar production 1970/71[4].—The 1970/71 sugar crop in British Honduras closed in July 1971 with an outturn of 64,851 tons of sugar produced from 632,629 tons of cane. The crop was not as large as that of 1969/70 (66,793 tons of sugar produced from 676,176 tons of cane), mainly owing to froghopper damage in all areas, but it was the second highest in the country's history. Of the total, 35,923 tons were manufactured at Corozal factory and 28,928 tons at Tower Hill.

* * *

Bagasse board factory in South Africa[5].—A factory costing 5 million Rand is under construction at Amatikulu for Huletts Corporation and includes storage capacity for 12,000 metric tons of briquetted bagasse which will ensure continuity of production during the three months of the year when the sugar factory is closed. The briquettes will be made from fresh bagasse immediately after flash-drying with flue gases to 15% moisture content, thus eliminating the danger of fermentation. Huletts also own the Ngoye Paper Mill at Felixton, where bagasse is also the main raw material, and is expanding production from 33,000 to 65,000 metric tons per year.

* * *

New sugar factory for Malaysia[6].—Japan's Hitachi Shipbuilding and Engineering Company announced that it has won a Malaysian order for a sugar factory with a crushing capacity of 2000 t.c.d. The plant, worth US $9,700,000, will be constructed in Kangar, Perlis, by early 1973 for the Kiland Gula Felda Perlis. Hitachi obtained the order in an international tender held by the Malaysian firm last year. It is the 10th plant to be exported by Hitachi in Asia; it has built 2 in Burma, 5 in the Philippines, and 2 in South Vietnam.

* * *

Trinidad sugar crop, 1970/71[7].—Total sugar production in the 1970/71 crop in Trinidad amounted to 216,501 long tons, which represents a drop of 21,721 tons compared with 1969/70. The main reason for the disappointing output was the unusually wet weather experienced during the harvesting season, which resulted in a very low juice quality. Cane crushed by the factories amounted to 2,568,940 long tons, of which estates supplied 1,571,277 tons or 61·2% and farmers 997,663 tons or 38·8%. The farmers' tonnage represents a record in the history of the industry and exceeds by 116,236 tons the previous record in 1961 of 881,427 tons.

* * *

Queensland bagasse pulp study[8].—Australian officials have visited the New York office of Grace & Company to discuss the establishment of a bagasse paper pulp industry in Queensland. A feasibility study made by the Department of Industrial Development in conjunction with the Federal Dept. of Trade and National Development, the C.S.I.R.O., the Australian Sugar Producers' Association and the Bureau of Sugar Experiment Stations, has been completed at a cost of $A100,000. The study considered the making of pulp from bagasse and took into account the area from Bundaberg to Cairns where there is a concentration of sugar mills[2].

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[1] *The Cane Farmer*, 1971, 211.
[2] *Zeitsch. Zuckerind.*, 1971, **96**, 408.
[3] F. O. Licht, *International Sugar Rpt.*, 1971, **103**, (21), 8.
[4] *The Cane Farmer*, 1971, 232.
[5] *S. African Sugar J.*, 1971, **55**, 369.
[6] *Reuter's Sugar Rpt.*, 7th June 1971.
[7] F. O. Licht, *International Sugar Rpt.*, 1971, **103**, (22), 8.
[8] *Queensland Newsletter*, 2nd September 1971.
[2] See also *I.S.J.*, 1971, **73**, 224.

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Printed by JOHN ROBERTS & SONS, Salford, Manchester; and published by the Proprietors, THE INTERNATIONAL SUGAR JOURNAL LTD., at 23a Easton Street, High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.

PRINTED IN GREAT BRITAIN.