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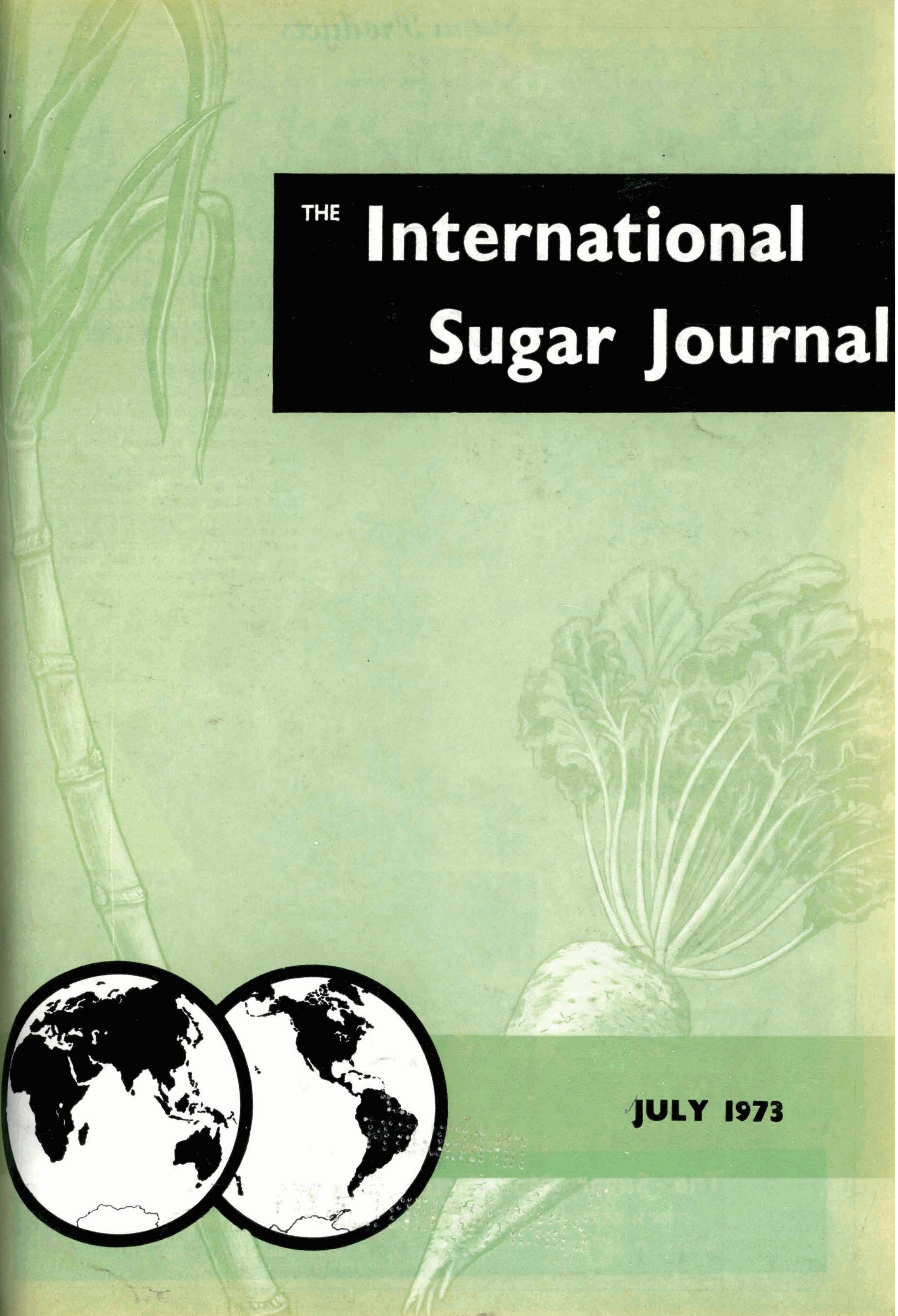

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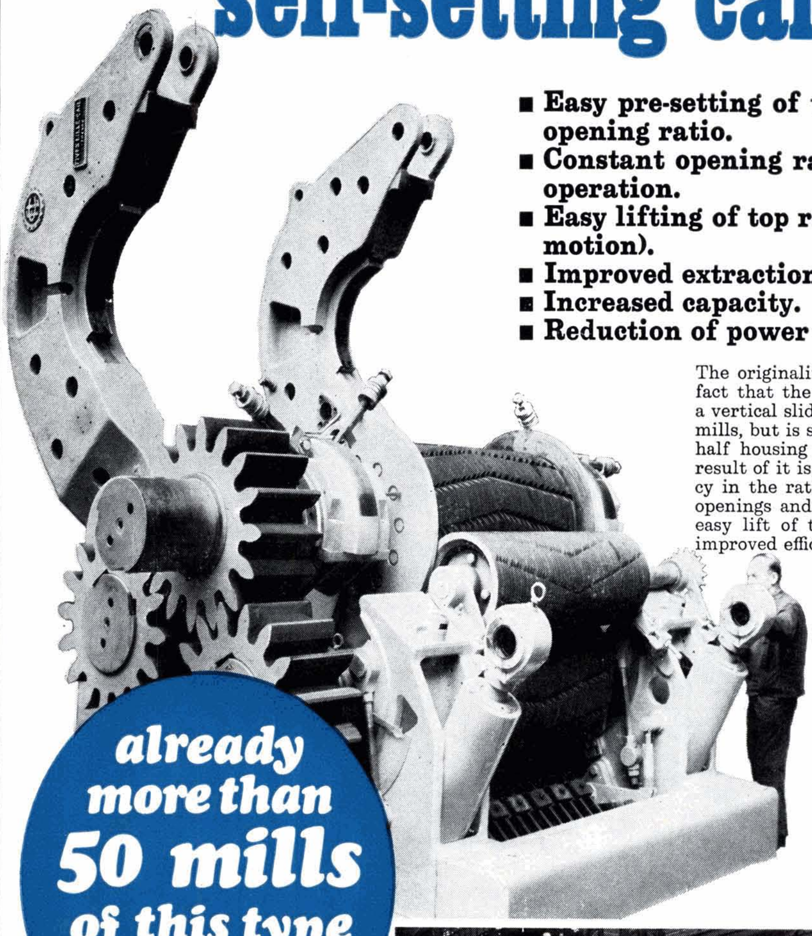

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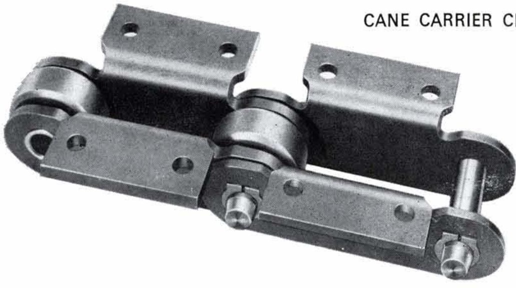

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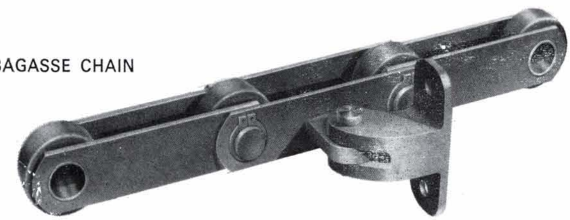

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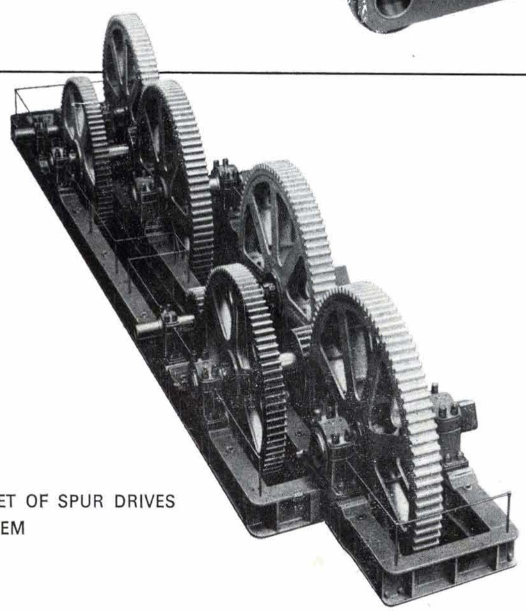

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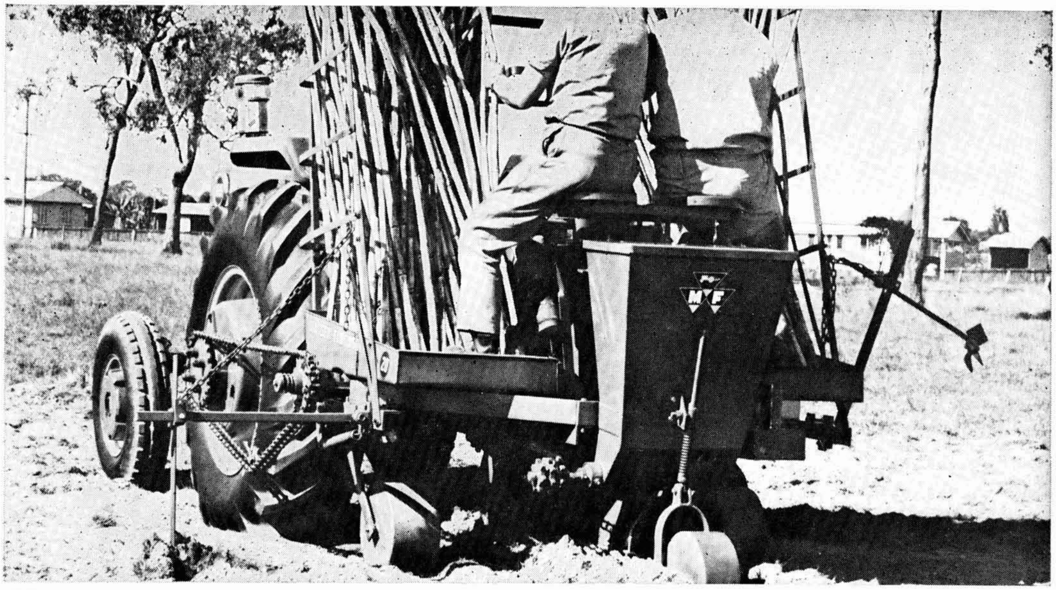

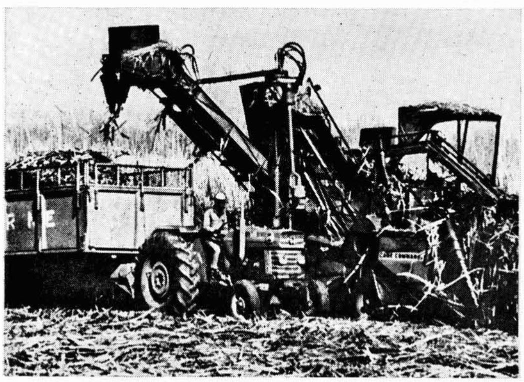

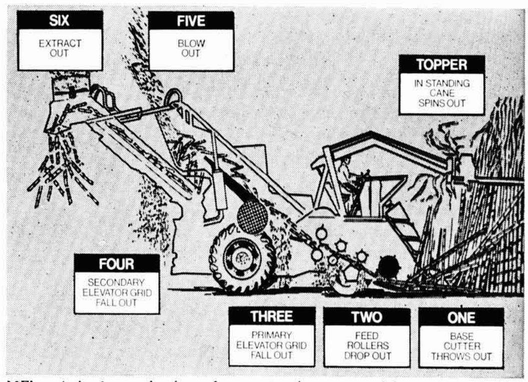


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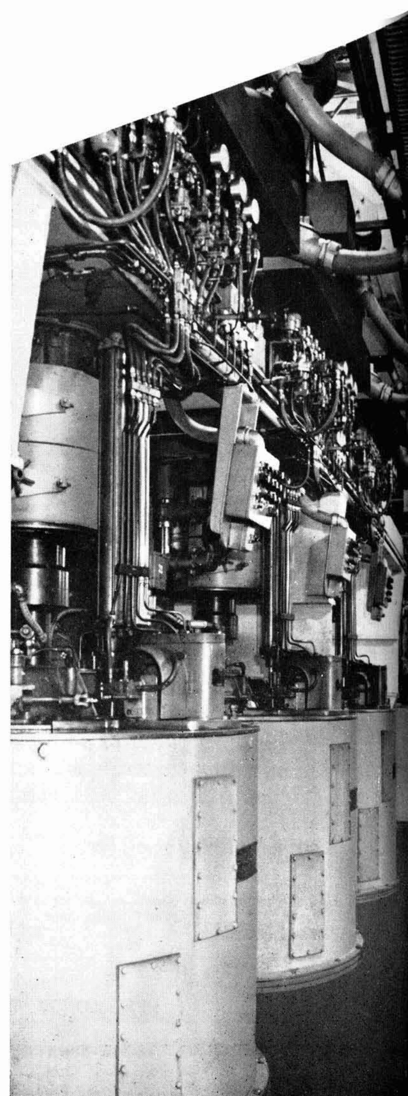

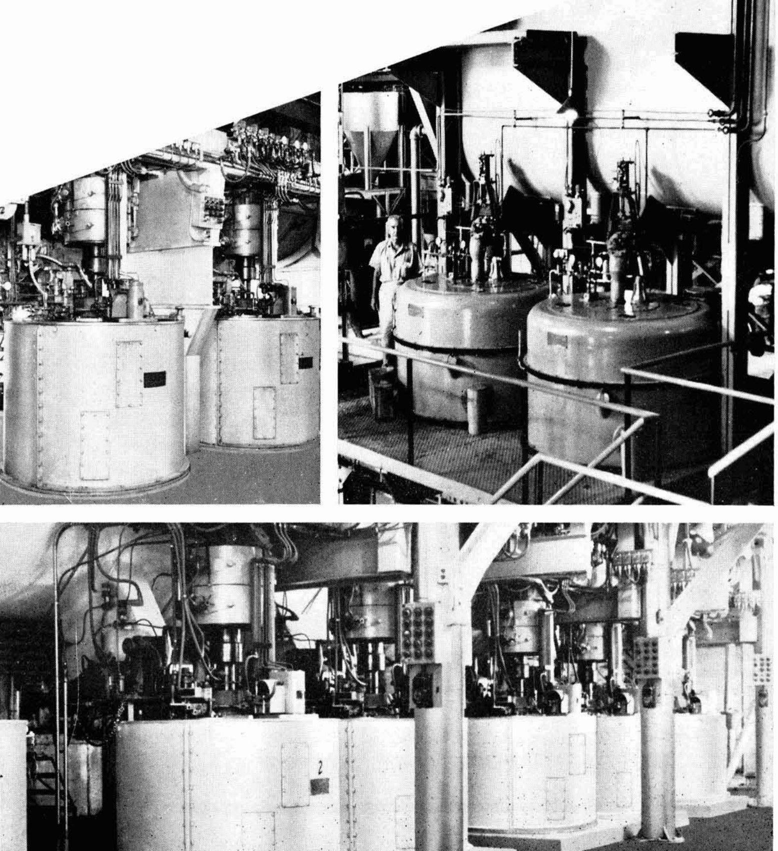

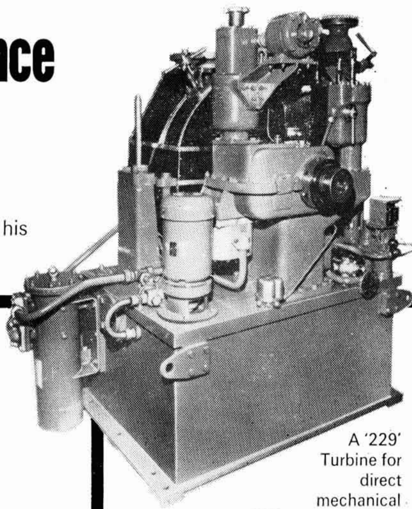

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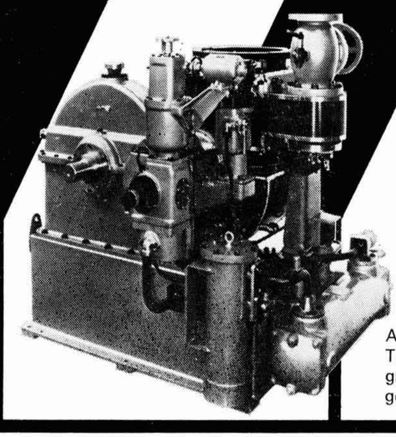

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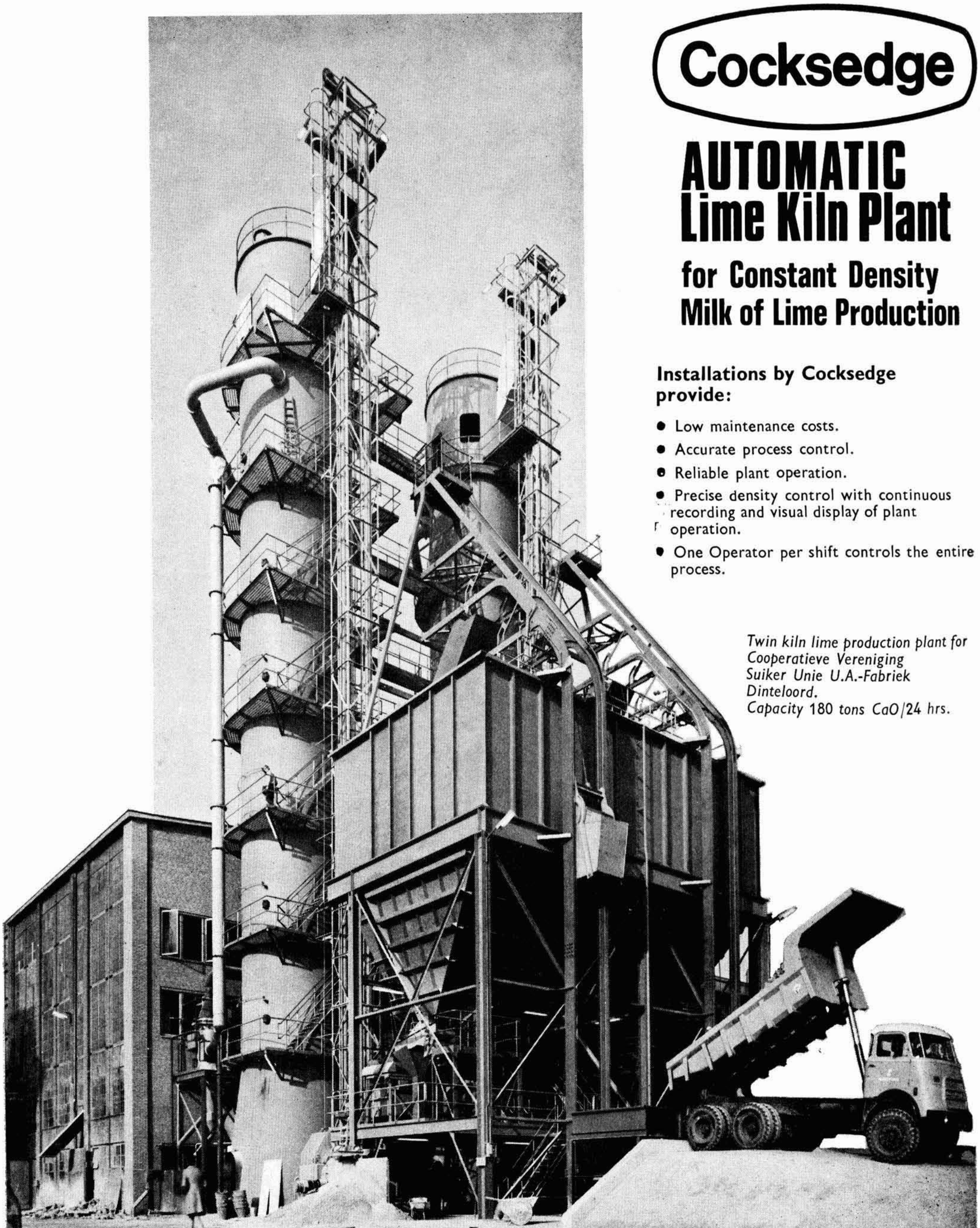

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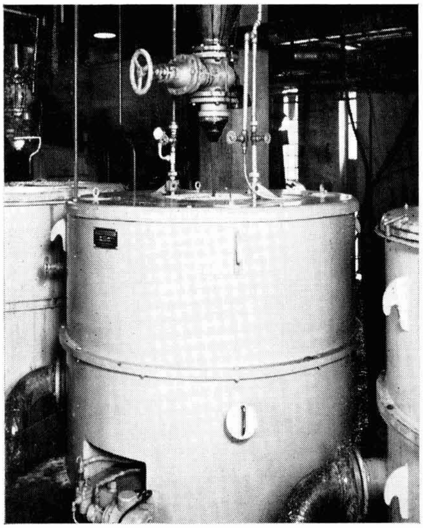

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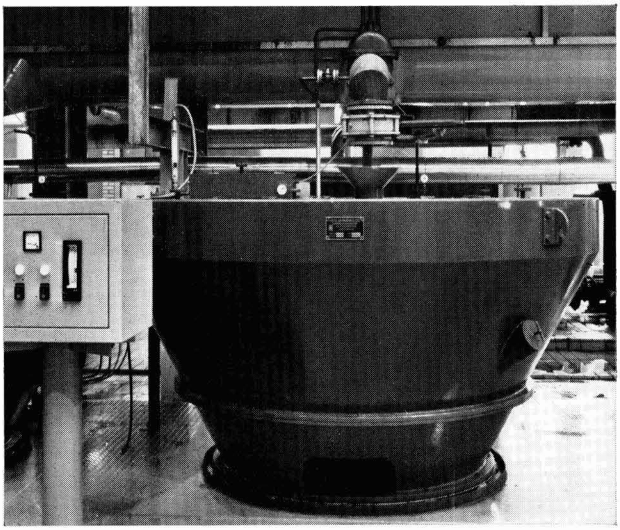

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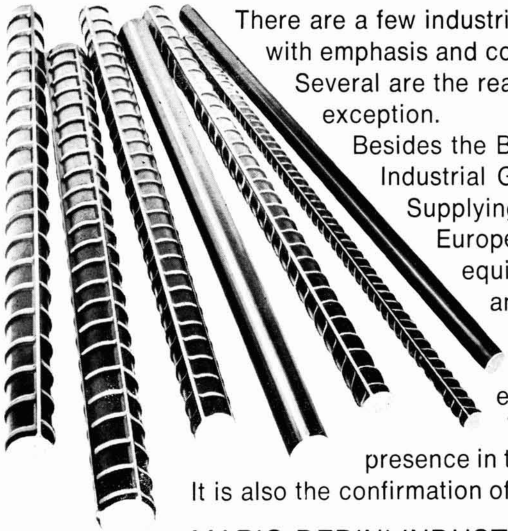

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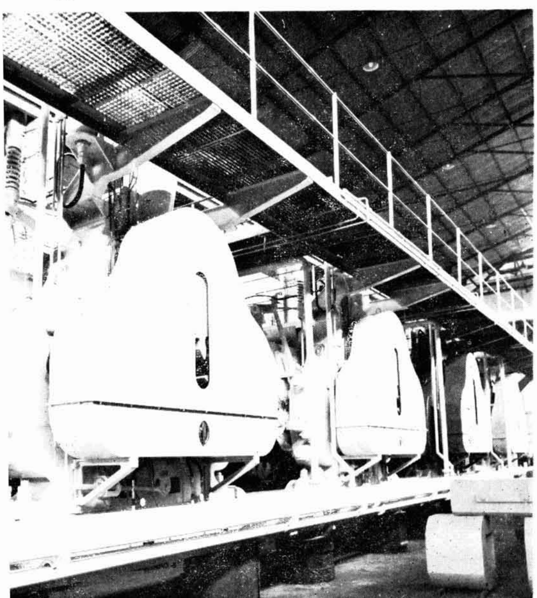

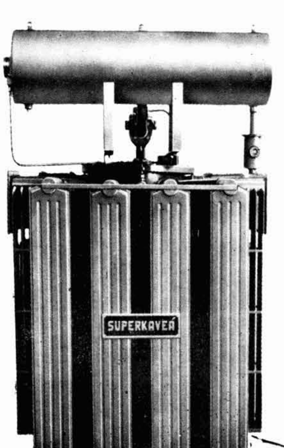


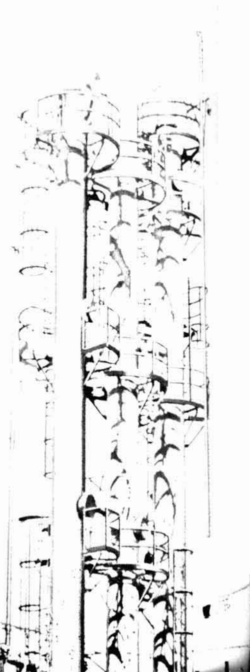

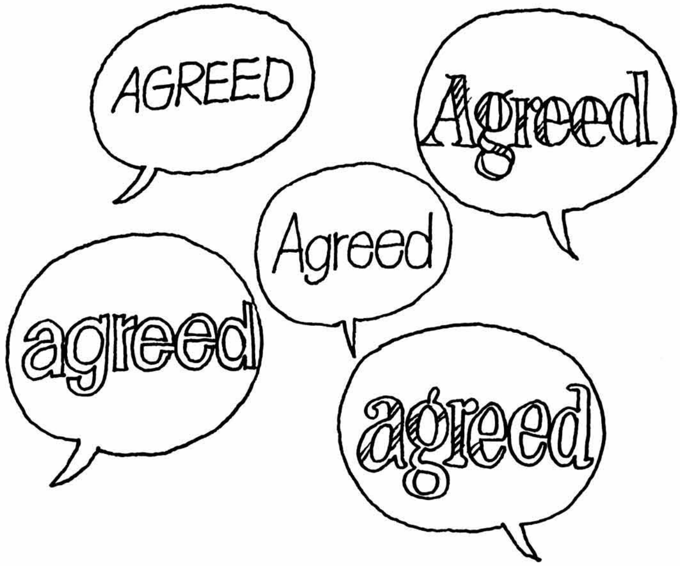
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# International Sugar Journal

*July 1973*

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# SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

**Phytotoxicité relative des esters herbicides 2,4-D/ioxynil.** B. M. SAVORY. *p.* 195–199

On rend compte d'essais entrepris en vue d'établir si une combinaison d'esters 2,4-D avec un ester ioxynil, utilisée pour le contrôle de mauvaises herbes dans les champs de canne, augmentait l'effet phytotoxique dû à la volatilisation ou au courant de vapeurs sur les cultures voisines. Les esters peu volatils testés ne causèrent qu'un dommage léger et passager à des plants de tomates cultivés en pots, tandis que l'ester éthylique hautement volatil causait un dommage plus important dont l'étendue augmentait avec les doses utilisées. Cependant, les calculs de la dose maximale utilisée et les références à la littérature concernant les quantités de vapeurs de 2,4-D présentes dans l'air ont montré que le risque de dommage causé par les vapeurs des combinaisons des esters à des cultures sensibles voisines de champs de canne était négligeable.

* * *

**Maladie de pousses herbeuses en Inde.** S. S. SANDHU, R. S. RAM et R. S. KANWAR. *p.* 200–201

On discute des recherches effectuées au Punjab sur le contrôle de la maladie de pousses herbeuses. Alors que le traitement à l'eau chaude de graines de canne ne donnait pas lieu à un contrôle complet, le traitement à l'air chaud s'est révélé être d'une efficacité totale sur les deux variétés testées et a augmenté les rendements de façon considérable. Un programme de contrôle est mis sur pied.

* * *

**L'activité du noir animal. Ière Partie. L'indice de performance.** J. C. ABRAM, R. M. MORTON et S. G. MULLER. *p.* 201–203

En se basant sur des analyses de noir animal s'étendant sur une période de 2 ans, on a développé une formule simple permettant d'évaluer l'efficacité du noir (élimination de la coloration et des cendres de liqueurs sucrées) en termes de trois propriétés physico-chimiques fondamentales: (i) l'étendue de la surface totale aisément accessible, (ii) la dispersion du carbone, c.-à-d. la surface de carbone présente par g de carbone et (iii) le DH, qui est la mesure de la quantité de calcium pouvant être éluée du noir dans l'eau et qui est directement reliée à la capacité de la surface d'hydroxyapatite pouvant adsorber les ions $Ca^{++}$.

---

**Relative Phytotoxizität von Herbiziden auf 2,4-D-Ester/Ioxynilester-Basis.** B. M. SAVORY. *S.* 195–199

Es werden Versuche beschrieben, welche dazu dienen sollten festzustellen, ob die Kombination von 2,4-D-Estern mit einem Ioxynilester zur Bekämpfung von Unkraut auf Zuckerrohrfeldern den durch die Flüchtigkeit und die Abdrift der Dämpfe auf benachbarte Felder bedingten phytotoxischen Effekt steigert. Die untersuchten wenig flüchtigen Ester riefen nur geringe und vorübergehende Schädigungen bei im Topf gezogenen Tomatenpflanzen hervor, während der hochflüchtige Aethylester grössere Schädigungen verursachte, die mit steigender Dosierung zunahmen. Jedoch ergaben die Berechnung der maximal angewandten Dosis und Literaturrecherchen über die in der Luft enthaltenen Mengen an 2,4-D-Dämpfen, dass die Gefahr zu vernachlässigen ist, dass durch die Dämpfe der Esterkombinationen empfindliche, den Zuckerrohrfeldern benachbarte Bestände geschädigt werden.

* * *

**"Grassy shoot"-Krankheit in Indien.** S. S. SANDHU, R. S. RAM und R. S. KANWAR. *S.* 200–201

Es werden Untersuchungen über die Bekämpfung der "Grassy shoot"-Krankheit im Punjab diskutiert. Während eine Behandlung des Rohrsamens mit heissem Wasser eine vollständige Bekämpfung nicht ermöglichte, war die Behandlung mit heisser Luft bei beiden untersuchten Rohrvarietäten voll wirksam und erhöhte den Ertrag wesentlich. Ein Bekämpfungsprogramm wird beschrieben.

* * *

**Die Aktivität von Knochenkohle. Teil I. Der Leistungsindex.** J. C. ABRAM, R. M. MORTON und S. G. MULLER. *S.* 201–203

Aus Knochenkohleanalysen, die zwei Jahre lang durchgeführt wurden, konnte eine einfache Formel zur Ermittlung der Kohleleistung (Entfernung von Farbe und Asche aus Zuckerklären) abgeleitet werden, in der als Faktoren drei grundlegende physikalische Eigenschaften enthalten sind: (i) die sofort zur Verfügung stehende Oberfläche, (ii) der Kohlenstoff-Dispersitätsgrad, d.h. die im Gramm Kohlenstoff vorhandene Kohlenstofffläche, und (iii) DH, was ein Mass für die von der Kohle in Wasser eluierbare Calciummenge ist und direkt der Kapazität der Hydroxyapatitoberfläche für die Adsorption der Calciumionen proportional ist.

---

**Fitotoxicidad relativa de hierbicidas que constan de ésteres de 2,4-D e ioxynil.** B. M. SAVORY. *Pág.* 195–199

Se recuerdan ensayos con el fin de establecer si la combinación de ésteres de 2,4-D con un éster de ioxynil para control químico de malas hierbas en campos cañeros crece el efecto fitotóxico en cosechas adyacentes, causado por volatilización o deriva de vapor. Los ésteres de baja volatilidad causaron daño solamente pequeño y transitorio a tomates plantado en tiestos, mientras el éster etílico, de gran volatilidad, causó daño más importante, la severidad creciendo con dosis. Sin embargo, calculaciones del dosis máximo usado y referencia a la literatura sobre cantidades del vapor de 2,4-D en el aire demuestran que es insignificante el peligro de daño por el vapor de las combinaciones de ésteres a cosechas sensibles en campos adyacentes a la caña.

* * *

**Mata zacatosa en la India.** S. S. SANDHU, R. S. RAM y R. S. KANWAR. *Pág.* 200–201

Investigaciones sobre control de mata zacatosa en el Punjab se discuten. Mientras tratamiento de estacas con agua caliente no ha dado control completo, tratamiento con aire caliente estuvó completamente eficaz con ambos variedades sujeto a los ensayos y rendimientos crecieron notablemente. Una programa de control se expone.

* * *

**El actividad de carbón animal. Parte I. El indice de cumplimiento.** J. C. ABRAM, R. M. MORTON y S. G. MULLER. *Pág.* 201–203

De análisises de carbones animales en un período de dos años, se ha derivado una fórmula sencilla para asesar la eficiencia del carbón (eliminación de color y cenizas de licores de azúcar) en términos de tres propiedades físico-químico básico: (i) el área superficial facilmente accesible, (ii) la dispersidad del carbón, es decir, el área de carbón elemental presente por gramo de carbón elemental, y (iii) DH, que es una medida de la cantidad de calcio que puede eluirse del carbón animal en agua y que es relatado directamente a la capacidad del superficie de la hidroxyapatita para adsorber iones de calcio.

THE

# INTERNATIONAL SUGAR JOURNAL

VOL. LXXV | JULY 1973 | No. 895

# Notes & Comments

### International Sugar Conference

The first part of the United Nations Sugar Conference was opened on the 7th May in Geneva by Sr. MANUEL PÉREZ GUERRERO, Secretary-General of UNCTAD, and it continued to the 30th May. A second part is to take place in September for settling details of a new International Sugar Agreement.

The meetings were attended by representatives of 89 governments, of the EEC, of UN agencies and of the Afro-Malagasy Sugar Agreement. Mr. ERNEST JONES-PARRY, Executive Director of the International Sugar Organization, was elected Chairman of the Conference and Sr. RAÚL LÉON TORRAS, Chairman of the International Sugar Council, was elected Conference Vice-Chairman.

Much of the beginning of the Conference was taken up with statements made by the representatives before discussion could begin of the draft document prepared by the ISO Secretariat as a basis for a new Agreement. The latter omitted details of price levels and quotas which will have to be settled at the September meetings, although proposals were made by speakers concerning price changes necessary to take into account parity variations since the 1968 negotiations.

The FAO representative pointed out that to give the same purchasing power as the 3·25–5·25 cents/lb price range of the 1968 Agreement, that of a new Agreement would have to be some 4·40 to 7·00 cents/lb. At the time of the 1968 negotiations, however, sugar prices had been depressed for four years and it might be more appropriate to relate the new prices to those of the 1953 agreement which would establish a new price range of 5·75 to 7·70 cents/lb.

The Cuban delegate called for purchase commitments under which importing countries would be obliged to buy when the price fell below 5 cents/lb; he also called for a price range of 6 to 9 cents/lb with a Supply Commitment Price of 11 cents/lb, and other exporting countries have been quoted as regarding these levels as equitable and remunerative—characteristics necessary to provide the developing countries with stability of their markets and to provide adequate assurance for orderly development of production and avoidance of excessive increases.

The Japanese delegate, representing a major importing member of the Agreement, recommended care in adjusting the existing Agreement to avoid over-stimulating production in developed countries or curbing consumption in importing countries. The Canadian delegate, on the other hand, criticized the draft document for its favouring of exporting countries.

A press conference was held after the meetings by Mr. JONES-PARRY; he said that the Conference had first to consider whether a new Agreement was necessary. The EEC delegate had expressed the Commission's view that it was not timely to negotiate a new agreement since the EEC's own future sugar arrangements had not yet been worked out and neither was it possible to estimate developments under the US Sugar Act or to know what was the future sugar policy of the USSR.

Having regard to the plans for expansion of sugar industries, however, and the probability that weather conditions would not again cause such damage to the output of important producers as had been recently experienced, it was felt that sooner rather than later a balanced pattern of supply and demand would be restored. This in turn would lead to a fall in prices in the world market. Accordingly, to prevent a recurrence of disorderly market conditions there was now an overwhelming desire on the part of delegates to establish a new ISA. There was no question but that the great majority of members were confident that the simple extension of the present Agreement was not a practicable possibility. The Conference also expressed the hope that the EEC would participate actively in the September session with a view to becoming a member of the Agreement.

C. Czarnikow Ltd.[1] note that a new Agreement will have to differ from the present ISA in some important aspects. Basic export tonnages will need to be changed and the indicative price levels of the Agreement will have to be reconsidered. Meanwhile certain changes

[1] *Sugar Review*, 1973, (1129), 95.

are needed in the pattern of rights and obligations of importers and exporters. On the other hand there has been acceptance that the present regulations which allow for special arrangements must be continued in a new Agreement.

No decisions of a fundamental nature were made at the Conference but working groups have succeeded in identifying the main problems though for the time being they have done little more than explore them.

The session was noteworthy for its friendly atmosphere. Considerable goodwill exists which would be most valuable in the informal discussions to be held before the 10th September when the second session of the Conference is convened.

It would be possible to draw up an International Sugar Agreement without the participation of the EEC. Indeed, the 1968 Agreement has functioned satisfactorily without its adherence. But now that the Community has been extended to include three new members, one of which is a key member in another regional trading group, the problems of an Agreement to which it did not adhere would be very much more complex. It may be hoped, therefore, that before September, some method will be evolved which will enable the EEC to join with other countries in arrangements for the orderly marketing of sugar, even if its own internal arrangements have still not been finalized.

* * *

### World raw sugar price

The tightness of raw sugar supplies to the world market during the first half of 1973 has kept prices high, the lowest London Daily price having been £87 per ton and the level usually above £90. During May, however, there were rumours of large purchases by Mainland China of up to 800,000 tons and near the end of the month sales were confirmed of 240,000 tons by Brazil and 50,000 tons by Australia as well as other sales giving in total 400,000 tons. This affected what had been an effectively balanced situation and the price rose rapidly, to reach the level of £105 per ton (the peak level of January 1973 which was a nine-year high) on the 29th May. Subsequently the price slipped and at the time of writing is £94 per ton.

* * *

### US sugar supply quota, 1973

On the 27th April the US Department of Agriculture announced a shortfall of 50,000 tons against the quota for Puerto Rico and this was reallocated among Western Hemisphere producers. On the 25th May a further deficit of 20,000 tons was declared in the Puerto Rico quota and deficits of 100,232 tons for the West Indies, 15,889 tons for Panama and 12,259 tons for Honduras. The Department has also made adjustments to quotas following a recalculation of an increase awarded to Hawaii in February; the overall effect is to increase Western Hemisphere countries' quotas and reduce quotas of holders outside this grouping. The individual changes are tabulated eleswhere in this issue.

* * *

### USSR sugar statistics

Calendar year statistics for the Soviet Union have been published by the International Sugar Organization[1] and appear elsewhere in this issue. Poor crops in two successive campaigns, coupled with reduced supplies from Cuba, have led to a dramatic change whereby, from being a re-exporter of sugar (with an ISA quota of over a million tons) the USSR has needed to call on the world market for over 600,000 tons, as well as imports of over 210,000 tons from East European countries.

C. Czarnikow Ltd.[2] write: "Looking ahead into the current year a similar pattern of trade in sugar can be expected. Final production figures for 1972/73 have not yet been released but our own estimate stands at eight million metric tons on a raw value basis. Accurate consumption figures are likewise difficult to come by but most observers place the total anticipated offtake for this year in excess of 10·5 million tons, raw value. Already, purchases from the world market for shipment in 1973 are thought to total between 800,000 and one million tons, which leave a balance of at least 1·5 million tons to be met by traditional suppliers. In effect this means Cuba and, given a crop of five million tons, this quantity should not prove impossible to deliver especially as for the past nine months Cuba has been a member of the Comecon group. Recent statements from the official news agency in Havana have not been optimistic, however, and much of the Soviet situation for the balance of this year will depend on final output in Cuba for 1972/73 and production prospects in the USSR for 1973/74".

* * *

**The late Dr. H. H. Dodds.**—Dr. H. H. DODDS, a pioneer of sugar research in South Africa, died in April at the age of 88. After graduation in 1906 he obtained his M.Sc. at Manchester University and joined the Kynoch explosives company in Co. Wicklow, Eire, as a supervisory chemist. After two years he went to South Africa for the same company as a supervisor. With the advent of war in 1914 came increased production for munitions and also the supply of fertilizers including those to cane farmers; it was from this time that his contact with the sugar industry stemmed. After the war, Kynoch reduced their activities and asked their permanent staff to try for alternative employment; DODDS went to Louisiana and took a degree in sugar technology at L.S.U., meanwhile studying the agricultural side of sugar production. After leaving the University he worked for a few years at different field and factory jobs in Cuba and US sugar factories. At this time, Uba canes, which had been the standby of Natal farmers for 40 years, were beginning to suffer from streak disease, with reduced yields. The South African Sugar Association decided to start an experiment station to find the remedy for streak and DODDS was asked to organize and start the Station which he did in 1924, choosing Mount Edgecombe as its site. He remained Director of the Station until 1950 when he retired, but subsequently acted as a consultant to sugar producers in Rhodesia and Portuguese East Africa, among other territories. In 1926 he helped to found the South African Sugar Technologists' Association of which he became Patron in 1965. In 1944 he was awarded an honorary D.Sc. of the University of South Africa in recognition of his services to the sugar industry.

[1] *Stat. Bull*, 1973, **32**, (3), 107–109.
[2] *Sugar Review*, 1973, (1124), 73.

# Relative phytotoxicity of 2,4-D ester/ioxynil ester herbicides

By B. M. SAVORY, M.A., Ph.D.
(May & Baker Ltd.)

*Introduction*

ESTERS of 2,4-dichlorophenoxyacetic acid (2,4-D) have been included in formulations which have been used successfully for the control of numerous weed species in commercial crops including sugar cane. There has been a certain amount of resistance to use of such ester formulations in cane countries as the result of damage to adjacent crops by drifting of the herbicide vapour; this hazard has been recognized for more than 20 years[1]. It is generally accepted that *droplet* drift is largely a function of droplet size and wind speed and will be similar for all 2,4-D formulations under similar spraying conditions[2].

*Vapour* drift hazards, however, vary very significantly according to the formulation used; amine salts and acid emulsions are non-volatile and considered to be completely safe[1,3] although under hot dry conditions they have been found to cause delayed damage to adjacent cotton[4]. Several low-volatile esters (e.g. *iso*-octyl, butoxyethyl) have also been widely used and are quite safe under most spraying conditions, although these become more volatile at ambient temperatures of over 40°C.

Much greater hazard is presented by the high-volatile esters such that, for instance, their use is banned in many parts of the United States. Such esters include those with five or less carbon atoms in the ester chain and it has been suggested[5] that branched-chain esters with up to six carbon atoms should also be included.

The differences in safety arise from the volatility of the esters concerned, an indication of which is given by measurements made[5] of their vapour pressures, in mm Hg at 187°C: ethyl ester 18, *iso*-propyl ester 17, butyl 9·2, *iso*-octyl 3·1 and 2-ethylhexyl ester 2·9. The practical implications of these differences in volatility are shown by measurements made[6] of the amount of different esters in the air during a period of 106 days in Summer. *iso*-Propyl 2,4-D ester was detected on 72 days at an average concentration of 0·13 $\mu g\ m^{-3}$ at one location and for 89 days at an average concentration of 0·28 $\mu g\ m^{-3}$ at another. Corresponding figures for the butyl ester of 2,4-D were 60 days at an average of 0·07 $\mu g\ m^{-3}$ and 69 days at an average of 0·12 $\mu g\ m^{-3}$. The *iso*-octyl ester was detected on only 11 days at an average concentration of 0·001 $\mu g\ m^{-3}$ and on 5 days at an average of 0·007 $\mu g\ m^{-3}$ for the two locations and thus clearly presents a very much smaller danger to growing crops than the high-volatile esters.

The relative safety or hazard involved in the use of 2,4-D esters combined with other herbicides (apart from 2,4,5-T) does not appear to have been studied although a mixture of the *iso*-octyl ester with ioxynil octanoate is widely used in sugar cane in the Caribbean and other areas.

The present work was carried out to examine the effect of the combination of the two herbicides on the volatility of either component to test whether the effect of the combination was to produce a greater phytotoxicity hazard for crops adjacent to the cane fields.

*Material and methods*

*Test plants.*—Crops vary in their sensitivity to 2,4-D but HITCHCOCK *et al.*[1] have found the tomato to be suitable for bio-assay of plant damage. Tomato plants (*Lycopersicon esulentum* Mill. var. "Bonny Best") were grown in potting compost, one per 12·7 cm pot. Three replicate plants were used for each treatment. The plants were grown in a glasshouse with minimum temperatures of 21°C during the day and 15·5°C during the night. Supplementary lighting was used to give a 16-hour photoperiod, and the plants were treated when they were 5–6 cm in height, with three developed leaves.

*Chemicals.*—All concentrations quoted in this report refer to phenol equivalent for ioxynil octanoate and acid equivalent for 2,4-D esters. The chemicals were:

| | *Formulation code* | *Active ingredient* |
|---|---|---|
| A | FR 376/1/1 | 50% 2,4-D, as *iso*-octyl ester |
| B | NPH 1330, batch PAFD 824 | 25% ioxynil, as octanoyl ester |
| C | "Actril D", batch WN 241 (commercial product) | 30% 2,4-D as *iso*-octyl ester + 5% ioxynil as octanoyl ester |
| D | "Actril D", ARD 12/47 (experimental formulation) | 60% 2,4-D as iso-octyl ester + 10% ioxynil as octanoyl ester |
| E | FR 376/2/1 | 50% 2,4-D, as 2-ethylhexyl ester |
| F | FR 382/1/1 | 50% 2,4-D, as ethyl ester |

Emulsions were prepared from these formulations by diluting with demineralized water. The treatment concentrations used were 1·0, 0·1 and 0·01% a.i. In the case of the two "Actril D" mixtures, the "active ingredient" was taken to be 2-4,D, and the ioxynil content was ignored.

[1] HITCHCOCK *et al.*: *Contrib. Boyce Thompson Inst.*, 1953, **17**, 243–263.
[2] GROVER *et al.*: *Weed Sci.*, 1972, **20**, 320–324.
[3] BASKIN and WALKER: *Weeds*, 1953, **2**, 280–287.
[4] DAY *et al.*: *Hilgardia*, 1959, **28**, 255–267.
[5] JENSEN and SCHALL: *J. Agric. Food Chem.*, 1966, **14**, 123–126.
[6] ADAMS *et al.*: *Weeds*, 1964, **12**, 280–283.

**Table I. Mean responses of tomato plants to 24 hr exposure to 2,4-D and ioxynil ester vapours**

| Chemical | Dose* (µg a.i.) | Treatment code | Leaf modification (leaves 6 and 7, 11 days after treatment) Score: 0 = leaves normal; 1 = slight modification; 2 = marked modification; 3 = moderately severe modification; 4 = severe modification | Stem bending (24 hours after treatment) Score: 1 = straight; 2 = slight bend; 3 = moderate bend; 4 = severe bend | Stem proliferation (11 days after treatment) Score: 0 = no proliferation; 1 = 25% of stem length proliferated; 2 = 50% ,,; 3 = 75% ,,; 4 = 100% ,, | Increase in height of stems (cm) during: First week after treatment | Second week after treatment† | Fresh weight per plant (g) (25 days after treatment) |
|---|---|---|---|---|---|---|---|---|
| 2,4-D | 10 | A1 | 0 | 1·2 | 0 | 4·4 | 5·83 abc | — |
| *iso*-octyl | 50 | A2 | 0·3 | 1·0 | 0 | 4·0 | 5·67 abc | — |
| ester | 100 | A3 | 0·3 | 1·0 | 0 | 4·5 | 5·17 abc | 63·3 |
| | 500 | A4 | 1·7 | 1·7 | 0 | 4·8 | 5·83 abc | — |
| | 1000 | A5 | 1·3 | 1·7 | 0 | 4·4 | 6·00 abc | — |
| | 5000 | A6 | 1·7 | 1·1 | 0 | 4·5 | 6·00 abc | 65·1 |
| Ioxynil | 10 | B1 | 0 | 1·3 | 0 | 4·4 | 5·83 abc | — |
| octanoate | 50 | B2 | 0 | 1·1 | 0 | 4·3 | 6·00 abc | — |
| | 100 | B3 | 0 | 1·4 | 0 | 4·6 | 5·50 abc | 67·1 |
| | 500 | B4 | 0 | 1·2 | 0 | 4·4 | 5·33 abc | — |
| | 1000 | B5 | 0 | 1·3 | 0 | 5·0 | 6·17 abc | — |
| | 5000 | B6 | 0 | 1·1 | 0 | 4·5 | 5·50 abc | 62·4 |
| "Actril D" | 10 | C1 | 0 | 1·2 | 0 | 5·3 | 5·33 abc | — |
| | 50 | C2 | 0 | 1·1 | 0 | 4·7 | 5·50 abc | — |
| | 100 | C3 | 0 | 1·3 | 0 | 4·9 | 5·83 abc | 71·5 |
| | 500 | C4 | 1·7 | 1·3 | 0 | 4·6 | 6·00 abc | — |
| | 1000 | C5 | 1·3 | 1·6 | 0 | 4·0 | 6·00 abc | — |
| | 5000 | C6 | 2·7 | 1·4 | 0 | 4·5 | 6·00 abc | 55·4 |
| "Actril D" | 10 | D1 | 0 | 1·0 | 0 | 4·9 | 5·50 abc | — |
| (double | 50 | D2 | 0·3 | 1·3 | 0 | 4·2 | 6·00 abc | — |
| strength) | 100 | D3 | 1·0 | 1·3 | 0 | 4·3 | 6·83 a | 73·2 |
| | 500 | D4 | 2·7 | 1·9 | 0 | 4·8 | 6·33 abc | — |
| | 1000 | D5 | 1·7 | 1·4 | 0 | 4·2 | 6·33 abc | — |
| | 5000 | D6 | 2·3 | 1·2 | 0 | 4·8 | 5·33 abc | 66·3 |
| 2,4-D | 10 | E1 | 0 | 1·2 | 0 | 5·2 | 5·00 bc | — |
| ethyl-hexyl | 50 | E2 | 0 | 1·3 | 0 | 4·8 | 6·00 abc | — |
| ester | 100 | E3 | 0·7 | 1·3 | 0 | 4·7 | 5·67 abc | 64·9 |
| | 500 | E4 | 1·0 | 1·6 | 0 | 5·0 | 6·50 abc | — |
| | 1000 | E5 | 1·0 | 1·4 | 0 | 4·6 | 5·67 abc | — |
| | 5000 | E6 | 2·7 | 1·4 | 0 | 4·8 | 5·83 abc | 61·4 |
| 2,4-D ethyl | 10 | F1 | 2·0 | 1·6 | 0 | 5·0 | 5·67 abc | 55·1 |
| ester | 50 | F2 | 3·7 | 2·3 | 0·3 | 4·8 | 5·00 bc | 57·8 |
| | 100 | F3 | 4·0 | 3·1 | 1·3 | 3·8 | 3·33 d | 48·2 |
| | 500 | F4 | leaves 6 and 7 | 3·8 | 4·0 | 0·8 | 0·33 e | 12·3 |
| | 1000 | F5 | failed to | 3·7 | 4·0 | 1·2 | 0·17 e | 10·2 |
| | 5000 | F6 | develop | 3·9 | 4·0 | 0·4 | 0 e | 6·1 |
| Untreated | — | U1 | 0 | 1·3 | 0 | 3·7 | 6·67 ab | — |
| (water | — | U2 | 0 | 1·3 | 0 | 4·9 | 5·83 abc | 66·2 |
| control) | — | U3 | 0 | 1·2 | 0 | 4·2 | 5·83 abc | 78·0 |
| | — | U4 | 0 | 1·4 | 0 | 5·0 | 4·83 c | — |

* See "*Material and methods*" for calculation of dose.
† Duncan's multiple range test: treatments with the same suffix letters are *not* significantly different at 5% probability level.
S.E. treatment means = 0·4986 cm.

Six doses were used:—

1. 0·1 ml of 0·01% emulsion containing 10 µg 2,4-D*
2. 0·5 ml of 0·01% emulsion containing 50 µg 2,4-D
3. 0·1 ml of 0·1% emulsion containing 100 µg 2,4-D
4. 0·5 ml of 0·1% emulsion containing 500 µg 2,4-D
5. 0·1 ml of 1·0% emulsion containing 1000 µg 2,4-D
6. 0·5 ml of 1·0% emulsion containing 5000 µg 2,4-D

* In the case of formulation B, these are amounts of ioxynil

*Application method.*—The required dose of emulsion was delivered by pipette on to a crumpled Whatman No. 1 (9 cm) filter paper placed in a 5 cm glass petri dish (lid or base only). The dish and filter paper were then placed in the bottom of a 5-litre plastic bucket, and a potted tomato plant was quickly placed next to the dish. The buckets had previously been placed inside a polythene bag, and the bag was now folded over twice and secured with paper clips. When sealed, the bags contained approximately 16 litres of air. Four sets of plants (= 12 in all) were similarly "dosed" with 0·5 ml water and acted as untreated controls.

The bagged plants were stood in the glasshouse for 24 hours; the temperature in the bags quickly rose to a maximum of 37°C, and fell during the night to a minimum of 23°C. After 24 hours, the plants were taken outside, the bags and buckets removed and the foliage thoroughly washed. The plants were then returned to the glasshouse until the end of the experiment (25 days).

## *Evaluation of Response*

The responses to exposure to 2,4-D vapour can be graded, in terms of increasing magnitude and severity as follows:

*Slight damage*—modification of developing leaves.

*Moderate damage*—leaf epinasty and stem bending.

*Severe damage*—proliferation of stem tissues, reduction in plant height, weight and leaf numbers.

These responses were evaluated as follows: leaf modification—on leaves 6 and 7, 11 days after treatment—on a score of 0 to 4 (see Table I for details). The modifications ranged from slight loss of colour and leaf area to severe deformation of leaflets and reduction in lamina area, and were most severe on the two leaves assessed. Stem bending was assessed on a score of 1 to 4, 24 hours after treatment. Height increase was measured 7 and 14 days after treatment. Stem proliferation was assessed on a score of 0 to 4, 11 days after treatment. Selected treatments were retained until the onset of flowering (25 days after treatment), and were then cut at ground level and weighed. Photographs of representative plants were taken 14 and 25 days after treatment.

### *Discussion*

The dose range used was selected after consideration of the results of HITCHCOCK *et al.*[1] and a preliminary experiment, which showed that increases in concentration of ester emulsion applied produced less dose response, particularly above 1% a.i., than increases in volume. It was therefore decided to use a combination of tenfold increases in concentration and fivefold increases in volume to achieve a reasonable dose response, which has been presented in terms of μg of 2,4-D acid applied (B treatments—ioxynil phenol), for the sake of simplicity.

The results (Table I and Figs. 1–4) quite clearly demonstrate three points:—

(1) Ioxynil octanoate had no vapour activity on tomato (the same result was obtained with bromoxynil octanoate.) The volatility of both chemicals is very low, which has hampered accurate determination of the vapour pressures, but present indications are that they are of the order of $10^{-6}$ mm Hg at 25°C[7]. Tomato plants at the three-leaf stage are susceptible to ioxynil and bromoxynil esters sprayed on the foliage (LD90's for ioxynil octanoate, bromoxynil octanate and 2,4-D *iso*-octyl ester were all 70 g/ha), so that the lack of response in this experiment must indicate an effective lack of volatility at the doses used.

(2) The mixtures of 2,4-D *iso*-octyl ester with ioxynil ("Actril" formulations) were not significantly more damaging to the test plants than 2,4-D *iso*-octyl or ethyl-hexyl esters alone at the same levels of 2,4-D a.e. The mixtures possibly caused slightly more leaf modification, but there was no sign of any epinasty,

[7] MUGGLETON: *Private Communication.*

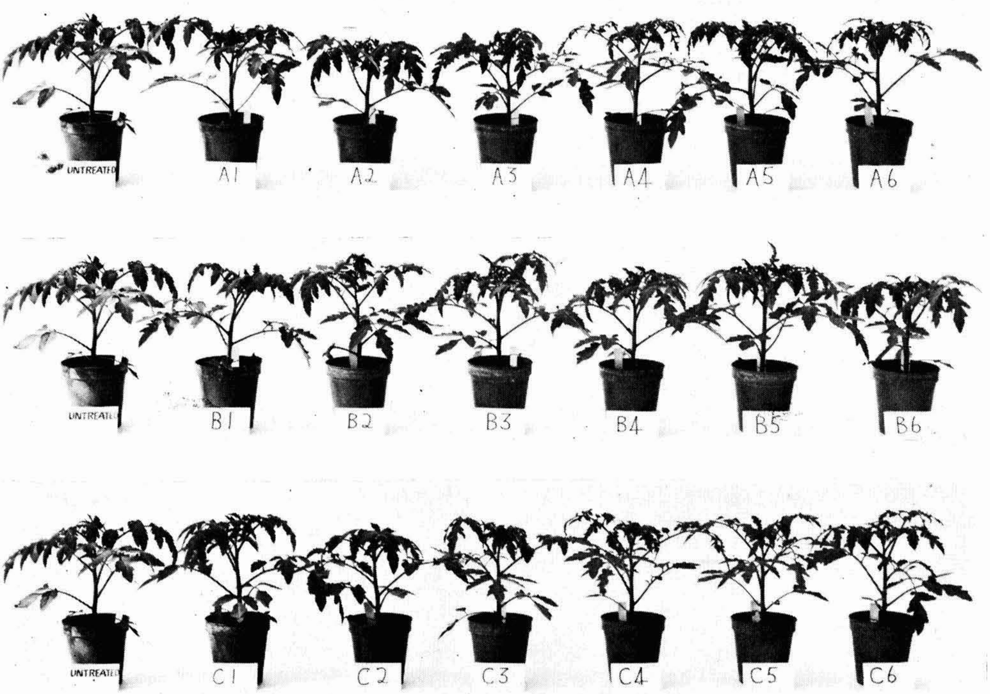



Fig. 1. Test plants photographed 14 days after treatment: Upper row—2,4-D *iso*-octyl ester. Middle row—Ioxynil octanoyl ester. Lower row—"Actril D"


Fig. 2. Test plants photographed 14 days after treatment: Upper row—"Actril D" (double-strength formulation). Middle row—2,4-D 2-ethyl-hexyl ester. Lower row—2,4-D ethyl ester

stem bending or any of the more serious forms of damage. The standard field dose of "Actril D" applied to sugar cane is equivalent to 0·84 kg/ha 2,4-D, compared with 1·5 kg/ha or more where 2,4-D is used alone, so that on balance the mixture is likely to be far less hazardous in the field.

(3) The maximum damage caused by 2,4-D *iso*-octyl ester (alone or with ioxynil octanoate) or 2-ethyl-hexyl ester at a dose of 5000 μg was a moderate degree of leaf modification restricted to leaves in an early stage of development at the time of treatment; subsequent development of leaves and flowers was normal (Fig. 4). By contrast, 2,4-D ethyl ester at 50–100 μg caused severe leaf modification and also stem bending, proliferation and slight stunting, while higher doses completely prevented further development of the plants. Under similar conditions, therefore, the low-volatile esters were about 100 times safer than the high-volatile ester.

The relative safety of low-volatile, compared with high-volatile, esters of 2,4-D has been recognised for many years, as noted in the introduction to this report. But how safe is "relatively safe" in the field? How does the top dose used in this experiment (5000 μg), which caused perceptible though transient damage, relate to field doses?

On an area basis, a standard dose of "Actril D" (2·8 litre/ha) is equivalent to 1,064 μg of 2,4-D a.e. on the surface area of the pots used (127 $cm^2$). On a volume basis, more relevant when vapour is under consideration, 5000 μg in a 16-litre bag is equivalent to a concentration of 312,500 μg $m^{-3}$ air, assuming complete volatilization. Under the conditions of this test, it is unlikely that more than 0·1% of the applied dose of 2,4-D *iso*-octyl or other low-volatile esters, equivalent to a concentration of 312·5 μg $m^{-3}$, was absorbed by the plant; this is nevertheless a very high concentration in relation to field usage. It must therefore be concluded that under most climatic conditions the risk of damage (due to volatilization or vapour drift) to nearby crops of sensitive species from application to sugar cane of the standard dose of "Actril D" or its separate components is infinitesimal.

### *Summary*

The effect of adding ioxynil octanoyl ester to 2,4-D *iso*-octyl ester, as used for weed control in sugar cane, on the physiological volatility of the latter ester was examined by means of a tomato vapour bioassay. Ioxynil ester alone exhibited no vapour activity at doses up to 5000 μg (top dose used), and did not significantly increase the vapour activity of 2,4-D *iso*-octyl ester, in mixtures.

2,4-D *iso*-octyl and 2-ethyl-hexyl esters (low-volatile esters) at 5000 μg doses caused only minor and transient damage to the test plants. 2,4-D ethyl ester (high-volatile ester) caused slightly more severe damage at 50 μg dose, and at 500 μg and higher doses completely prevented further development of the test plants. The low-volatile esters were thus about 100 times less hazardous than the high-volatile ester, under the experimental conditions.

Calculations of the maximum dose used, in relation to field determinations in the literature of quantities of 2,4-D vapour in the air, showed that the risk of vapour damage to sensitive crop species resulting from cane field applications of 2,4-D *iso*-octyl ester/ioxynil octanoate mixtures is infinitesimal.

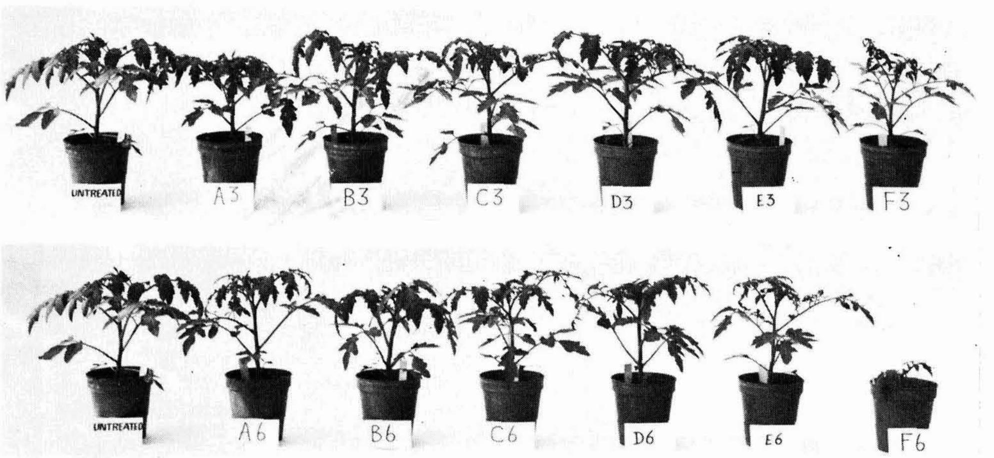



Fig. 3. Test plants photographed 14 days after treatment: Upper row—comparison of the six chemicals in Figs. 1 and 2, all 100 μg dose. Lower row—comparison of the six chemicals in Figs. 1 and 2, all at 5000 μg dose

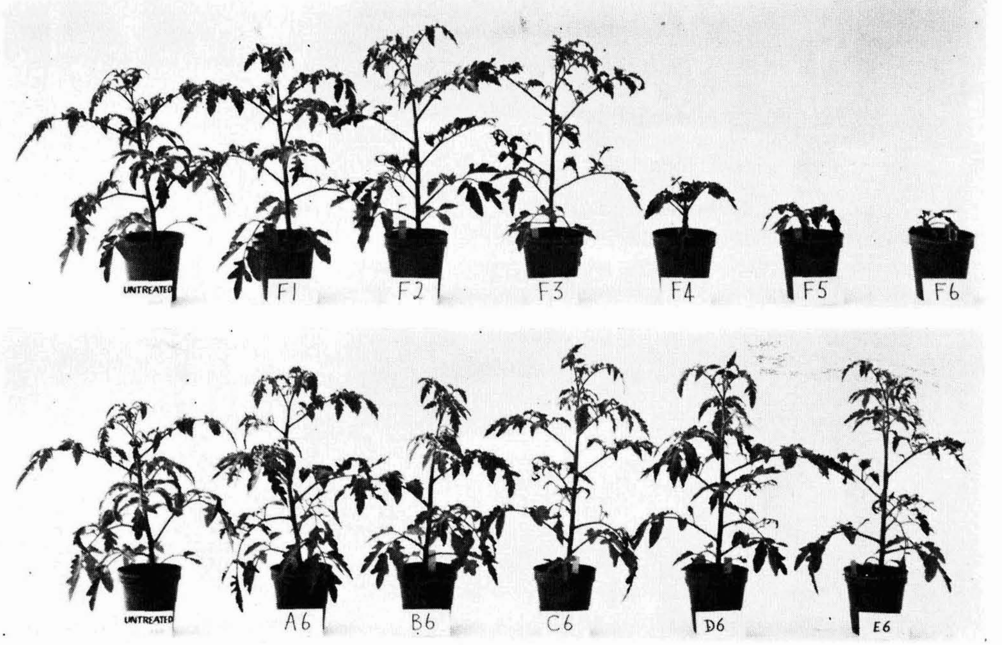



Fig. 4. Test plants photographed 25 days after treatment, all plants in flower except treatments F4, F5 and F6: Upper row—2,4-D ethyl ester. Lower row—comparison of the other five chemicals at 5000 μg dose

# Grassy shoot disease in India

## Studies on the control of grassy shoot in the Punjab

By S. S. SANDHU, R. S. RAM and R. S. KANWAR

(Sugarcane Research Station, Punjab Agricultural University, Jullundur, Punjab, India)

### *Introduction*

THE first record of grassy shoot, a virus disease of sugar cane, in India was made in Maharashtra State in 1949[1], and it was recorded in the Punjab in 1961[2]. Since then the incidence and extent of the disease have continued to increase[3]. SINGH[4] also observed the disease in the Punjab and some other states in a number of important varieties. Apprehending the potentialities of the disease, a regular survey was undertaken in 1967–69 and revealed that the disease was fairly widespread in different districts of Punjab and that all the important varieties were affected.

### *Symptoms, time of appearance and mortality*

Only thin tillers are produced from the base of the diseased plants. Their number increases rapidly, resulting in a crowded bunch. The leaves, which are reduced in size, are also thin and narrow and develop different shades of chlorotic appearance. In some cases, however, chlorosis may not be indicated. As the buds go on throwing out only thin tillers no canes are formed in severely affected plants but where the attack of the disease is light one to two subnormal canes may be formed. When the season has advanced, infection is characterized by the premature sprouting of buds on standing canes, usually giving out slender, chlorotic shoots and/or by the production of abnormally large number of tillers at the base with pale green leaves.

Although the disease could be detected soon after germination, under field conditions at Jullundur the symptoms become pronounced in July with the onset of the monsoon rains resulting in the acceleration of growth. The percentage of diseased plants appearing during different months in the susceptible variety CoJ 46 is given in Table I.

Severely infected stools died in the course of time. Thus 14·6% of CoJ 46 stools showed complete drying, 68·5% did not show any cane formation till harvest and only 16·9% of the affected stools formed 1–3 subnormal canes. Out of the 14·6% stools showing complete drying, 10·5% dried during October, 75% during November and 14·5% in December.

**Table I**

| *Month* | *% diseased plants appearing* |
|---|---|
| July | 39 |
| August | 20 |
| September | 15 |
| October | 12 |
| November | 9 |
| December | 5 |

### *Control*

Studies carried out at the Jullundur Sugarcane Research Station have shown that the disease can be effectively controlled by hot air treatment of seed cane.

The relevant data concerning the trials conducted with CoJ 46, a late maturing approved variety, on the efficacy of treatment of seed cane with hot air[4] at 54°C for 8 hours and hot water[5] at 50°C for 2 hours are presented in Table II.

**Table II**

| *Treatment* | *Germination %* 1969/70 | 1971/72 | *Incidence of GSD (%)* 1969/70 | 1971/72 |
|---|---|---|---|---|
| Untreated | 29·9 | 49·5 | 56·2 | 10·0 |
| Hot air treated | 22·0 | 40·1 | 0·0 | 0·0 |
| Hot water treated | 23·3 | 37·5 | 12·5 | 3·6 |

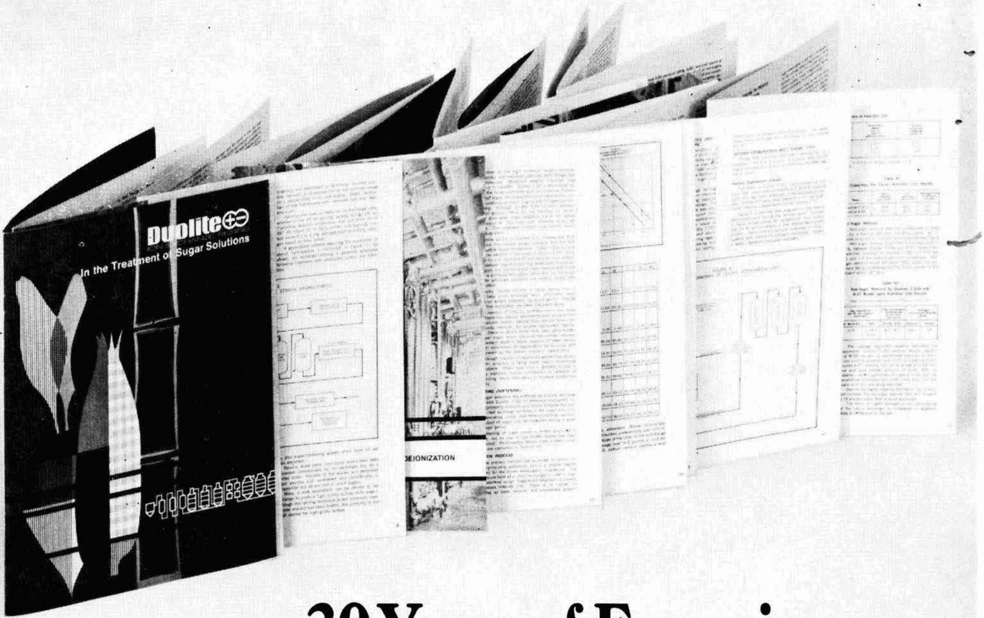
The above data show that whereas the hot air treatment completely eliminated the disease the hot water treatment was not fully effective in as much as 3·6 to 12·5% escapes were noticed in the resultant crop. Both the treatments caused reduction in germination.

The data relating to the beneficial effect of hot air treatment in increasing the yield are set out in Table III.

[1] CHONA: *Indian Phytopath.*, 1958, **11**, 1–9.
[2] KAR and VERMA: *Indian Sugar*, 1961, **11**, 131–133.
[3] SANDHU *et al.*: *J. Research Punjab Agric. Univ.*, 1967, **4**, 533–535.
[4] *Indian Sugar*, 1967, **17**, 181–186.
[5] SRINIVASAN and RAO: *Indian Farming*, 1968, **18**, 25–26.

**Table III**

| | | | *Untreated* | | | *Hot air treated* | | |
|---|---|---|---|---|---|---|---|---|
| *Year* | *Crop* | *Variety* | *Germination, %* | *Incidence of GSD %* | *Ave. wt. of millable canes (kg) per 10 ft row* | *Germination, %* | *Incidence of GSD, %* | *Ave. wt. of millable canes (kg) per 10 ft row* |
| 1968/69 | Plant | CoJ 46 | 71·0 | 86·4 | 8·0 | 45·0 | 0 | 26·0 |
| | | Co 1148 | 50·3 | 65·3 | 13·0 | 45·2 | 0 | 33·0 |
| 1969/70 | Plant | CoJ 46 | 29·9 | 56·2 | 4·0 | 32·0 | 0 | 11·7 |
| | | Co 1148 | 19·2 | 19·2 | 8·3 | 18·5 | 0 | 15·9 |
| 1969/70 | Ratoon | CoJ 46 | — | 89·2 | 6·0 | — | 0 | 20·5 |
| | | Co 1148 | — | 71·4 | 7·0 | — | 0 | 19·5 |


Duolite
In the Treatment of Sugar Solutions
DEIONIZATION

As a result of the control of GSD by hot air treatment, variety CoJ 46 recorded cane yield improvements ranging from 192·5 to 225·0% in plant and 241·6% in ratoon crop. In Co 1148 the increase in yield varied from 91·5 to 153·8% in plant and 176·6% in ratoon cane.

*Seed treatment programme for controlling grassy shoot disease*

The success of cane cultivation is intimately connected with the supply of disease-free seed to the growers. This is now being taken up as a well-knit programme comprising the following steps.

1. The hot air treatment of the nucleus seed of the various improved varieties will be conducted at the main sugar cane research station at Jullundur under the technical supervision of the Pathologist. Such treated seed will be planted at the main research station at Jullundur and at the two sub-stations at Gurdaspur (submontane area) and Kheri (south-east Punjab).

2. The multiplication of the foundation seed will then be taken to the six sugar factory farms in the state.

3. At the third stage the seed grown at the factory farms will be passed on to 20–25 progressive growers for multiplication and distribution amongst the growers for planting in each factory zone.

The above programme of seed cane production will be kept constantly under supervision at all the stages and necessary measures such as roguing and spraying with suitable insecticides adopted to give effective control of the vectors of this disease.

# The activity of bone charcoal

## Part I. The index of performance

By J. C. ABRAM, R. M. MORTON and E. G. MULLER
(Tate & Lyle Refineries Ltd., Plaistow Wharf, London E16 2AG)

*Introduction*

A CONSIDERABLE effort has been directed by the sugar industry to the problems of assessing regeneration efficiency and the activity of char stocks.

Certain tests[1] such as the Lye test, and the *DH* and pH of revivified char have proved to be useful indicators of kilning efficiency, but there remains no simple absolute test for char activity.

It is possible to determine the quality of stocks by comparing their decolorization performance in column tests. These tests, however, are tedious, and the results depend as much on the nature of the liquor used as on the quality of the char. The value of such tests is severely limited.

More recently a series of tests have been established[2] which allow the adsorptive properties of bone char to be examined in depth. These tests, which are outlined in Table I, provide fundamental information about the two basic component surfaces of char, hydroxyapatite and carbon, the availability of these surfaces for adsorption and the nature of the surfaces.

**Table I. Bone char activity tests***

1. Total surface area: measured by the equilibrium adsorption of sodium di-2-ethylhexylsulphosuccinate (OT) from water.
2. Readily accessible surface area: an indication of the amount of surface readily available to colorant molecules is given by the amount of OT adsorbed by 0·5 g char from 10 ml of 10 mM OT at 30°C during ½ hr contact time.
3. Carbon surface area: the amount of carbon surface present, as distinct from the hydroxyapatite surface, can be determined by measuring the equilibrium adsorption of cetyltrimethylammonium bromide (CTAB) from water.
4. Readily accessible carbon surface: the availability of the carbon surface for adsorption is indicated by the amount of CTAB adsorbed by 0·5 g char from 10 ml of 10 mM CTAB at 30°C during 3 hr contact time.
5. Carbon content: expressed as the % carbon present on sample. Normal chars should have carbon contents between 5 and 12%.
6. Carbon dispersity: this is expressed as the area of carbon present in char per gram of carbon, and is calculated from Test 3 ÷ Test 5. Basically this test describes the way in which the carbon has been deposited within the hydroxyapatite lattice[2,3]. The carbon in new char has been deposited as a thin layer and is of high activity. In service, the pores within the bone char structure become blocked with inactive carbon, resulting from the carbonization of adsorbed organic impurities and the dispersity falls.
7. *DH*: this is a measure of the amount of calcium which can be eluted from bone char in water, and is directly related to the capacity of the hydroxyapatite surface to adsorb calcium ions[4]. For a constant hydroxyapatite surface area, the lower the *DH*, the higher the capacity of the char for calcium (ash) and colour. The *DH* is affected by the effectiveness of washing and kilning, and the previous history of the char.
8. pH: the chemical factors which influence the pH of revivified char are complex. Additional information as provided by the other tests is required to enable a meaningful interpretation of the test to be made.
9. Lye test: this test is used to indicate under-burning of char, and as such is useful for controlling the kilning reaction. For maximum effect it should be interpreted in conjunction with a *DH* test.
10. % sulphate.
11. % carbonate.

These last two tests are necessary for accurate interpretation of the previous tests.

[1] (a) *Tech. Rpt. Bone Char Research Project*, 1961, (62); *Rpt. Nat. Bureau Standards* (Washington, D.C.), (7321).
(b) DE WHALLEY: "ICUMSA Methods of Sugar Analysis" (Elsevier, Amsterdam). 1964.

[2] BENNETT and ABRAM: *Sugar Industry Tech. Inc.*, 1970, **29**, 88–101.

12. Liquor decolorization, bottle shaking test. This test gives a reasonable indication of char activity and a check on information provided by Tests 1–9. The results are usually expressed as % colour removed and % ash removed by 10–30 g char from 100 ml of 65°Bx carbonatated or phosphated liquor at 75°C during 4 hr contact time.

* Tests 7–11 are recommended by ICUMSA.

A more detailed explanation of these tests is given elsewhere[1].

Although these tests have been shown to of be significant value for determining the quality of stocks on a three- or six-monthly basis, they are too time-consuming and comprehensive for routine control of revivification, where a rapid assessment of performance is required. The results of several of the tests are interrelated. Others provide information of a confirmatory rather than basic nature, essential only when a complete picture of the char is required.

When the object is to obtain either a more accurate picture of revivification performance than is given solely by the Lye test, or to provide a means whereby the relative activity of a stock may be assessed, then it may be possible to reduce the number of tests employed.

### *Experimental*

In order to test this hypothesis and to determine the relative importance of each of the tests, the results obtained over a two-year period of fourteen stock and new chars from six different countries were analysed. Each of these chars had at one time been compared for ash and colour removal capacity (Test 12) with a single sample of Tate & Lyle Refineries Ltd. stock char. Thus the ratios of % colour removal ($C$) and % ash removal ($A$) between the stock char and the test chars provide a relative measure of char performance.

The relevant results are given in Table II.

### *Analysis of Results*

The results for each of the activity tests were compared with the colour and ash removal ratios, $C$ and $A$ respectively. A correlation matrix was then calculated using standard statistical techniques.

No correlation was found between either colour or ash removal and the Lye test, the bulk analyses fo carbon, calcium sulphate and calcium carbonate, and the pH test.

Significant correlations were obtained between $C$ and

(*a*) accessible total area, $AT$ and

(*b*) carbon dispersity, $CD$.

Other lesser correlations were shown to be due to the dependence on the two main factors.

A multiple regression analysis provided the following equation:

$$C = 0{\cdot}000232\,(CD) + 0{\cdot}00448\,(AT) + 0{\cdot}247 \quad \ldots (1)$$

Only one of the tests showed any correlation with ash removal, $A$, that being $DH$. The correlation was improved when $1/DH$ was considered. This is to be expected for, under normal kilning conditions with a maximum working temperature of 550°C, as the $DH$ falls so the capacity of char to adsorb calcium increases. Above 600°C the trend reverses, but this condition can be neglected[4].

An equation of the form

$$A = \frac{k_1}{DH} + k_2 \quad \ldots (2)$$

would tend to infinity as the DH decreases. New chars with $DH$ values of 0 are not unknown and the problem was overcome by reformulating equation 2 as follows:

$$A = \frac{K_1}{(DH + 0{\cdot}5)} + K_2 \quad \ldots (3)$$

It was found by multiple regression analysis that the equation

$$A = \frac{1{\cdot}23}{(DH + 0{\cdot}5)} + 0{\cdot}29 \quad \ldots (4)$$

gave a good fit to the data shown in Table II.

In a recent paper, Chou and Hanson[5] have shown that the rate-determining step in column decolorization by bone char is one of intraparticle diffusion. This is regulated by the size and porosity of the particle and by the chemical nature of its surface with respect to the colorant molecule.

The rate of adsorption of $OT$, test 2, was designed to give a relative measure of the size and porosity of

[3] Bennett & Abram: *J. Colloid Interface Sci.*, 1967, **23**, 513.
[4] Abram: Unpublished work.
[5] *Sugar Industry Tech. Inc.*, 1971, **30**, 27–40.

**Table II. Analyses of char stocks**

| Char | Comparison test with T & L Stock Char Relative removal of: Colour $C$ | Ash $A$ | 1 Total area $T$ (μ moles/g) | 2 Accessible total area $AT$ (μ moles/g) | 3 Carbon area $B$ (μ moles/g) | 4 Accessible Carbon area $AB$ (μ moles/g) | 5 % Carbon $PC$ | 6 Carbon Dispersity $CD$ (μ moles/g) | 7 $DH$ ($Ca^{++}mN$) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0·99 | 1·05 | 166 | 73 | 110 | 65 | 9·2 | 1196 | 3·4 |
| 2 | 0·90 | 0·69 | 171 | 95 | 88 | 53 | 4·8 | 1833 | 2·2 |
| 3 | 0·63 | 0·56 | 107 | 51 | 44 | 20 | 3·1 | 1419 | 1·8 |
| 4 | 0·80 | 2·12 | 175 | 83 | 106 | 57 | 12·4 | 855 | 0·4 |
| 5 | 0·63 | 0·85 | 103 | 49 | 49 | 19 | 9·6 | 510 | 7·6 |
| 6 | 0·63 | 0·60 | 106 | 23 | 61 | 24 | 5·6 | 1090 | 3·6 |
| 7 | 0·60 | 0·63 | 102 | 23 | 61 | 24 | 5·3 | 1150 | 3·1 |
| 8 | 0·79 | 0·63 | 150 | 62 | 98 | 46 | 14·0 | 700 | 4·6 |
| 9 | 0·87 | 0·75 | 210 | 80 | 110 | 49 | 8·9 | 1236 | 2·9 |
| 10 | 0·63 | 0·53 | 165 | 94 | 115 | 60 | 15·5 | 742 | 1·0 |
| 11 | 0·59 | 0·56 | 123 | 53 | 99 | 62 | 17·0 | 582 | 2·4 |
| 12 | 1·20 | 1·00 | 196 | 74 | 128 | 61 | 5·6 | 2286 | 0·9 |
| 13 | 1·14 | 0·36 | 140 | 100 | 54 | 26 | 4·9 | 1102 | 5·0 |
| 14 | 1·18 | 0·36 | 153 | 99 | 66 | 34 | 3·7 | 1784 | 4·2 |

bone char, for both carbon and hydroxyapatite surfaces. The *DH*, test 7, gives a measure of the available hydroxyapatite surface for ash and anionic colour. The carbon dispersity, test 6, provides the best available assessment of the nature of the carbon surface. Thus the three terms chosen to describe colour and ash capacities by a statistical analysis of data describing basic physico-chemical properties of char, together provide the sort of information which is required to define the limiting rate-determining step in the kinetic theory of adsorption.

These three terms are not sufficiently comprehensive to give an absolute measure of char activity. It should be possible, however, to combine them into an equation giving a relative measure of char performance, which can be used to assess the effectiveness of regeneration or to provide a good indication of char stock activity. Hitherto, this has been possible only by undertaking column decolorization or bottle shaking tests using reference chars which have been stored under carefully controlled conditions. Even then the results have been dependent on the liquor used in the tests.

It must be pointed out at this stage that the analysis of the results failed to show a significant correlation between colour removal in the bottle test and *DH*. It can be shown, however, under certain conditions of constant carbon surface that the decolorizing ability is influenced by *DH*[4]. It can also be shown that the hydroxyapatite surface is of secondary importance when compared with the carbon surface in decolorization. It is possible, therefore, that any correlation between decolorization and *DH* for the fourteen very diverse chars investigated has been masked by the overriding influence of the carbon surface.

While the most important function of bone char in the refining process is the removal of colour, the removal of ash is also of value and must be considered in any performance index.

We assess the relative importance of these two factors to be in the ratio of approximately 85:15.

It is proposed, therefore, that the performance index, (*pi*), for bone char be represented by the equation:

$$pi = 0{\cdot}85 \text{ (equation 1)} + 0{\cdot}15 \text{ (equation 4)}$$

$$\text{i.e. } pi = 0{\cdot}000197\,(CD) + 0{\cdot}0038\,(AT) + \frac{0{\cdot}184}{(DH + 0{\cdot}5)} + 0{\cdot}253 \quad \ldots\ldots\ldots\ldots\ldots(5)$$

This is not in a convenient form and it would be desirable if char performance could be rated on the scale 0–100, with new char standing at 100. This can be achieved by substituting results for the three significant tests on new char in equation (5),

$$\text{then } PI = 100pi/pi \text{ (new char)}$$

The analyses of some fifteen samples of high activity new chars provided the following average results:

| | |
|---|---|
| Total readily accessible surface (*AT*) | 160 μ moles/g |
| Carbon dispersity (*CD*) | 2200 μ moles/g |
| *DH* | 1·0 |

Substituting in equation (5) gives *pi* (new char) = 1·418.

$$\therefore \text{ Performance Index} = \frac{100}{1{\cdot}418}\,[0{\cdot}000197(CD) + 0{\cdot}0038(AT) + \frac{0{\cdot}184}{(DH + 0{\cdot}5)} + 0{\cdot}253]$$

$$\text{i.e. } PI = 0{\cdot}014\,(CD) + 0{\cdot}27\,(AT) + \frac{13}{(DH + 0{\cdot}5)} + 18 \ldots\ldots\ldots(6)$$

On this scale new char has a *PI* of 100, and an average stock char 75.

This index has been calculated for a number of chars used in comparative bottle shaking and column decolorization tests. In every case the actual performance measured in decolorization terms was in agreement with the index of performance.

It is not claimed that this gives an absolute measure of char activity. It is thought, however, that it provides a simple and fairly accurate measure of relative char performance.

### *Conclusions*

The ability of a char to remove colour and ash from impure sugar liquors has been related to three basic physico-chemical properties of char:

(a) readily accessible total surface area (*AT*)

(b) the carbon dispersity (*CD*), that is the carbon area present per gram of carbon.

(c) the *DH*.

These terms, which can be measured very readily, have been combined to give a Performance Index, which provides a useful working guide to the decolorizing and ash removal efficiency of char.

$$PI = 0{\cdot}014\,(CD) + 0{\cdot}27\,(AT) + \frac{13}{(DH + 0{\cdot}5)} + 18$$

On this scale a good new char would rate at 100, and an average stock char at 75.

### *Summary*

In a recent paper[2] Bennett and Abram have described methods by which the activity of bone charcoal can be assessed. A series of twelve tests were listed which together yielded a comprehensive picture of the state of the char.

These tests have proved useful for the overall control of refinery stocks, and for ascertaining the reasons why a char has deteriorated in any particular respect, with resulting loss of activity.

They are, however, too time-consuming to use in full for the routine control of revivification, where a rapid evaluation of char performance is required. It would be desirable if the decolorizing performance of a char could be assessed rapidly and expressed as a number or performance index.

This article describes the development of a simple formula which relates decolorizing performance to three readily measurable basic physico-chemical properties of char.

# Sugar cane agriculture

**Sprinkler irrigation.** C. BAYMA. *Brasil Açuc.*, 1971, **78,** 550–557; 1972, **79,** 38–47.—Details, including mathematical formulae applicable to sprinkler irrigation of cane, are discussed and the need for economical control stressed. Government regulations on irrigation and drainage are reproduced and some comparative data tabulated showing the effects of natural, sprinkler and mixed irrigation on cane yields.

* * *

**Mud and more mud.** L. L. LAUDEN. *Sugar Bull.*, 1972, **50,** (Jan. 1), 3.—The difficulties caused by an excessively wet season at harvesting time in Louisiana connected with lodged and twisted cane, are outlined. The behaviour of different cane varieties is described.

* * *

**New type cane planter demonstrated.** ANON. *Producers' Rev.*, 1972, **62,** (1), 13–14.—A new type of cane planter, the "Etwell", designed to be used on large areas, is described and illustrated with photographs. It can plant 1½ acres per hour under reasonable conditions. A three-man team is needed to operate it. It is capable of single or double-row planting but the former works out at nearly double the cost of the latter, as three men are still needed. Setts or billets from a chopper harvester are used. Bin capacity is two tons. Large fertilizer and spray storage bins are fitted.

* * *

**Pollution control—how far and at what cost.** ANON. *Producers' Rev.*, 1972, **62,** (1), 16.—Atmospheric pollution associated with the burning of sugar cane trash is discussed, particularly its implications in Hawaii where trash burning is likely to become illegal. Radical changes in cane harvesting may be called for and this could apply to Australia in time.

* * *

**Novel cane harvester—grower designed.** ANON. *Producers' Rev.*, 1972, **62,** (1), 55–56.—An unusual cane harvester, designed and built by an Australian cane grower (Mr. CLIVE MORTON of Hambledon), is described. The machine was designed to deal with the high percentage of lodged cane on Mr. MORETON's farm.

* * *

**Louisiana sugar industry continues research on cane cleaner.** ANON. *Sugar Bull.*, 1972, **50,** (Jan. 15), 8–9. Work with an experimental cane cleaner is described with the aid of photographs, the work being a joint effort of the American Sugar Cane League, the US Department of Agriculture and Louisiana State University.

* * *

**The Cyclone and Drought Insurance Board (Mauritius) 1946–1971.** ANON. 44 pp.—The history of this insurance fund, established in 1946 to compensate cane growers for losses incurred as a result of cyclones and drought, is outlined and its operation explained.

* * *

**Smut disease now in Hawaii.** L. L. LAUDEN. *Sugar Bull.*, 1972, **50,** (Jan. 15), 14.—Reference is made to the recent discovery of this dreaded sugar cane disease in Hawaii. At present the disease is isolated on one plantation near Honolulu. How the disease was introduced is still uncertain. There is a good chance that a cutting may have been brought in by some well-meaning but uninformed individual. For many years the Louisiana, Florida and Hawaiian sugar industries have attempted to prevent this and other sugar cane diseases from entering their states.

* * *

**A comparison of the sugar industry of Peru with that of Venezuela.** P. E. SEQUERA. *Azúcar y Productividad* (Venezuela), 1971, **1,** (2), 7–9.—Comparisons are made of various aspects of the sugar cane industries of the two countries. Various recommendations are given for improving sugar production in Venezuela, the main needs being improved harvesting and transport to the factory.

* * *

**The dry savannahs of the Ureña and their employment for sugar production.** ANON. *Azúcar y Productividad* (Venezuela), 1971, **1,** (2), 47.—This is a continuation of an earlier article[1] and describes the commencement of irrigation in the area.

* * *

**A proven new system of sugar cane cultivation in central Venezuela.** ANON. *Azúcar y Productividad* (Venezuela), 1971, **1,** (2), 57–59.—The great success that has been achieved in central Venezuela with mechanization is described with the aid of illustrations showing Howard rotary cultivators and Massey-Ferguson harvesters in action.

* * *

**Recommendations for the control of Johnson grass and other weeds in Louisiana sugar cane, Spring 1972.** ANON. *Sugar Bull.*, 1972, **50,** (Feb. 1), 5–11.—Both chemical and mechanical control methods are dis-

[1] *I.S.J.*, 1972, **74,** 276.

cussed. Discussion relates to (i) removal of winter weeds with both methods and (ii) application of pre-emergence herbicides, the latter involving programmes using TCA, "Fenac", "Terbacil" ("Sinbar"), "Trifluralin" ("Treflan"), etc. Raoul grass and Bermuda grass are the other main grass weeds discussed.

* * *

**An evaluation of poultry manure as a sugar cane fertilizer.** P. K. MOBERLY and D. W. A. STEVENSON. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 136–141.—The material used was from broiler houses in which sawdust was used for litter. The findings of a number of experiments designed to test the response of sugar cane to poultry litter are reported. The experiments were conducted with both plant and ratoon crops. In general, yield responses to poultry litter are no greater than can be obtained from the equivalent N-P-K content of mineral fertilizers. It was concluded that organic manures of this type may be satisfactorily used if available on the farm, but to purchase at ruling prices would be economically unsound.

* * *

**The effects of filter cake on soil fertility and yield of sugar cane.** G. ROTH. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 142–148.—The varying responses of cane to filter cake application are well known. A study in the different stages of its decomposition are here recorded. In the later stages of decomposition an invasion of spore-forming bacilli and actinomycetes was found. These micro-organisms were shown to have a positive influence on soil aggregate stability. It may be of considerable practical significance that some micro-organisms which thrive in filter cake are antagonistic to *Pythium arrhenomanes*, the cause of root rot in sugar cane.

* * *

**The growth and productivity of sugar cane.** H. ROSTRON. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 152–157.—Largely because of improved cane varieties and improved agronomy (notably use of fertilizers and weed control), the average sugar yields in South Africa have increased from 3·08 tons ha in 1949/50 to 5·05 tons/ha in 1969/70. Data are here presented to show that there should be considerable scope for increasing yields beyond the limits of existing varieties. It is confirmed that radiation, temperature and plant age or size are important factors affecting growth when water and nutrients are freely available. It is concluded that detailed investigations are necessary to determine what morphological and physiological characteristics should be incorporated into new varieties in order to maximize sucrose production.

* * *

**Changes in sucrose % cane and yield of sucrose per unit area associated with cold, drought and ripening.** J. GLOVER. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 158–164.—It is shown that under South African conditions, increasing dryness (drop in monthly rainfall) produces a more rapid increase in sucrose % cane than does increasing cold. The ripening of cane (defined as sucrose storage in the stem) is discussed and the construction of a simple model of the process explained. It is pointed out that since cane weight increase does not follow the same pattern as increase in sucrose content, there is a limit to cane ripening beyond which the gain in sucrose is offset by the penalty incurred as a result of the greater fresh weight of cane to be transported to the factory. However, under "non-ripening" conditions any gain in sucrose is accompanied by considerable increases in fresh weight and hence still greater penalties.

* * *

**Asphalt barriers to improve productivity of sandy soils—preliminary assessment.** M. E. SUMNER and E. C. GILFILLAN. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 165–168.—Much of the South Aftican sugar cane area consists of light, sandy soils, easily leached and subject to rapid moisture loss through deep percolation. The value of the asphalt layer[1] was tested and gave outstanding results with sugar cane and some other crops. The barrier is placed 60 cm below the surface by excavating and then sprayed with 60% asphalt emulsion and the soil replaced. It was felt that further experimentation was needed before the practice could be recommended on a large scale. The high cost of laying asphalt barriers commercially is a serious obstacle.

* * *

**Comparisons of measured evapotranspiration of sugar cane from large and small lysimeters.** G. D. THOMPSON and J. P. BOYCE. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 169–177.—Evapotranspiration, estimated for plant, 1st and 2nd ratoon crops in a large 405 $m^2$ plastic-lined lysimeter and three small 3·71 $m^2$ lysimeters, was found to be little affected by size of lysimeter during the first 230 days of the plant crop, but during the final 80 days of the experiment differed considerably between the two sizes as a result of lodging in the large lysimeter which caused a 30% reduction in evapotranspiration. This drop in water use is shown to last for at least 2½–3 months after lodging occurs. It is concluded that productivity per unit time is reduced by about 30% after lodging, since the yield of cane per 100 mm evapotranspiration was the same for both lodged and erect cane.

* * *

**Reclamation of some sodic soils by the high salt water dilution method.** R. W. FITZPATRICK, D. P. TURNER, A. CASS and M. E. SUMNER. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 178–188.—In some South African cane areas a long history of injudicious irrigation has produced saline soils with consequent deterioration of physical structure causing cane yields to decline drastically. The aim of this work was to investigate the high salt water dilution method of reclamation on a laboratory scale so that the

[1] WANG *et al.*: *I.S.J.*, 1971, **73**, 143.

information could be used for the design of a suitable drainage system. The exchangeable sodium percentage (ESP) of all soils was decreased by leaching with solutions of decreasing Na but constant Ca concentration. Although a final leaching with water of low electrolyte concentration did not produce a rapid decrease in hydraulic conductivity, most soils showed an overall decrease of up to 34%.

* * *

**The soils of the Eastern Transvaal sugar industry.** C. N. MACVICAR and G. A. PERFECT. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 189–195. The physiography, geology and soils of the area are described. Because irrigation is essential for sugar cane growing there, the physical properties of the soils are emphasized.

* * *

**A nutrient survey of sugar cane in the South African industry with special reference to trace elements.** J. H. MEYER, R. A. WOOD, and P. DU PREEZ. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 196–204. This survey was undertaken to ascertain whether large-scale deficiencies of major nutrients or trace elements exist. Results indicated that the only extensive major nutrient deficiency is in potassium, although sulphur levels in Swaziland and Eastern Transvaal are low without actually appearing to limit sugar cane growth. There are no widespread trace element deficiencies, but zinc is undoubtedly a problem in certain areas of the midlands and coastal lowlands. The survey also showed that the midlands mistbelt region has considerable areas where the toxic levels of soil aluminium may be a hazard to sugar cane production, and there is possibly cause for concern regarding certain of the sandy soils of the coastal lowlands.

* * *

**The nitrogen requirements of ratoon crops of sugar cane in relation to age and time of harvest.** P. K. MOBERLY. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 205–211.—With regard to the effects of excessive nitrogen on recoverable sugar it was found that, when the ratoon cane is 18 months of age (or more) the time of cutting is relatively unimportant in contrast to 12-month cane, on which the adverse effect of excessive nitrogen is greater at an unfavourable than at a favourable time of the year, e.g. May *vs.* November. The uptake of nitrogen is more efficient in crops grown during a favourable climatic cycle compared with a less favourable cycle, e.g. in winter months. Lower levels of nitrogen could be used therefore for crops grown during a favourable climatic cycle. High levels of nitrogen would, in general, be more profitable when applied to long (18-month) rather than to short ratoons. The merits of a 12-month cutting cycle on the coastal midlands are questioned.

* * *

**Incidence of toxic aluminium in sandy soils.** M. E. SUMNER and J. H. MEYER. *Proc. 45th Congr. S. African Sugar Cane Tech. Assoc.*, 1971, 212–216.—This is a summary of available information on the subject in relation to sugar cane soils in South Africa. The occurrence of toxic quantities of aluminium in these soils is a widespread phenomenon and the potential benefits of limestone under these conditions should be more widely known. It is considered that some 18,500 hectares of cane land would benefit from liming.

* * *

**Some factors affecting foliar analysis in sugar cane.** J. M. GOSNELL and A. C. LONG. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 217–232.—The advantages and disadvantages of foliar analysis in connexion with fertilizer recommendations are well known. Foliar analysis introduces a whole set of variables which are not present in the case of soil analysis. These are discussed and include effects of: time of sampling, delay in midrib removal, age, season, variety, moisture stress, nitrogen, potash and other elements. There were large differences between different cane varieties suggesting that the critical level must be found for each variety.

* * *

**A system of routine foliar analysis of sugar cane major and trace elements.** A. C. LONG. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 233–239.—A system of routine foliar analysis, as practised in Rhodesia, is discussed. Together with subsequent field soil analysis it is used for fertilizer recommendations on sugar estates and privately-owned sugar farms in Rhodesia. This paper gives a brief account of the procedure adopted, from sampling to analytical methods. When planning the foliar analysis it was resolved that methods should be rapid and economical, a turnover of 500 samples a month being envisaged.

* * *

**Some effects of hot water treatment.** G. L. JAMES. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 240–248.—The rôle of ratoon stunting disease in causing yield losses under fully irrigated conditions in the lowveld is as yet undefined. Hot water treatment at 50·5°C for 2 hr was shown to affect germination adversely and reduce stalk populations in certain varieties. The optimum age for hot water treatment of N:Co 310 and N:Co 376 seed cane was found to be 11–12 months. Leaving hot water-treated cane stacked in the field had no detrimental effect if the period did not exceed two days. No unsatisfactory stands resulted from planting hot water-treated cane during a mild winter. Later infections of culmicolous smut were controlled by thermotherapy.

* * *

**Recent investigations on nematodes in sugar cane fields.** J. DICK and R. H. G. HARRIS. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 249–254.—Three experiments on nematode control under prevailing conditions are discussed. *Meloidogyne* practically disappeared when the grass *Eragrostis curvula* was grown for three seasons, but increased when tomatoes and beans were grown. Yield responses to nematicides in the absence of *Meloidogyne* show that this is not the only nematode concerned. The sugar cane variety N 50/211 responded considerably more to treatment with nematicide than did N 55/805, suggesting a degree of tolerance in the latter variety. As control, chicken litter proved ineffective. The nematicides EDB and DBCP were more effective than "Temik" or "Lannate" but this might have been due to the high pH of the soil in the experimental site. There now seems to be some evidence that "Temik" is inactivated in alkaline soils.

* * *

**A comparison of herbicide treatments for the control of grass and *Cyperus* species.** F. E. RICHARDSON. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 255–260.—The experiments were carried out on two Natal soils, one heavy with high organic matter, the other sandy with low organic matter. The trials were designed to evaluate pre- and post-emergence herbicide treatment on the specific weeds *Panicum maximum* (a grass), *Cyperus rotundus*, *C. esculentus* and annual grasses, the more important of which were: *Digitaria adscendens*, *D. ternata* (the two commonest), *Panicum laevifolium*, *Setaria pallidefusca*, *Paspalum urvillei*, *Phalaris angusta* and *Eragrostis curvula*. "Alachlor"/2,4-D was the most successful herbicide mixture for pre-emergence grass control. No pre-emergence treatment effectively controlled *Cyperus* (nut grass and water grass). Post-emergence grass control was dependent upon the stage of growth when treatments were applied. Mixtures of "Ametryne" or "Diuron" with 2,4-D were highly satisfactory for the post-emergence control of grass and *Cyperus* species. The addition of a non-ionic surfactant was always beneficial.

* * *

**Soil compaction studies at Pongola.** M. A. JOHNSTON and R. A. WOOD. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 261–269.—In South Africa, past studies on the effects of soil compaction on cane yield appear to have been somewhat contradictory or variable, partly because of the onset of drought. Consequently it was decided to conduct a well-replicated trial under irrigation conditions on a uniform sandy clay at Pongola, previously shown to be highly compactable. Ratoon cane was used. In spite of significant compactive efforts on soil bulk density and macroporosity, no reductions in yield due to compaction were recorded. Restorative treatments following compaction sometimes improved the soil's physical condition without increasing yield. Utilization of moisture from considerable depths and regular irrigation are thought to be the main factors responsible for preventing a decline in yield.

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**A study on the response of sugar cane to "Diquat" for tassel control.** S. S. GARRUCHO. *Sugar News* (Philippines), 1971, **47**, 592–598.—Earlier work on the subject in the Philippines and elsewhere is reviewed. Experiments showed that different varieties of cane varied in their reaction to "Diquat" ("Reglone") and that by judicious enzyme control it is possible to wilt the leaves, to maintain some photosynthesis and to retard metabolism, thereby effecting tassel control. The application of "Diquat" for tassel control gave a marked additional net income.

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**New harvesters purchased during the 1971 season.** L. G. VALLANCE. *Australian Sugar J.*, 1972, **63**, 473–477.—Information is given on chopper harvesters purchased by Queensland cane growers in 1971. Of the 250 bought, most were of the larger type such as the Don "Mizzi", the Massey-Ferguson "201" and the Toft "Robot".

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**Diversification of crops on sugar cane soils.** R. ANTOINE. *Rev. Agric. Sucr. Maurice*, 1971, **50**, 214–218.—For various reasons, such as excessive stoniness of the soil or irrigation difficulties, a large proportion of the land devoted to sugar cane is unsuitable for most other crops. However, crops such as maize, potatoes, sunflower and groundnuts can be grown in many areas, their climatic requirements being roughly similar to those of cane. These crops are discussed.

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**Regional selection of sugar cane in Réunion: varietal tests and their applications.** F. LÉOVILLE. *Rev. Agric. Sucr. Maurice*, 1971, **50**, 248–255.—The different sugar cane growing areas of the island are well illustrated in a map, there being four main zones: the super-humid zone (Saint André, Saint Philippe), the humid zone (Bel Air, Bois Rouge), the dry, irrigated zone and the dry zone. Several varieties have had to be eliminated because of susceptibility to disease such as leaf scald, gummosis, and yellow spot.

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**Reflections on mechanical loading of cane (in Réunion).** M. HOARAU. *Rev. Agric. Sucr. Maurice*, 1971, **50**, 353–363.—The difficult labour conditions now prevailing in Réunion in regard to sugar cane are stressed. It is pointed out that the production of a ton of sugar in Réunion requires the equivalent of 12 days work for one man, whereas in France, with the present high degree of mechanization of the beet sugar industry, the production of a ton of sugar needs only 12 hours. The performance of an Australian cane loader (the Toft WTL 250) is described and illustrated.

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**Sugar cane varieties.** F. GUILLERMO L. *Memoria Campaña 1970–71* (Chacra Expt. Sta., Argentina), 1972, (March), 10 pp.—An account is given of the Chacra Experiment Station, founded in 1951, and its work, especially on sugar cane breeding. In 1969 a glasshouse was erected for raising seedlings and the first 400 seedlings bred at the Station were germinated in it. The prefix "NA" to seedlings or new varieties stands for Northern Argentina.

**Economics of fertilizer use (India).** P. D. JHAMB. *Sugar News* (India), 1971, **3**, (8), 15–17.—In India irrigation and fertilizers are often complementary in obtaining maximum or optimum yields. A table is given showing the response (in Northern India) in cane yield and sugar to different amounts of nitrogen, i.e. from 50 to 200 kg/ha, where 150 kg/ha proved to be the optimum or most profitable rate.

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**Problems and prospects of the sugar industry in Maharashtra.** D. M. POPAT. *Indian Sugar*, 1971, **21**, 597–599.—The fall in Indian sugar production in 1970–71 compared with the previous season is discussed. The fall was steeper in some states than in others. Contributing factors were reduced areas of cane cultivation and damage to crops by floods, drought and pests, and greater cane utilization for gur production because of higher gur prices.

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**Review of the work done on subterranean pests of sugar cane in India.** S. KUMAR. *Indian Sugar*, 1971, **21**, 605–608.—Subterranean pests of sugar cane in India are restricted to termites and beetle grubs. The 5 species of termite known to be capable of damaging cane in India are listed. Control measures are discussed. BHC or gamma-BHC application lasts up to 3 or 4 months only, i.e. during the germination and tillering stage. "Aldrin", "Dieldrin" and "Heptachlor" dusts can be effective for two crop seasons. Eight different beetle grubs are listed and recognised methods of control or reducing damage considered. Suggested future lines of work on chemical and possibly biological control are discussed.

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**Prospect of adsali (monsoon) planting of cane in North Bihar.** R. B. PRASAD. *Indian Sugar*, 1971, **21**, 609–611. The high reputation of North Bihar as a sugar cane-growing area is discussed. It is considered that some of the newer cane varieties that proved unsuitable under normal planting conditions might well prove profitable if used for adsali (monsoon) planting. This would involve an 18-month instead of a 12-month period and greater attention to the problems of pests, diseases and cane lodging.

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**Performance of foreign varieties under wetland conditions of Tiruchirappalli district.** T. R. SRINIVASAN, P. S. SANJEEVI, P. PARAMESWARAN and K. N. GOVINDASWAMY. *Indian Sugar*, 1971, **21**, 613–616.—The special climatic conditions that prevail in this area of Tamil Nadu State mean that a cane crop planted in the main season has to face the adverse effects of acute drought during early growth and continuous water logging caused by the monsoon later. With the special season crop (planted in August or September) the reverse applies. This considerably restricts choice of varieties. The answer may well lie in the future use of locally-bred varieties.

**Some observations on a sugar cane disease complex in Nizamabad district of Andhra Pradesh.** N. N. SARMA. *Indian Sugar*, 1971, **21**, 619–627.—An account is given of studies undertaken to ascertain the cause of large-scale death of cane stalks which occurred in the area in 1958. It was concluded that the pathogen mainly responsible was the fungus *Cephalosporium sacchari*, the rôle of bacteria being secondary. The presence of scale insects may have created favourable conditions for invasion by bacteria.

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**Plant cane nurseries.** ANON. *Sugar Bull.*, 1972, **50**, (Feb. 15), 8.—All the commercially cultivated cane in Louisiana is susceptible to either mosaic or ratoon stunting disease. Control measures must be exercised by the grower. The value of plant cane nurseries in this connexion is discussed. Varieties are grown on the grower's best land and treated for ratoon stunting disease if need be. They are rogued and double checked for borers and usually fertilized more than at recommended rates. Plots are kept free of weeds. The beneficial experiences of several farmers, who have run their own plant nurseries for some time, are given.

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**Fertilizer and soil fertility practices for sugar cane production.** L. E. GOLDEN, R. RICAUD, D. T. LOUPE and O. D. CURTIS. *Sugar Bull.*, 1972, **50**, (Feb. 15), 10–11.—Solid and liquid fertilizers from any of the common materials are approximately equal in their effectiveness on cane. Except in cases where a late application of nitrogen is anticipated, all fertilizers should be applied in the Spring and should be placed 6 to 10 inches deep in the soil on both sides of the row. Fertilizer recommendations for plant cane and ratoon cane are given. Other materials considered are rock phosphate and filter press mud. Any decision by a grower to use sulphur, rock phosphate or cement kiln dust should be made only after advice from a competent authority.

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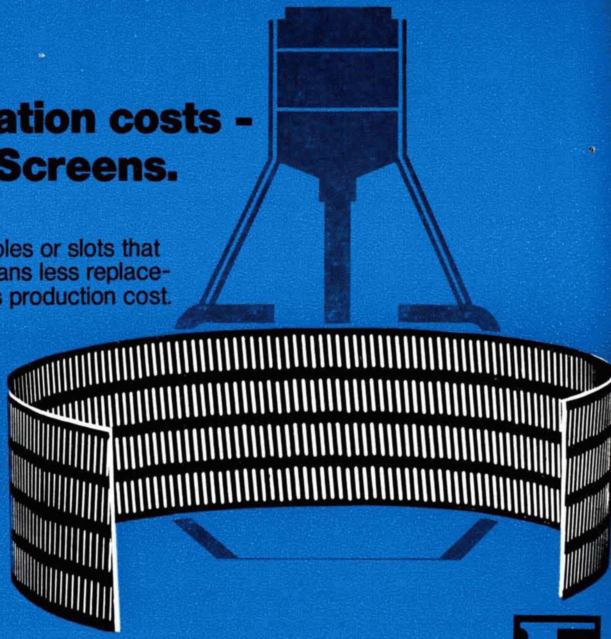
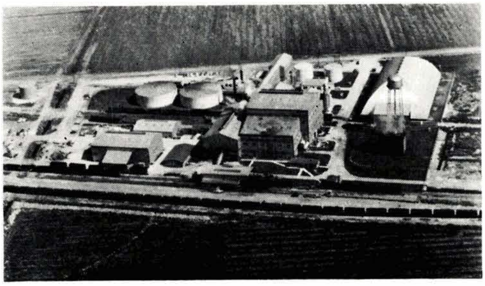
**Mechanical application of nematicides.** ANON. *S. African Sugar J.*, 1972, **56**, 115–117.—Damage to sugar cane by nematodes is very prevalent in Natal, especially on some of the light sandy soils. It may result in stunting, leaf roll and general debility. Subject to the conditions for their registration, four nematicides have been selected for soil treatment before planting sugar cane. They are: "Aldicarp" ("Temik"), D-D, EDB and DBCP. Information is given on timing and placement, soil conditions, methods of mechanical application, etc. A table gives specifications of four different makes of nematicide mechanical applicators that are available. It is pointed out that nematicides are expensive and that they should always be applied at the recommended optimum rate. The use of quantities in excess of the recommended dosage does not increase the response in proportion to the additional expenditure.





10,000 TPD Glades Sugar Factory, Belle Glade, Florida





10,000 TPD Bryant Sugar Factory, Bryant, Florida

**Recommendations for the control of mosaic disease in sugar cane in Louisiana, 1972.** ANON. *Sugar Bull.*, 1972, **50**, (March 1), 6–7.—Mosaic disease of sugar cane occurs universally throughout the sugar cane growing areas of Louisiana, although only traces of infection occur in the northern area of the cane belt. Plant cane and ratoon cane are discussed separately. Recommendations advised for control include: getting to know the symptoms of the disease thoroughly; surveying in spring all fields which are to be used for seed cane; roguing diseased cane; and planting mosaic-resistant varieties.

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**Mechanical cane cleaning.** G. J. DURBIN. *Sugar Bull.*, 1972, **50**, (March 1), 8.—Reasons why mechanical cleaning of cane is desirable are discussed. It is pointed out that in the future it may not be possible to burn trash on account of air pollution. A new approach towards mechanically cleaning of cane is being tried and is described. The aim is to develop a new piece of field equipment which will clean the cane and leave the trash in the field. The cleaner would not be a part of the harvester but could be combined with the loader or operated separately from the loader.

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**Ultrastructure of cells in toxin-treated and** ***Helminthosporium sacchari*****-infected sugar cane leaves.** G. A. STROBEL, W. M. HESS and G. W. STEINER. *Phytopathology*, 1972, **62**, (3), 339–345.—*Helminthosporium sacchari* is the causal agent of eye spot disease of sugar cane and produces a host-specific toxin, helminthosporoside. In this study, resistant and susceptible clones of sugar cane were treated for varying periods, with normal helminthosporoside and with the same chemical with radio-carbon in its molecule, and then examined by electron microscopy and radioautography. Cells from fungus-infected leaves and from leaves of a susceptible clone treated with the toxin varied from showing virtually no alteration of the cytoplasm to its complete disruption. Furthermore the cytological alterations seen in fungus-infected tissues greatly resembled those observed in susceptible tissues treated with helminthosporoside.

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**Effect of soil types on response of sugar cane to N-P-K in Uttar Pradesh.** C. L. MEHROTRA, K. N. TIWARI and P. S. PANWAR. *Fertilizer News*, 1972, **17**, (2), 43–48.—The response to N was universal, irrespective of soil type, whereas the response to P and K showed more variation. In general, yield response was in direct proportion to the maturity of the soil, the youngest soil showing least response and fully matured soils the maximum.

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**Study of press mud as medium for raising seedlings from sugar cane fluffs.** M. A. ELAHI and N. N. SARKAR. *Pakistan J. Sci.*, 1970, **22**, (3/4), 148–150; through *Hort. Abs.*, 1972, **42**, 314.—Press mud mixed with soil and sand (2:2:1) was an excellent medium for raising sugar cane seedlings.

**The mass selection reservoir and sugar cane selection.** A. H. D. BROWN, J. DANIELS and N. D. STEVENSON. *Theoret. Appl. Genetics*, 1971, **41**, (4), 174–180; through *Hort. Abs.*, 1972, **42**, 314.—A method is proposed which extends the use of this selection technique to a clonally propagated crop. The populations selected in an MRS programme in Fiji produced yields greater than those of the commercial clone or variety Ragnar. Two possible artificial selection methods are compared.

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**Efficacy of hydrochloric acid on the germination of shy germinator cane variety Col. 9.** O. SINGH. *Indian J. Sci. Ind.*, 1970, **4**, (3/4), 179–180; through *Hort. Abs.*, 1972, **42**, 316.—The treatment of cane setts by soaking in 0·01% HCl for 1 hour more than doubled the subsequent germinating percentage. Some improvement in germination also resulted from soaking in 0·05% HCl, but treatment with 0·1% and 0·5% solutions inhibited growth.

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**Sex-attractant in sugar cane stalk borer,** ***Chilo auricilius*****.** A. N. KALRA and H. DAVID. *Ind. J. Agric. Sci.*, 1971, **41**, (1), 21–24; through *Hort. Abs.*, 1972, **42**, 319.—The techniques tested in these experiments are described. The addition of 1 ml of sandalwood oil to 100 ml of an extract of crushed abdominal tips of 250 females enhanced attraction. Anhydrous ether was the best extractant used.

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**Big future tipped for Joe Mizzi cane harvester.** ANON. *Producers' Rev.*, 1972, **62**, (2), 17–21.—Details are given of a chopper harvester, designed by Mr. JOE MIZZI and tested in the Ingham area of Queensland. Intended by the designer, a local cane grower, to handle green and burnt cane, the harvester has a number of noteworthy features which are described.

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**A new approach in cultivation of sugar cane for TSC farms.** ANON. *Taiwan Sugar*, 1972, **19**, 3–4.—The changes in agriculture and field practice brought about by increasing mechanization, especially harvesting, are discussed.

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**The improvement of cultivation conditions for successful growing of ratoon cane.** T. P. PAO. *Taiwan Sugar*, 1972, **19**, 5–11.—The purpose of the experiments described was to find a method or methods of improving ratooning under Taiwan conditions, long known to leave much to be desired. Soil water content proved to be specially important. Irrigation was more important than fertilizers which ranked second in importance.

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**Review and progress of chemical weed control for sugar cane in Taiwan.** S. Y. PENG. *Taiwan Sugar*, 1972, **19**, 12–17.—The combating of labour shortage in the Taiwan sugar industry has become all-important in recent years and herbicides are an effective weapon. Matters discussed include: herbicides for pre-emergence control; danger of indiscriminate use of 2,4-D; selection of pre-emergence herbicides for autumn- and spring-planted crops; herbicides for post-emergence control; herbicides for intercropped sugar cane; eradication of perennial weeds during fallow; sensitivity of growing cane to weed composition; effect of time of herbicide uptake by roots on cane tolerance of herbicides; use of a soil conservation agent ("Curasol AH") to protect cane intercrops against herbicides washed into furrows from field ridges by heavy rain; suspicion that herbicidal residues cause reduction in cane yield (unconfirmed); and improvement in ratoon yield by combined application of plant growth regulators and herbicides.

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**Report of a cane planter operated on Nanchow sugar mill farm.** S. T. KING. *Taiwan Sugar*, 1972, **19,** 18–20. Because of the inability to obtain enough seasonal labourers for cane planting, increased attention has been given to mechanization, especially of planting operations. Experiments with 5 different types of mechanical planter, one made by Nanchow sugar mill staff, are discussed. Suggestions are made for improvements of some of the machines and costs between manual and mechanical planting compared. These are shown in a table which presents a detailed analysis. Mechanical planting was cheaper than hand planting.

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**Studies on the chemical control of sugar cane flowering in Taiwan.** P. C. YANG, T. P. PAO and F. W. HO. *Taiwan Sugar*, 1972, **19,** 21–27.—The effects of "Reglone" and CMU applied by means of an automatic hand sprayer and aerial spraying on the cane varieties N:Co 310 and F 146 were evaluated. The application of "Reglone" at the rate of 0·75 litres/ha and CMU at 5·6 kg/ha, sprayed at the end of August and early September, produced the best results in flower control with the variety F 146. The variety N:Co 310 flowered little because of lodging caused by typhoons. It was concluded that chemicals can be used effectively to control cane flowering but that no substantial increase in sugar yield can be expected if the cane is harvested before February under the environmental conditions of Taiwan.

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**"No-plough" sugar cane farming being tested by TSC.** ANON. *Taiwan Sugar*, 1972, **19,** 33–34.—The phenomenal growth of industrial development in Taiwan during the last decade has resulted in greatly decreased labour supplies for the sugar cane industry. "No-plough" sugar cane farming is described as Taiwan's most revolutionary innovation in cane cultivation. It is currently being tested and successfully implemented at Peikang sugar mill plantation. After the harvesting of rice, the land was not ploughed or harrowed but was immediately mechanically planted to cane. Germination and growth compared favourably with other crops. Advantages of the method are listed under 8 headings. Two disadvantages are that root development in the subsoil is restricted (but could be overcome by subsoiling) and weeds are likely to grow more rapidly.

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**Sugar cane in the Vidarbha—Marathwada regions of Maharashtra.** J. R. KAKDE. *Sugar News* (India), 1972, **3,** (10), 6–12.—The prevailing climatic and soil conditions in relation to sugar cane cultivation are described. A map is supplied showing location of irrigated areas and of existing and proposed future mills.

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**Studies on the effect of lodging on sugar cane.** M. LAKSHMIKANTHAM, B. GOPALAM, K. L. RAO and N. N. V. V. P. RAO. *Sugar News* (India), 1972, **3,** (10), 15–17, 21.—The weight and sucrose content of lodged and of erect cane was studied at monthly intervals at the Anakapalle Sugar Research Station. Lodged cane showed, irrespective of variety, a steady decline in the mean cane weight from December to April. Erect cane was always richer in sugar than lodged cane. There was some varietal difference in the effect of lodging on juice quality.

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**Response of mid-season and late varieties of sugar cane to nitrogen.** O. SINGH and B. P. SINGH. *Indian Sugar*, 1972, **21,** 679–682.—The response of 4 sugar cane varieties to 4 levels of nitrogen was studied with a view to ascertaining the most profitable method for growers to adopt, having regard to costs. The two mid-season varieties were CoL 9 and Co 975 and the two late varieties Co 1148 and Co 1328. One cane variety, Co 975, gave greater increases in yield at all levels of nitrogen than did the other varieties, while CoL 9 gave the lowest yields. In all cases, yields and net profits were higher with the experimentally-found optimum than with the officially recommended lower level.

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**Incidence of stalk borer (*Chilotraea auricilius* Dudg.) in relation to the condition of the sugar cane crop.** Y. P. MADAN. *Indian Sugar*, 1972, **21,** 683–684.—This pest is a serious one in some places, as in the terai (wet belt) areas under cane in the U.P. Recently it has spread to some parts of Haryana and Punjab. It was found that cane showing poor growth was less likely to be attacked than cane of good growth. The cane variety Co 1148 was preferred by the pest to other varieties.

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**Studies on the utility of distillery effluent (spent wash) for its manurial value and its effect on soil properties.** P. D. BAJPAI and S. P. DUA. *Indian Sugar*, 1972, **21,** 687–689.—In view of the great need for additional nitrogen for cane growing in India, an intensive study was made of the value of distillery effluent (containing 0·1% N, 0·9% K and 0·2% P on dry basis) as a fertilizer when applied to cane. A table is given showing the chemical composition of distillery effluent or spent wash. It was concluded from trials that the diluted spent wash applied up to 200 kg N/ha increased sugar cane yields but higher doses had an adverse effect on yields and on available nitrogen in the soil. It needs to be judiciously applied to avoid damage to the cane crop.

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**Co 1053—a promising variety for Orissa.** K. C. MISHRA and K. C. PANDA. *Indian Sugar*, 1972, **21,** 691–693.—An account is given of this variety and its successful cultivation in Orissa where it is replacing existing varieties. It is a hard cane with profuse tillering ability, is high-yielding and resistant to red rot and smut. The canes are greenish yellow in colour with occasional green stripes.

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**Attack of scale insect, *Melanaspis glomerata* Green, on sugar cane in Delhi.** S. KUMAR, S. S. MISRA and S. K. PRASAD. *Indian Sugar*, 1972, **21,** 695.—Areas where this sugar cane pest is known to occur in India are listed. Punjab, Haryana, Rajasthan and Uttar Pradesh are areas so far considered free from attack. This note records the insect as a sugar cane pest in the Delhi region.

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**What happens when a sugar company takes up pig farming?** C. C. CATANAOAN. *World Farming*, 1972, **14,** (3), 6–8, 24.—The Taiwan Sugar Corporation's pig breeding project, involving about 310,000 pigs in 1971, is described and illustrated.

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**Better sugar cane burns with "Gramoxone".** ANON. *World Farming*, 1972, **14,** (3), 17.—For burning-off sugar cane trash before harvesting, "Gramoxone" has proved to be the best desiccant at present available according to experience in such countries as Hawaii, Mexico, Puerto Rico, Taiwan and elsewhere. As more and more cane is cut by machine it becomes even more important to get good burns prior to harvest. This means less trash to cut, load, transport and mill. It is early in the season that the value of "Gramoxone" is particularly noticeable.

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**Spring and fall planting.** I. S. RALSTON. *J.A.S.T.J.*, 1969, **30,** 18–21.—Planting practices on a 2900-acre estate, all of which is irrigated (400 acres by sprinkler), are discussed. Spring planting takes place during January–June while autumn (fall) planting is carried out in July–December, although there is no marked difference between seasons as in temperate-climate countries. Previously, two-thirds of the planting had been carried out in spring; this was increased to 85% with adverse results, and finally a planting ratio between the two seasons of 1:1 was adopted. Advantages of the latest scheme include the possibility of improving: land preparation, equipment utilization, supervision, deployment of labour and ratoon maintenance as well as seed material availability.

**Tractor maintenance and costing.** N. C. HYLTON. *J.A.S.T.J.*, 1969, **30,** 53–57.—It is felt that greater attention should be paid by cane estates to tractor economics. The seven basic factors affecting the economic life of a tractor which are considered are: initial cost, depreciation, operating costs, repair costs, down-time, increased cost of replacement and proper matching of implements to the tractor.

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**Transportation of sugar cane.** J. C. VAN GROENIGEN. *J.A.S.T.J.*, 1969, **30,** 104–108.—Cane transport on an estate is discussed and a number of factors involved in efficient transport organization considered. Four systems of cane handling in the factory yard are described, viz. the use of slings, side-dumping (chain-net system), side-tipping, and discharge from containers (which can also be left unemptied in the yard until required). The last two systems are regarded as ideal for chopped cane handling.

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**Hot-water treatment for mosaic and RSD control.** G. T. A. BENDA. *Sugar J.*, 1972, **34,** (10), 32–39.—The writer considers that the full potential of heat treatment for sugar cane diseases has not been fully realized. This paper describes a method for heat-curing virus diseases that uses a series of treatments. A treatment at lower temperature precedes one or more treatments at higher temperature, and each treatment is separated from the one that follows by an interval of a day. With certain combinations of treatments, it is possible to free the majority of setts from symptoms of sugar cane mosaic and ratoon stunting disease. It has not been possible, so far, to free all the treated setts from both. Results of experiments with different varieties are tabulated. (See also BENDA: *I.S.J.*, 1973, **75,** 48.)

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**An insecticide test to control the sugar cane beetle borer (Coleoptera: Curculionidae).** A. K. OTA and W. C. MITCHELL. *Hawaiian Planters' Record*, 1971, **58,** 147–158.—Owing to a combination of circumstances, the beetle borer or New Guinea sugar cane weevil (*Rhabdoscelus obscurus*) was causing excessive damage on the island of Kauai. An account is given of an attempt to control the pest with insecticides in an experiment using "Aldrin", "Dieldrin" and "Carbaryl" ("Sevin") applied as both granules and apple pomice bait. Both "Aldrin" and "Dieldrin" applied at a rate of 3 and 2 lb a.i. per acre, respectively, reduced borer damage for at least 9 months. However, beetle borer damage increased in the treated plots until it was equal to untreated plots at harvest. The insecticides did not adversely affect parasitism of the weevil larvae by the tachinid parasite, *Lixophaga sphenophori*, but "Aldrin" and "Dieldrin" reduced the population of the ant, *Pheidole megacephala*, which is known to feed on larvae and pupae of the weevil.

# Sugar beet agriculture

**The effect of N-P-K applied singly and in combination on the quality of sugar beet juice at different stages of growth in the Hyderabad region.** M. Slaeem and T. M. Choudhry. *West Pakistan J. Agric. Res.*, 1970, **8**, 141–151.—The study here reported was undertaken to investigate the possibilities of getting higher recovery and better quality juice under Hyderabad conditions. The experiments were carried out at the Agricultural College and Research Institute, Tandojam. It was concluded that the sugar beet with good quality juice may be grown successfully up to the end of April in the Hyderabad region, especially when adequately fertilized with N-P-K. With regard to optimum doses of N-K, P-K and N-P-K it is suggested that further research work should be carried out to ascertain the exact applications of nutrients required for getting the most economical return from standard varieties.

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**Studies on the effect of different rates and combinations of nitrogen, phosphorus and potassium on the yield and quality of sugar beet.** A. A. Khan, M. Athar, G. A. Shah and H. Rehman. *West Pakistan J. Agric. Res.*, 1970, **8**, 210–215.—It is stated that in recent years sugar beet has become the most important cash crop in the Peshawar Valley. In 1958/59 only some 700 acres were planted to beet, but by 1969/70 this had increased to 25,000 acres. Experiments at the Agricultural Research Institute, Tarnab, indicated that a combination of 90 lb N, 60 lb P (as $P_2O_5$) and 60 lb K (as $K_2O$) per acre gave the highest yield of various combinations tested, i.e. 743·29 maunds (approximately 37 tons) of beet/acre.

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**Developmental physiology of sugar beet. III. Effects of decapitation, defoliation and removing part of the root and shoot on subsequent growth of sugar beet.** D. K. D. Gupta. *J. Exp. Bot.*, 1972, **23**, 93–102.—Decapitation and subsequent removal of unfolding leaves of sugar beet plants at 2-, 4-, 14- and 31-leaf stages resulted in much greater growth of the remaining leaves, the effect being more pronounced the less advanced the leaves at the time of treatment. A two- or three-fold increase in area was accompanied by a five to six-fold increase in weight. Both treatments caused a transient increase in the rate of growth of the root. Removal of part of the shoot resulted in proportionately greater growth of that remaining, whereas removal of part of the root had no effect on the shoot unless it was reduced to one quarter. The change in the amount of shoot had no significant effect on the growth of the root, nor was there a compensating effect on the growth of the remaining root after more than one half of it had been removed.

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**Developmental physiology of sugar beet. IV. Effects of growth substances and differential root and shoot temperature on subsequent growth.** D. K. D. Gupta. *J. Exp. Bot.*, 1972, **23**, 103–113.—Results are discussed of the effects of three growth substances (indolyl acetic acid, gibberellic acid and kinetin) and of differential shoot and root temperatures on growth of sugar beet plants. The growth substances were applied in aqueous lanolin at different concentrations (50 ppm to 5000 ppm) to decapitated sugar beet plants at the 8-leaf stage, one group also having alternate leaves removed. The growth substances significantly increased the dry weight of the plants when all the leaves were present, which was mainly explained by the large increase in roots. Combinations of root and shoot temperatures were imposed on plants decapitated at the 8-leaf stage. When all the leaves were present, growth rate was maximal at shoot temperatures of 17°C and root temperature of 25°C. With alternate leaves removed maximum root growth occurred at shoot and root temperatures of 25°C.

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**Herbicidal activity of chloroacetamides and pyridazinones on sugar beets and weeds.** E. E. Schweizer. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 359–368. Herbicides currently used for sugar beet in the western United States include "Cycloate", "Diallate", "Pyrazon" and "Endothal". Complete control has been difficult because of the diversity of weed species that may infect beet fields, belonging to several different families and two of them (*Chenopodium album* and *Kochia saponaria*) belonging to the same family as sugar beet. There is need for herbicides that will control a broader spectrum of annual weeds when herbicides are incorporated with the soil or applied to the soil surface. In investigations which are described, the chloroacetamides controlled foxtail millet the best, whereas the pyridazinones were more effective against common lambs-quarters and wild buckwheat. Both groups of compounds controlled pigweed effectively, but not *Kochia*. The herbicides BAS 2430 and "Delachlor" surpassed the standard herbicide "Cycloate" in reducing the average stand of all five weeds.

**Effect of agronomic and storage practices on raffinose, reducing sugar, and amino-acid content of sugar beet varieties.** R. E. WYSE and S. T. DEXTER. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 369–383.—Results of this work stressed the importance of temperature in affecting the development or accumulation of non-sucrose products. Less than ideal storage practices were found to have a much greater effect on the chemical composition of beets with the exception of the amino-acid content than did agronomic practices. In beets stored at various temperatures, varieties differed considerably with respect to the level of raffinose, reducing sugars, and amino-acids in the clarified juice. Since these compounds make up the major proportion of the non-sucrose constituents of the clear juice, it would appear that the level of these impurities could be controlled through variety improvement and proper agronomic and storage practices.

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**Techniques for evaluating sugar beet for resistance to** *Cercospora beticola* **in the field.** E. G. RUPPEL and J. O. GASKILL. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 384–389.—A successful method for uniformly infecting sugar beet fields with leaf spot (*Cercospora beticola*) in order to test resistance of new varieties is explained. This has been done because so many requests have been received about the method, which is notable for its simplicity, reliability and low cost. Viability tests indicated only 2% spore germination in the stock suspension, whereas 49% of the spores germinated in a more dilute inoculum.

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**Source of recoverable sugar losses in several sugar beet varieties during storage.** R. E. WYSE and S. T. DEXTER. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 390–398.—The recoverable sugar per ton (RSPT) of beet was determined at harvest and after 130 days' storage for five varieties treated with 24 and 150 kg nitrogen/acre during growth. The effect of N on storage losses differed widely between varieties, but in general RSPT loss was greater with the smaller N application. On average, 65% of the RSPT reduction was due to direct loss of sucrose (through respiration and conversion to compounds not found in clear juice), while the remainder was due to impurity accumulation in factory juice. The impurity content was the same quantitatively at 3° and 10° storage temperature, but qualitatively there was marked difference: raffinose accounted for 34% of the total impurities after 100 days at 3°C, whereas at 10°C reducing sugars, amino-acids and other unknown impurities predominated.

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**Impurity index selections on individual sugar beets.** G. K. RYSER and J. C. THEURER. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 399–407.—In work carried out at two centres in Utah (Logan and Farmington) the merit of utilizing an economical and easy method of individual sugar beet selection for high and low sugar content and high and low impurity index was evaluated. Recurring selections, made by use of Mendelian male sterility as a crossing tool, resulted in positive selection pressure for all factors studied. Self-sterile progenies, selected on an individual beet basis, gave varied results, probably as a result of inbreeding and fixing of the genes. Progress in the direction of low quality selection was easier to accomplish than was selection toward high quality. The impurity index was an effective breeding tool for improving the beet quality of a line, while maintaining high sugar content.

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**The influence of root zone temperature on phosphorus nutrition of sugar beet seedlings.** K. M. SIPITANOS and A. ULRICH. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 408–421.—It has been previously established that the period of phosphorus deficiency normally occurs very early in the life of sugar beet plants. Low soil temperatures prevail at the seedling stage. Pot experiments are here reported where soil temperatures were maintained at 5, 10, 15, 20, 25 and 30°C by means of thermostatically-controlled water baths. Four phosphorus treatments were replicated six times. Temperature greatly influenced seedling emergence, the optimum temperature being about 25°C. Phosphorus fertilization had no effect on emergence except at 5°C. There appeared to be a plant age factor in considering sugar beet seedling response to phosphorus fertilization.

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**A plot seeder for sugar beet field experiments.** I. O. SKOYEN and J. S. MCFARLANE. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 422–427.—A seed drill adapted to sowing sugar beet seed nurseries and variety trials is described and illustrated with photographs. It was developed at the US Agricultural Research Station, Salinas, California. Cone-fed units were attached to commercial seeders and equipped with sprocket combinations to permit the sowing of various size plots up to 86 feet long. Seeder frame construction provided seating for operators and permitted simple adjustment for different bed or row spacings.

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**Boron nutrition in the growth and sugar content of sugar beets.** J. VLAMIS and A. ULRICH. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 428–439.—This study was made to determine the growth, boron content of the tissues and sugar production of sugar beet plants grown in nutrient solutions covering a wide range of boron supply. The first signs of boron deficiency appeared within a week in the treatments where no boron was added. The growing point of the shoot and root failed to grow and the plant remained stunted. Other boron deficiency symptoms are described. The mature blades were found to be the most suitable tissues for assessing the boron status of sugar beet plants. The blades had a higher boron content than the petioles where the boron supply was adequate but this relation was reversed in the deficient plants.

**Prevention and control of fungal root diseases of young sugar beet plants.** W. R. Schäufele and C. Winner. *Zucker*, 1972, **25**, 153–156.—Modern methods of cultivation and sowing to an extremely thin stand have greatly increased the risk of loss through young plants being attacked by root diseases. The environmental conditions which influence the level of infection are described. The early protection of young plants from root or soil fungi may be obtained by dressing the seed, but this is normally only effective locally and for a limited period.

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**Important aspects of sugar beet cultivation in Sriganganagar, Rajasthan.** N. Mukerji. *Indian Sugar*, 1971, **21**, 565–568.—A general account is given of the extended sugar beet cultivation now taking place in the area. It is pointed out that as difficulties or problems arise, such as those from pests and diseases, it is important that they be dealt with or remedied promptly, otherwise the peasant cultivators who raise the beet are likely to be discouraged or lose interest in the new crop.

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**Observations on seed beds for sugar beet.** E. Dalleinne. *Hautes Etudes Betterav. Agric.*, 1972, **4**, (14), 7–13.—The various soil factors concerned with the successful germination of sugar beet seed are discussed. Special emphasis is given to the deleterious effects, on germination, of compaction of the soil as caused by the wheels of heavy vehicles.

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**Regarding irrigation.** M. Robelin. *Hautes Etudes Betterav. Agric.*, 1972, **4**, (14), 24–29.—Crop irrigation has, of course, been practised from the earliest times. Since sugar beet is primarily a temperate climate crop, it is only in exceptional dry seasons that irrigation is likely to prove really beneficial. But in other warmer regions, where rainfall is minimal, irrigation may be essential for good sugar beet crops. Various aspects of sugar beet irrigation are here discussed, especially spray irrigation.

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**The cultivation of sugar beet in Spain.** R. J. Alvarez. *Hautes Etudes Betterav. Agric.*, 1972, **4**, (14), 34–39. A summary is given of the history of sugar beet cultivation in Spain, which commenced in 1878 in the provinces of Granada and Córdoba. Present day cultivation and production in the various beet producing areas of the country are then discussed. During the last decade the area devoted to sugar beet has greatly increased (by over 30%). There has been a similar increase in the per caput consumption of sugar in Spain during this period. The varieties of sugar beet at present cultivated are listed and some of the modern machinery used in harvesting in Spain illustrated.

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**Combating weeds by chemical means.** Anon. *Supplement to Betterav. Franç.*, 1971, (230), 20 pp.—The main weeds of sugar beet in France are listed under their French names (without scientific names) along with notes on their importance in beet cultivation and their sensitivity to various herbicides. The herbicides described and discussed include: "Pyramine", "Venzar", "Avadex", "Ro-neet", CL85, "Betanal" and mineral oil. The grass or monocotyledonous weeds are considered separately from the broad-leaved or dicotyledonous weeds.

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**Influence of inoculation date on expression of beet western yellows tolerance in twelve sugar beet varieties.** G. I. Mink. *Plant Disease Reporter*, 1972, **56**, 93–96. This disease is the major form of yellowing in Washington and other parts of the USA. Inoculation experiments with 12 varieties of sugar beet are described. It was found that the varieties could be separated into two groups based on level of total sugar loss resulting from the inoculations. Group 1 showed little or no disease tolerance when infected early but appeared tolerant when infected late. Group 2 showed little or no measurable tolerance regardless of the date inoculated. There was no apparent correlation between rate of symptom development and effects on sugar yield.

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**Production of sugar beet in Poland.** H. W. Byszewski. *Sucr. Belge*, 1972, **91**, 139–145.—Poland has about 400,000 hectares devoted to sugar beet, mainly in the form of small farmer's holdings (under 0·6 ha). Various technical, economic and social aspects of sugar beet production in the country are presented. Cultural methods at present practised are discussed and a broad outline given of selection and the production of Polish sugar beet varieties. There are 1120 regional reception centres for the crop. There are many complex problems of handling, transport and storage.

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**The fight against *Cercospora* disease of sugar beet in Turkey in 1970 with new systemic fungicides.** M. Göbelez. *Sucr. Belge*, 1972, **91**, 151–153.—The fight against *Cercospora* disease of sugar beet in Turkey in 1970 with new systemic fungicides is discussed. The efficiency of tin-based fungicides was compared with the newer systemic fungicides "Benlate" and "Enovit". A double treatment with them was more profitable than a triple treatment with the tin-based fungicide. There was no notable difference in beet yield, but polarization was affected.

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**Changes in sugar beet caused by γ-irradiation of seed.** M. P. Fasulo, G. Mantovani, G. dall'Olio, M. Berti and G. Pancaldi. *Zucker*, 1972, **25**, 247–256. Experiments were carried out to determine the effects of varying doses of irradiation in the range 250–50,000 rads on the seed of two diploid beet varieties, one a high-yielding and the other a high-sugar variety. Investigations of the morphology of pot- and field-grown plants, of root histological structure and of the caused marked damage, while the effects of smaller doses varied and could not be clearly described.

**Variation among Washington isolates of beet western yellows virus.** A. AAPOLA and G. I. MINK. *Plant Disease Reporter*, 1972, **56,** 198–202.—Thirty-two field isolates of beet western yellows virus (BWYV) were tested for their ability to infect 9 plant species. Sugar beets and shepherds' purse (*Calsella bursa-pastoris*) were infected by all 32 isolates. The other plants, mainly weeds, were affected by some of the isolates, varying from 3 to 28. Differences were found in the behaviour of some isolates from different geographical areas. In further tests, 9 isolates failed to infect one or both sugar beet varieties. Most produced slight stunting and reductions of top weight. Greatest variation occurred in root weights. Only one isolate significantly reduced root growth. There was no apparent correlation between origin of the isolates and effect on plant growth.

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**The incidence of sugar beet seedling diseases and effects of seed treatment in England.** W. J. BYFORD. *Plant Pathology*, 1972, **21,** (1), 16–19.—On average, 180 samples of sugar beet seed grown in England between 1958 and 1970, and examined before being steeped in ethyl mercuric phosphate (EMP), had 39% of clusters infected with *Phoma betae*. However, the fungus damaged few seedlings in commercial crops because this treatment controlled it. In 1969 *Aphanomyces* sp. was unusually prevalent in sugar beet crops. Treating EMP-steeped seed with a protectant fungicide did not, on average, significantly increase seedling emergence or final plant stand. It was concluded that the general use of protectant fungicides on sugar beet seed in England could not be justified. A method of soil treatment at drilling should be sought for use in fields where there is a special risk of soil-borne seedling disease, especially with late drilling in soil containing *Aphanomyces*.

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**Interpreting the rate of change in nitrate-nitrogen in sugar beet petioles.** J. N. CARTER, M. E. JENSEN and S. E. BOSMA. *Agronomy J.*, 1971, **63,** 669–674; through *Soils and Fertilizers*, 1972, **35,** 218.—Sugar beet was grown at 4 fertilizer rates and 2 irrigation levels to determine root yields, sucrose percentage, sucrose yield and N uptake in relation to $NO_3$-N concentration. The $NO_3$-N in the petioles increased to a peak concentration and then decreased during the growing season. The "rate of change approach" could be used to predict N needs of sugar beet and to characterize the N status of the soil crop system.

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**Effect of soil cultivation on development and yield of sugar beet (Experimental results 1968-70).** A. VEZ and P. VULLIOUD. *Mitt. Schweiz. Landwirt.*, 1971, **19,** (9), 161–170; through *Soils and Fertilizers*, 1972, **35,** 218. Three-year trials showed that sugar beet on medium to heavy soils benefited most (high emergence and yield) from autumn ploughing. Ploughing in the spring, especially on heavy soils, resulted in heterogeneous soil structure (owing to compression by tractor wheels), unfavourably affecting the emergence and quality of the beet; subsequent disc harrowing minimized the harmful effects of late ploughing on soil structure without improving emergence very much. Ploughless cultivation of sugar beet was not promising, as it generally resulted in lower yields and poorer quality of beets.

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**Effect of nitrogen fertilization on the nitrate nitrogen of petiole and its relation to root yield of sugar beet.** M. C. SAXENA, K. V. PARMESWARAN and A. JOSEPH. *Indian J. Agric. Sci.*, 1971, **41,** 206–209; through *Soils and Fertilizers*, 1972, **35,** 219.—Sugar beet, which was growing in a silty loam, was fertilized with N at various levels, either all at planting or part applied subsequently. Petiole $NO_3$-N contents generally decreased with age. N fertilizing significantly increased petiole $NO_3$-N content at all stages and the differences between N rates were greatest 120 days after planting. Petiole $NO_3$-N at 120 days was greatest in treatments receiving part of the N application as a top dressing. The best correlation of petiole $NO_3$-N content with root yield was obtained at 120 days.

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**Effect of lithium on growth, salt absorption and chemical composition of sugar beet plants.** A. M. EL-SHEIKH, A. ULRICH and T. C. BROYER. *Agronomy J.*, 1971, **63,** 755–758; through *Soils and Fertilizers*, 1972, **35,** 219.—Sugar beet plants were grown in a greenhouse with two K concentrations and lithium at 0·25 and 8·0 meq/litre. Li was detrimental to sugar beet growth at very low concentrations, especially to fibrous roots under low K conditions. Li toxicity induced yellow colouring of the leaf margins. The concentration in plant tissues was low, partly owing to low Li uptake, and increased with leaf age. Li induced an increase in K concentration and a decrease in Ca concentration in the plant, especially in mature and old leaves. Li was readily absorbed until the K in the nutrient solution was depleted.

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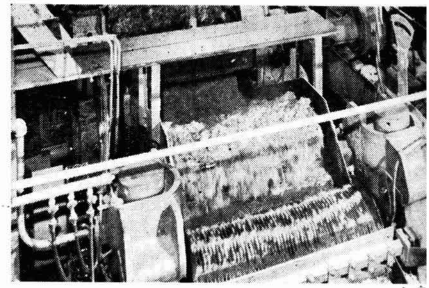
**Experiences in the application of herbicides and insecticides in a reduced amount of water to sugar beet.** F. LÖCHER. *Zucker*, 1972, **25,** 292–295.—In the experiments described, various soil-acting herbicides ("Pyrazon", "Diallate", "Triallate") and one insecticide ("Dimethoate") were tested with different amounts of liquid (50–400 litres/ha). The efficiency of "Pyramin" was not influenced by the reduction in the amount of liquid per ha, but with "Diallate" a clear reduction in efficiency was observed with 50 litres/ha. The insecticidal effect was not altered by the amount of spray mixture. With the reduced amounts of spray mixture, drift increased markedly, especially with 50 and 100 litres/ha. It is considered that in practice not less than 100–150 litres/ha of spray mixture should be used. Trials also showed that with different active ingredients the amount of spray mixture may not be reduced to the same extent.

# Cane sugar manufacture



**The Louisiana sugar industry.** G. J. DURBIN. *Sugar y Azúcar*, 1972, **67**, (6), 33–34.—A brief survey is presented on cane agriculture and sugar production in Louisiana.

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**The Florida sugar industry's outlook for the 1970's: continued growth with stability.** J. N. FAIRBANKS. *Sugar y Azúcar*, 1972, **67**, (6), 35–37.—Prospects and problems facing cane growing and sugar production in Florida are discussed.

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**Milling.** M. ANAND. *Sugar News* (India), 1972, **3**, (12), 4–9, 22–26.—The subject of cane milling is examined, including advantages of the inclined mill, mill drives, roller speeds, hydraulics, roller groovings, imbibition and sanitation.

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**Further work on fondant seeding and boiling of final massecuite.** T. C. JHINGAN and S. C. ARORA. *Sugar News* (India), 1972, **3**, (12), 27–30.—The use of a ball mill for seed slurry preparation has led to improvements in *C*-massecuite boiling and curing at the authors' factory. The practices used and results obtained are discussed.

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**Reclamation of continuous centrifugal screens.** J. P. MUKHERJEE and K. CHETTY. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.11–E.12.—See *I.S.J.*, 1973, **75**, 115.

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**Observations on the use of steel tubes in juice heaters.** K. P. MITTAL and A. PRAKASH. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.13–E.16. Tabulated data indicate no adverse effects on raw and sulphitation juice of steel tubes used in juice heaters instead of brass tubes.

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**Some aspects of steam turbine operations.** R. K. SIRDESHMUKH. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.17–E.22.—Advice, based on the author's experience, is given on factors to be considered regarding steam conditions and layout of steam piping for the satisfactory operation of a steam turbine in a generator plant.

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**Studies on cane diffusion.** D. P. KULKARNI and J. R. UNDE. *Proc. 4th Joint. Conv. Indian Sugar Tech. Assocs.*, 1971, E.23–E.38.—Laboratory data showed that diffusion extracted more soluble impurities from bagasse than did milling. Factory data for a mill plus DDS diffuser showed that the increases in CaO and ash contents from primary to mixed juice were greater than with milling alone but the latter extracted more gums and colloidal matter. Optimum diffusion temperature at which soluble impurity extraction was minimum was 65–70°C. Reducing sugars and ash contents were minimum and juice purity maximum at pH 6, although colour was minimum at pH 4–5, after which it increased with pH rise.

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**Facts about continuous centrifugals.** J. P. MUKHERJI, A. C. CHATTERJEE and S. S. GANGAVATI. *Proc. 4th Joint Conv. Indian Sugar Tech. Assoc.*, 1971, E.43–E.50.—See *I.S.J.*, 1973, **75**, 54.

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**An improvement in juice heaters and the process of heating juice therewith.** J. P. MUKHERJI, A. C. CHATTERJEE, C. SHYAMSUNDER and B. A. BHAGWAT. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.51–E.60, E.93–E.99.—Details are given of a "dynamic" juice heater in which the steam/vapour flow arrangement is such that there is positive flow and minimum condensation, heat transfer is better than in a conventional heater and steam consumption is lower for the same effective heat exchange area.

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**The continuous cane diffusion system "Nandi".** B. L. MITTAL. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.61–E.65.—A description is given of a patented cane diffuser design (the "Nandi") which consists of a horizontal rotary drum containing a scroll fitted with perforated screens and vanes fixed to the interior drum wall. The bagasse flows against the extraction liquid (water and thin juice from dewatering mills), heating being effected by low-pressure steam. Pilot-scale trials are to be carried out.

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**Observation on the working of a De Smet diffuser.** B. NARAYANARAO, K. BRAHMANANDAM and K. PATCHAPPALAM. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.67–E.76.—Performance data are presented for the De Smet diffuser at the Tanuku sugar factory of Andhra Sugars Ltd. Covering the second season of the diffuser's operation, they indicate greater extraction of sugar but not non-sugars. The problem of uneven bagasse discharge was overcome by modifications to the discharge scraper. Considerable reductions in the crushing rate had no adverse effect on diffusion. Other advantages are mentioned.

**Chemical cleaning and water conditioning for boilers in sugar industries.** A. K. BASU. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.77–E.79 —Boiler feedwater treatment is discussed and chemical cleaning and off-season protection of boilers using products of A1 Industries, of Bombay, are described.

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**Free floating of mill top rollers.** N. S. BHAT. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.81–E.83.—To reduce friction causing wear of upper brasses and mill housing when mill top rollers were free floating, the author introduced needle-type roller bearings between the feed side faces of the brasses and the mill housing, thereby replacing sliding friction with rolling friction.

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**Chemical cleaning of industrial equipment.** P. K. CHHEDA. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.85–E.92.—The pros and cons of chemical *vs.* mechanical cleaning of various types of vessels in the sugar factory are discussed and chemical descaling using products of Ashok Industries is described.

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**Bagasse saving.** K. R. PUNDIR. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.101–E.111.—See *I.S.J.*, 1970, **72**, 338.

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**The concept of manufacture of bold grains in sugar factories.** D. R. PARASHAR. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.1–M.6.—See *I.S.J.*, 1972, **74**, 247.

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**Influence of imbibition on recovery as observed in New Horizon Sugar Mills Private Ltd. during the season 1970-71.** L. C. BANERJI. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.7–M.9—It was found that sugar recovery % cane tended to fall (by 0·4–0·6% absolute) when imbibition was reduced from 20–25% to 15–18% on cane, best results being obtained generally about the 25% level.

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**Total purity loss—true index of boiling house efficiency.** B. S. GURUMURTHY. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.11–M.19.—Data and sample calculations of boiling house efficiency in terms of total purity loss (virtual molasses purity)[1] are presented to demonstrate the validity of the concept.

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**Virtual purity of molasses—the concept and its utility.** T. T. OOMMEN and B. S. GURUMURTHY. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.21–M.28.—See *I.S.J.*, 1971, **73**, 92.

**A case of entrainment.** K. K. RAO. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.29–M.32. Causes of entrainment in the last vessel of a quadruple-effect evaporator and how the problem was solved are discussed.

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**Different systems for cleaning of evaporators and their merits and demerits.** S. SRINIVASAN. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.33–M.41. See *I.S.J.*, 1971, **73**, 180.

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**Use of surface-active additive chemicals in low-grade massecuite boilings.** S. SRINIVASAN and T. S. THIYAGARAJAN. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.43–M.47.—Despite a lower purity drop in low-grade boiling and massecuite cooling, lower molasses Brix and purity and higher purity *C*-sugar when "Cutol" surfactant was used compared with "Instol" and with the absence of a surfactant, "Instol" is considered preferable for a number of reasons, including shorter boiling and purging times and better handling of massecuite. Addition of triple superphosphate to clarified juice was found to contribute to better molasses exhaustion.

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**Continuous filtration in a carbonatation sugar factory.** U. P. SINGH and R. K. GUPTA. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.49–M.57.—The performances of a Dorr-Oliver 3-tray clarifier and Oliver belt filter used for 1st carbonatation juice treatment at Mawana factory are reported, and comparison made with the results of filter-press operation. The rotary filter cake had a pol content of 0·4–1·6% compared with 3–35% in the filter-press cake. Clarifier overflow had a suspended solids content of 0·2–0·4%.

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**Studies on the working of Grand Pont filters in carbonatation sugar factories.** N. K. SAWHNEY. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.59–M.65.—Grand Pont filters, manufactured under licence by Triveni Engineering Works Ltd., have been installed at Ramkola sugar factory for continuous 2nd carbonatation juice treatment. Their operation and performances are discussed and their advantage over plate-and-frame filters listed. Filtrate from the Grand Pont filters is clear and free of haze. Use of the filters for 1st carbonatation juice treatment, with rotary filters to handle the muds, is considered practical.

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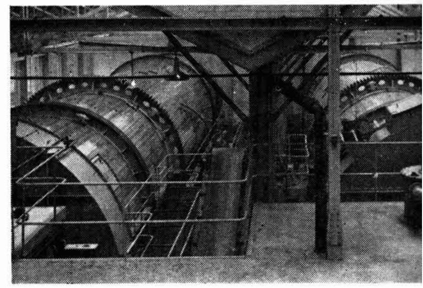
**A method for calculation of net gain in recovery on installation of a diffuser in cane sugar factories.** S. K. GOEL. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.193–M.199.—The method described has been applied to results at a particular factory and shows that sugar and non-sugar extraction was greater in diffusion than in milling, although there was a net gain in sugar recovery of 0·356% on cane.

[1] *I.S.J.*, 1971, **73**, 92.

# Beet sugar manufacture



**Automatic control of 1st carbonatation juice clarifier operation based on juice quality parameters.** A. M. BUNYAK, V. P. KOVAL'CHUK and I. I. GRITSENKO. *Sakhar. Prom.*, 1972, (5), 26–30.—A system, which has proved satisfactory in factory trials, is described which is based on measurement of juice turbidity in the vertical zone between clarified juice above and mud suspension below. With a fall in turbidity caused by downward mixing, the mud discharge port is closed until re-establishment of required conditions.

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**Sharpening beet slicer knives in tempered form with discs of very hard materials.** A. D. BAGLYUK. *Sakhar. Prom.*, 1972, (5), 31–33.—A unit constructed by the author for beet slicer knife sharpening with diamond or cubanite discs is described and the resultant high cossette quality discussed.

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**Evaporator boiling-out without clarifier liquidation.** A. P. LAPIN. *Sakhar. Prom.*, 1972, (5), 33–34.—At the author's factory the evaporator is boiled out during 6·5–7 hr but the clarifiers are not liquidated, formalin being added to the juice every 2 hr; filtrate from the mud filters and muddy suspension are recirculated to the clarifiers.

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**Improving the control of low-grade massecuite crystallization.** I. N. AKINDINOV. *Sakhar. Prom.*, 1972, (5), 35–37.—Expressions are given for calculation of permissible massecuite purity and Brix at the end of cooling. Sample calculations are presented and some calculated results tabulated.

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**Mixtures of liquid sugars and starch hydrolysates and their use.** C. KRÜGER and W. STEINMETZER. *Zucker*, 1972, **25**, 356–360, 396–401.—The applications of liquid sugar mixtures and their advantages and disadvantages are discussed, and references made to the literature and experiments regarding discoloration in storage, solubilities of various types of sugar in syrup mixtures, mixture viscosities, equilibrium relative humidity of mixed syrups and their microbiological stability as well as their effects in sugar-containing foodstuffs.

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**Calculation of uniflow drum dryers by means of transfer units.** W. POERSCH and P. THELEN. *Zeitsch. Zuckerind.*, 1972, **97**, 311–319.—It is shown how the dimensions of a drum dryer can be calculated with the aid of a computer from the number and length of the transfer units as in distillation and absorption calculations. The theoretical considerations are discussed and the effects of changes in operating conditions examined, with a beet pulp dryer as example, using processed data to simulate the course of each drying stage 1.

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**The dependence of technological criteria—alkalinity, molasses sugar and juice purity—of sugar beet on location-related and modifiable production factors.** A. GRAF. *Zeitsch. Zuckerind.*, 1972, **97**, 320–324. Beet yield, Na, K, amino-N and sugar contents, juice alkalinity and purity, molasses sugar and beet sugar yield are tabulated to show the effect of year, growth area, climatic conditions, soil factors (type, heaviness and $P_2O_5$ and $K_2O$ contents), N fertilizing and variety. The aim is to demonstrate the number of beet quality factors which can be controlled by modifications in beet growing and physiology.

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**Decomposition of predefecation mud during raw juice liming.** K. D. ZHURA, S. S. MIROSHNICHENKO and S. P. OLYANSKAYA. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 85–88.—Laboratory tests showed that at 50°C the albumin in predefecation mud starts to decompose and the amino-N content rises, the effect increasing with temperature and time, although the process is most pronounced in the first 60 min.

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**Effect of boiling point on colour change in sugar solutions.** M. A. GEISHTOVT, L. P. MAIOROVA and V. V. MAIOROV. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 89–91.—Experiments with a test plant showed that under otherwise identical heating conditions, the colour rise in thick juice with time of evaporation was smaller with forced circulation than with natural circulation. Empirical equations are presented which relate the colour rise to time at constant Brix and thus permit approximate calculation of the permissible juice residence time.

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**Effect of number of recirculation cycles on massecuite density in continuous boiling.** I. S. GULYI and N. M. FEDOTKIN. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 138–143.—A series of equations based on the recirculation theory is presented for use in analysing the continuous boiling process and calculating massecuite Brix as a function of the number of times the massecuite is circulated through the downtake and risers.

**Sugar crystallization rate during low-grade massecuite boiling with cutting.** M. I. DAISHEV and N. A. LYUSYI. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 185–186.—An equation is presented for calculation of crystallization rate between cuts as a function of massecuite purity in low-grade boiling. Using massecuite cutting has been found to give crystals having the same sizes as crystals in 2nd massecuite in a 3-boiling scheme. At an initial purity of about 84 no false graining was observed in tests.

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**NVI-L-1000-03 centrifugal for sugar.** M. I. IL'IN *et al.* *Sakhar. Prom.*, 1972, (6), 11–15.—Details and some performance data are given of the Soviet NVI-L-1000-03 continuous centrifugal which has a 2nd massecuite throughput of 15 tons/hr in a basket of 1000 mm diameter. The machine can also be used for affination.

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**Efficient types of batch vacuum pans.** L. G. BELOSTOTSKII and YU. D. KOT. *Sakhar. Prom.*, 1972, (6), 19–22.—The VAMTs-600 Soviet-designed vacuum pan is described and its advantages discussed. This so-called "multi-sectioned" pan has a series of annular elements, made of rectangular-section tubing, above a conventional calandria, the upper heating elements coming into operation only when the massecuite level rises above the calandria.

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**Experience in the use of beet slicers.** M. I. RYBALKIN. *Sakhar. Prom.*, 1972, (6), 22–23.—The author calls for greater attention to cossette length and quality than is being paid in many Soviet sugar factories and gives advice on slicer operation and knife maintenance.

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**Nomogram for establishing optimum conditions of regenerating strongly acidic cation exchange resins with sulphuric acid.** V. N. BELOUS and K. P. ZAKHAROV. *Sakhar. Prom.*, 1972, (6), 24–27.—A nomogram, based on demineralization experiments with green syrup, is presented and its use to find optimum regeneration conditions explained. A graph is also given showing the number of regeneration stages from 1 to 5 which is recommended according to acid concentration and consumption.

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**Determination of the cross-section area of evaporator circulation tubes.** B. A. MATVIENKO. *Sakhar. Prom.*, 1972, (6), 28–33.—Empirical equations and graphs are given for calculation of the minimum area of cross-section of evaporator circulation tubes at which optimum technological conditions are maintained. Satisfactory agreement was found between results calculated with the formula and experimental values of the ratio between the areas of cross-sections of circulation and boiling tube sections under optimum conditions.

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**Examination of entrainment characteristics of evaporators.** D. A. STOLYAR and N. YU. TOBILEVICH. *Sakhar. Prom.*, 1972, (6), 34–36.—Factors leading to entrainment in evaporators are examined on the basis of data obtained from an experimental unit, and graphs relating entrainment to juice level and steam rate are presented. A formula is derived which permits evaporator throughput to be calculated at a given permissible entrainment level.

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**Coagulation of organic matter by lime in beet juices in the presence of calcium carbonate.** J. VAŠÁTKO, A. DANDÁR and L. ZÁVODSKÝ. *Sucr. Belge*, 1972, **91**, 235–242.—Laboratory tests with a sucrose solution containing added albumin to which calcium carbonate and milk-of-lime were fed in controlled quantities showed that the improvement in coagulation was brought about by two distinct reactions: fixing of the colloids on the carbonate crystals in conformity with the law of adsorption, and the formation of insoluble $(CaO)_n$-$(CaCO_3)_m$ compounds having a stability governed by the quantity of $CaCO_3$ and reducing the reaction between sucrose and lime.

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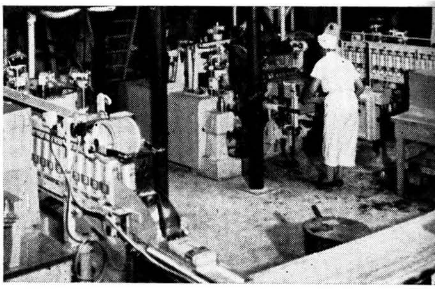
**Experiments on oil firing of a lime kiln.** D. E. ASH. *Paper presented to the 21st Tech. Conf., British Sugar Corp.*, 1972.—Because of threatened supplies of coke for limestone burning, tests were made with oil firing of a standard "Belgian" kiln at Peterborough factory during the 1971 off-season. The installation is described and an account given of the three tests. The main difficulty in the first two was fusion of limestone in the burner quarls which badly affected combustion. Modifications were made to the quarls for the third test, gas recirculation was introduced and the fuel water content increased to 50%, while additional thermocouples were fitted for recording more information during the test. Loading and firing were to be carried out at 600°C, afterwards rising slowly to 650–700°C. Adjustment of the firing rate and water content, temperature, etc., followed during the test and the % calcination data are recorded. Burning was even and controlled, and the kiln lining undamaged. Although calcination was not as great as with coke, this was compensated by the lower cost of the oil fuel.

* * *

**Applications of powder technology in sugar handling.** J. MATHER. *Paper presented to the 21st Tech. Conf., British Sugar Corp.*, 1972.—The literature contains much information on the properties of solids in powder form—including sugar—but this has not previously been assembled. The author reviews the properties of sugar in respect of factors which may be used for theoretical design of bulk handling equipment and bulk storage plant; these include the primary properties (temperature, moisture content, particle size analysis, crystal density, concentration and previous history) and the secondary properties dependent on these (angular properties, pneumatic conveying properties, bulk density, packing characteristics, permeability, explosive properties and Jenikes flow function and cohesion).

# Sugar refining



**Some aspects of the pore structure of carbonaceous adsorbents.** C. C. Chou. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 16–27.—Measurements of N sorption isotherms at —195°C, adsorption of cetyl trimethyl ammonium bromide from aqueous solution, oxidation of the carbon in adsorbents and retention of sucrose on adsorbent contacted with 60°Bx pure solution were used to examine the pore structure of carbonaceous adsorbents. It was found that an activated condition is necessary for the entry of an adsorbate molecule into the so-called "ink bottle" type of pore, the "activated entry" effect being used to explain the mechanism of sucrose retention which is mainly a pore-filling process. Pore blockage is responsible for adsorbent deterioration in service.

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**Use of chloride electrodes in refinery control.** P. Pommez and S. Stachenko. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 82–102.—Since chloride was found to be the constituent most removed (about 90%) in raw sugar affination and there was little variation in the quantity removed from raws of different origins, measurement of $Cl^-$ was chosen as a means of determining affination efficiency. Tests with a solid-state ion-selective chloride electrode paired with a silver-silver chloride reference electrode are described. Response of the electrode to changes in chloride concentration depended on temperature, Brix and liquor flow conditions around the electrode. Measured values were always higher than and not as accurate as values obtained by potentiometric titration with silver nitrate, but the latter is too time-consuming for on-line determination. Further studies are to be made using differential techniques. Measurement of potassium or sodium instead of chloride entails the use of flame photometry and possible interference, although the possibility of using selective electrodes, if available, is mentioned.

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**The rate of reaction of synthetic colorants and resinous adsorbents.** J. E. Rader and R. E. Anderson. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 114–124.—Studies are reported in which model colorants (caramelized sucrose, melanoidins and alkaline degraded fructose) were treated with each of four resinous adsorbents. It is shown that the percentage decolorization with time was governed by the nature of the colorant and the adsorbent structure, so that no one adsorbent would be capable of removing all the colorants in a sugar solution.

**Chemical losses of sugar in cane raw sugar processing.** Kh. Kh. Fai and S. Z. Ivanov. *Sakhar. Prom.*, 1972, **46,** (2), 14–16.—Investigations at a refinery have shown that in calculating the losses in boiling as a proportion of the total factory undetermined losses, the value obtained will be exaggerated if no allowance is made for the fact that the quantity of sugar in the pan increases gradually, i.e. the total amount in each strike is not subjected to heating throughout the entire boiling period. Reducing sugars adversely affect the thermal stability of sugar by reducing the product pH. No relationship was found between product purity and buffering capacity which is affected by non-sugar quality as well as quantity.

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**Raw sugar treatment in beet sugar factories with recycling of some of the green syrup to purification.** M. I. Daishev and I. F. Golubov. *Sakhar. Prom.*, 1972, **46,** (2), 17–20.—A major problem in inter-campaign processing of raw sugar at Soviet beet sugar factories is the inadequate number of boiling stages, which should be at least five where each strike is boiled on the preceding massecuite run-off, in contrast to three with normal campaign operation. One solution is use of a liquor composed of 1st massecuite raw syrup and 2nd and 3rd sugar remelt together with 1st massecuite raw washings for 1st massecuite boiling to yield white sugar, a 2nd massecuite boiled on 40% of the total 1st massecuite raw syrup, and 3rd massecuite boiled exclusively from 2nd massecuite run-off. Results at a factory using this scheme indicated a greater output of white sugar of lower colour content (0·75°St) and a lower molasses purity (50·9) and sugar loss (0·93%) than with previous schemes at the same factory.

* * *

**The use of new types of bags for sugar storage.** M. B. Yarmolinskii. *Sakhar. Prom.*, 1972, **46,** (2), 29–30. Snags in the use of plastic bags for sugar which are discussed include the possibility of caking under adverse storage conditions and the creation of pockets of infection. Hence, the author advocates the evacuation of air from the bags before heat sealing or, better still, bulk storage and transport.

* * *

**Decolorization and filtration of sugars.** W. B. Hill. *Paper presented to meeting of Filtration Society*, 1972, 4 pp.—Colour removal in refining is briefly discussed and details given of the "Talofloc" system[1], with its advantages and disadvantages listed and representative efficiency compared with that of a conventional system.

[1] *I.S.J.*, 1972, **74,** 313.

**Establishment of theoretical and experimental bases for continuous decolorization. I. Derivation of fundamental relationships from the viewpoint of kinetics of sorption processes.** M. FRIML, B. TICHÁ and K. TONINGER. *Listy Cukr.*, 1972, **88,** 65–69.—A method of calculating the parameters involved in continuous counter-current remelt colour adsorption in a column is proposed. The formulae are valid under conditions of constant temperature and constant adsorbent and adsorptive properties. Constants in the formulae are independent of column size and shape. The principle of drawing-up a colour balance on the basis of extinction measurement is explained.

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**Examination of the causes of crushed crystals in refined sugar.** S. A. BRENMAN and N. K. KUDRYAVTSEVA. *Sakhar. Prom.*, 1972, **46,** (3), 20–23.—Causes of crystal crushing during packaging, conveying, storage and transporting of refined sugar (granulated and cube) are investigated and recommendations made for its avoidance.

* * *

**Possible means of controlling refined sugar drying in multi-zone units.** V. A. DEMCHENKO. *Sakhar. Prom.*, 1972, **46,** (4), 21–23.—The principles of a control scheme for refined sugar drying in a Chambon unit based on variations in the initial moisture content of the input sugar are described[1].

* * *

**Mathematical statistics applied to maintenance in the refinery.** E. VERGARA. *ATAC*, 1972, (1), 11–15. Maintenance presents special problems for a developing country because of the economic difficulties arising from the need to import spare parts, lack of resources, etc., and it is necessary to extend the useful life of machinery to the maximum. A planned preventive maintenance programme is necessary and it is shown how statistical methods can be applied to identify the areas and equipment in a refinery where priority should be given to reduce breakages and downtime.

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**Activated carbon in the refining of sugar.** A. VERA Z. *ATAC*, 1972, (1), 42–45.—The nature, preparation, analysis and use of activated carbon as a decolorizing agent are reviewed.

* * *

**Strong base anion resins in the chloride form as a supplement to bone char in a refinery employing phosphatation.** W. R. TUSON, R. N. POLLET and E. J. GUIDRY. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 14–26. The liquor decolorizing plant at Gramercy refinery which is described consists of four columns charged with macroreticular strongly basic resin in $Cl^-$ form and is used as a supplement to the bone char station. Performance ranges from 52% to 62% and costs are calculated as 0·89 cents per cwt of solids filtered, or 0·61 cents per cwt of refined sugar.

**The kinetics of colorants adsorption on carbons.** C. C. CHOU and K. R. HANSON. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 27–40.—Batch and column tests on decolorization of raw sugar liquor with bone char were carried out to determine the effect of system variables on performance with the aim of establishing the relative importance of film and intra-particle diffusion and separating the controlling mechanisms in order to demonstrate the effect of each type of diffusion on colour removal and evaluate the rate coefficients of each diffusion. The results are discussed in terms of the effects of particle size and flow rate. Experimental data correlated satisfactorily with a theoretical diffusion model.

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**Thoughts on desweetening of char.** F. M. CHAPMAN. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 41–43. The costs of decolorizing with bone char will be strongly affected by its capacity as expressed by the volume of liquor decolorized and this varies widely within world-wide extremes of 30:1. This capacity will be related to the physical nature of the char which should be protected by care in its handling. Conditions in four sweetening-off installations are tabulated and compared, and conclusions drawn as to the optimum.

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**"Vibro" process for C & H cube sugars.** J. SHPAK and D. M. HUMM. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 44–51.—A description is given of the "Vibro" cube sugar installation[2] at Crockett refinery which replaced a Hersey unit. Reasons for selection of the new system are listed and a number of teething problems encountered with it are discussed. Solutions to the problems are described and the benefits derived during 3½ years' operation are enumerated.

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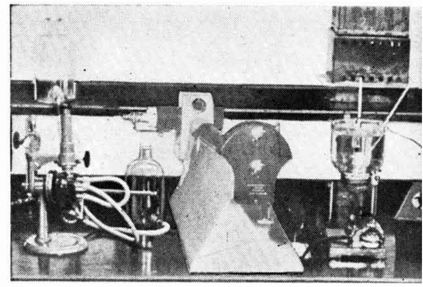
**Preliminary results on the use of "Talofloc" in sugar refining.** M. C. BENNETT. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 52–59.—See *I.S.J.*, 1972, **74,** 313; 1973, **75,** 183.

* * *

**Modernization of affination and carbonatation stations at Redpath Sugars Ltd., Montreal.** R. VALKERS, K. E. BAKER and S. STACHENKO. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 60–77.—Details are given of the modernized station, which is equipped with a Stevens coil heater and four 48 × 36-inch Western States automatic centrifugals, and modifications to the Sweetland filter station are described. Advantages of the changes include steady maintenance of melt rate and savings in manpower (only 2 operators run the entire affination-carbonatation station) as well as reduced maintenance and power costs.

[1] *I.S.J.*, 1972, **74,** 313.
[2] BIRCH-IENSEN: *I.S.J.*, 1965, **67,** 148.

# Laboratory methods & Chemical reports



**Determination of mineral oils in waste waters.** M. MAROUNEK. *Listy Cukr.*, 1972, **88,** 88–91.—Adsorption chromatography on a silica gel column was found to be suitable for examination of the composition of effluent extract. In experiments which are described, beet sugar factory waste water yielded three fractions, of which two were non-polar and contained mineral oils, while the third, clearly polar, contained oxidized mineral oils. The results indicate that the gravimetric method used to determine mineral oils in waste waters is imprecise and gives inaccurate values.

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**The standard criteria of raw sugar and the premium and penalty involved.** A. H. HIÑOLA. *Philssuccap Crystal*, 1972, **1**, (1), 18–21.—The standard set by US refiners for imported raw sugar pol, moisture, ash, osmophilic yeasts, grain size, filtrability and colour are set out and the possible monetary losses and gains to be made from above- and below-standard sugar are calculated. The standard set by the Philippines Sugar Quota Administration for raw sugar quality to meet the US requirements is a sugar pol of 97·2 and a safety factor of 0·25 ex-warehouse.

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**Statistical evaluation of polarization results as analysed by three sugar laboratories.** E. G. QUE and A. P. GUERRERO. *Sugar News* (Philippines), 1972, **48,** 49–53. Statistical analysis of polarization values obtained in 1969/70 at three Philippine sugar laboratories indicated significant differences in other than the first quarter of the fiscal year. It is suggested that these are the result of differences in the times taken to transport the samples from the bulk terminal to the laboratories, since the laboratory and sugar factory effects were eliminated as possible causes.

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**Determination of sodium, potassium and calcium in final molasses by means of the flame photometer.** S. H. FLEITES, M. MURO and J. MONTERDE. *Bol. Azuc. Mex.*, 1971, (264), 20–23.—The method described earlier[1] has been applied to molasses ashed in the presence of HCl, and its precision determined.

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**Effect of double curing on the quality of white sugar obtained.** P. DEVILLERS, M. LOILIER and J. ROGER. *Sucr. Franç.*, 1972, **113,** 257–260.—Double curing was simulated under laboratory conditions by mixing 1 kg of sugar with 1 kg of syrup (obtained by dissolving sugar in water) for 1 hr at 20°C followed by centrifuging for 5 min at 3000 rpm. Comparison between the resultant sugar and the initial sugar was made on the basis of visual appearance, ICUMSA colour value and ash, and indicated that double curing improves white sugar quality.

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**Prepared cane sampling at Mossman.** S. C. GRIMLEY. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 231–243.—Details are given of the cane sampling system at Mossman which incorporates a Rietz P.B.12 "Prebreaker" and a rotary sub-sampling table. A series of tests was conducted in 1971 and the results are analysed statistically.

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**The density of primary mud.** K. J. NIX. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 281–287.—An empirical formula $\frac{P_m}{P_j} = 1 + 0{\cdot}40\ X_1$, where $P_m$ and $P_j$ are, respectively, primary mud density and mud juice density at the temperature of the mud, and $X_1$ = mass fraction of the insoluble solids, has been found to give accurate values of primary mud density to within $\pm$ 2% for temperatures in the range 0–100°C. Details are given of the experimental procedure used, and the theoretical analysis of mud is explained.

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**Nucleation studies.** R. BROADFOOT and P. G. WRIGHT. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 353–362.—Empirical relationships have been developed under simulated factory conditions for the threshold supersaturation limit and for the rate of nucleation once the limit has been exceeded. However, it is stressed that the expressions, obtained only for high-purity solutions, should be used only with reservation, since many aspects are still to be investigated, particularly the effect of temperature on the threshold limit and the effects of supersaturation, temperature, crystal surface area, time and syrup purity on nucleation rates.

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**Conversion of a sieve analysis to a number size distribution.** E. T. WHITE and P. G. WRIGHT. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 369–377. An approximate method of interconverting sieve analysis values (crystal mass distribution with size interpreted as a sieve size, $L_s$) and crystal size distribution expressed as a number with size measured as the volume equivalent size $L_v$ is described, which is based on the counting of the number of crystals in a

[1] *I.S.J.*, 1973, **75,** 185.

given weight of a narrowly-sieved fraction, calculation of $L_r$ from the crystal mass by means of an expression which is given and plotting $L_v$ *vs.* $L_s$ for that fraction. The expression derived from the plot is only approximate, since the $L_r$:$L_s$ ratio is shape-dependent and will thus vary from crystal to crystal. Because of this, the same ratio can be used as a measure of crystal shape, as is briefly demonstrated.

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**The technological quality of sugar beet.** S. G. Enikeev and L. Z. Meshkova. *Sakhar. Prom.*, 1972, (5), 10–11. The adverse effects of cavity formation in the central parenchyma of beet crowns, here considered one of the major causes of poor processing quality because of the reduced sugar and increased noxious nitrogen contents, are discussed and free amino-acid and asparagine/aspartic acid contents in the central and outside parenchymata tabulated, showing the considerable increase in these with the formation of a hidden cavity.

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**Laboratory and manufacturing notes. I. Sugar losses in the factory.** C. Bayma. *Brasil Açuc.*, 1972, **79**, 329–333.—Owing to the large tonnage of cane and sugar processed, the effect of even small improvements in reducing losses can be economically important, and it is necessary to measure such loseses accurately. Control determination methods are briefly discussed for bagasse, filter cake, evaporator losses, final molasses and inversion losses, while undetermined losses are also discussed.

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**Sugar loss through hyperthermophilic micro-organisms in beet sugar factory diffusers. II. Microbial decomposition of reducing sugars.** H. Klaushofer and G. Pollach. *Zucker*, 1972, **25**, 388–395.—Investigations showed that different strains of micro-organisms were responsible for decomposition of sucrose, glucose and fructose, and that many act preferentially on monosaccharides, while others decompose sucrose more rapidly than they decompose its monosaccharide components. Reasons for the differences in decomposition rates are suggested. Mention is made of the fact that a strain of hyperthermophilic bacillus frequently occurs in diffusion juices which primarily decomposes reducing sugars but not sucrose and has a marked nitrate-reducing capacity.

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**Hydrolysis of polysaccharides in raw juice.** R. Bretschneider, B. Kopřiva, V. Žídek and I. Bohačenko. *Listy Cukr.*, 1972, **88**, 103–107.—Descending paper chromatography has revealed the presence of mannose, xylose and ribose as well as glucose, galactose, arabinose, rhamnose and galacturonic acid in hydrolysates of dispersed colloids from raw juice. Full details of the experiments and results are given.

**Method of determining contamination in diffusion.** L. Vokounová and J. Smolík. *Listy Cukr.*, 1972, **88**, 108–111.—Descriptions are given of quick methods, selected from the literature, which are recommended for (i) determination of bacterial counts under the microscope after staining with Congo red, and (ii) determination of bacterial metabolic activity by methods of pH or acidity measurement, nitrite determination and the redox indicator method using triphenyl tetrazolium chloride and resazurine.

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**Effect of ionizing radiation on the browning reaction of D-glucose, D-fructose, sucrose and raw cane sugar.** W. W. Binkley, M. E. Altenburg and M. L. Wolfrom. *Sugar J.*, 1972, **34**, (12), 25–28.—Irradiation of glycine and D-glucose separately before browning polymerization in aqueous solution caused a considerable increase in colour formation compared with a non-irradiated mixture. More colour was produced by irradiated D-fructose than irradiated D-glucose in a model system containing the reducing sugar and γ-amino-butyric acid. Irradiated sucrose contained products (probably irradiated reducing sugars) which participated in the browning reaction. Raw cane sugar received less protection from irradiation when stored in glass or plastic, which gave about the same protection.

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**Ageing of white sugars.** P. Devillers and J. Roger. *Sucr. Franç.*, 1972, **113**, 303–309.—Tabulated values indicate the deterioration in colour aspect and solution colour of white sugar samples stored for 2 years at 20°C and 60% relative humidity. Conductimetric ash values did not change during storage.

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**Reducing the colour of solutions by means of aluminium hydroxide.** S. E. Kharin and V. V. Maslova. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 26–29.—Addition of $Al(OH)_3$ to 20 ml solutions (209 mg Al per litre) of melanoidins, caramels and sucrose alkaline degradation products reduced the colour content, the greatest effect being obtained with caramels and the smallest effect with melanoidins. The decolorizing efficiency fell with rise in pH (which also caused a rise in the initial colour), best results being achieved at about pH 4. The presence of up to 20% sucrose had no effect, but at higher concentrations sucrose in an alkaline medium caused a fall in decolorization.

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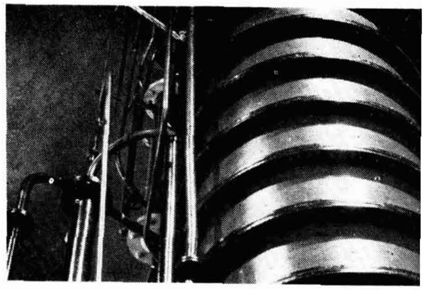
**Coefficients of interdiffusion of molecules in the system sucrose-water.** L. P. Zhmyrya, M. N. Dadenkova, B. M. Lysyanskii. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 131–133—Experiments are reported in which the molecular diffusion coefficient $D$ was determined by light diffraction at 25°C for aqueous sucrose solutions in the concentration range 3–70%. Comparison of results with values obtained by others indicate reliable accuracy. At concentrations above 40% the $D$ *vs.* concentration curve is practically linear.

# By-products



**Torula yeast as a supplement to pasture plus molasses for Holstein × Brahman heifers in early lactation.** J. GUZMÁN. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 259–262.—In tests in which torula yeast (produced from fermented final molasses) was added to pasture plus restricted quantities of molasses with or without urea, none of the yeast quantities had any effect on milk yield or composition.

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**Effect of diets based on concentrates or molasses on growth performance and rumen fermentation in early weaned dairy calves.** N. PERÓN. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 279–293.—Molasses-based diets caused lower dry matter and higher ash and water intakes than did concentrates, reduced the daily live weight gain and feed conversion compared with concentrates and had a number of effects on rumen fermentation.

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**Digestibility and rate of passage through the gastro-intestinal tract of torula/molasses in pig diets.** O. CARRILLO and M. C. BENAVIDES. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 331–339.—Results are presented of comparative tests in which pigs were fed on two different rations, one containing molasses and the other based on maize; both contained torula yeast.

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**A note on sucrase activity in the small intestine of growing pigs fed molasses.** J. LY. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 347–350.—The specific activity of the intestinal sucrase in the pigs was significantly greater in pigs fed on maize meal than in pigs fed on molasses-based diets.

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**Intestinal digestion of molasses in growing pigs.** J. LY. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 351–361.—Studies are reported on the intestinal digestion of pigs fed on molasses-based diets. The carbohydrates comprised fructose and sucrose but not glucose, and their maximum concentration was 0·9 mM/litre. The organic acids resulting from intestinal fermentation of molasses did not affect the metabolizable energy values.

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**Alcohol in rumen and blood pyruvate in animals affected by molasses toxicity.** F. DIXON. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 363–367.—In bulls fed on diets containing varying proportions of molasses, molasses toxicity was accompanied by a rise in blood pyruvate, the levels of which fell with thiamine administration or change of diet. Alcohol levels in blood and rumen liquor were considerably higher than in control animals fed only forage.

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**Thiamine and molasses toxicity. I. Effects with roughage free diets.** H. LOSADA, F. DIXON and T. R. PRESTON. *Rev. Cubana Cienc. Agric.*, 1971, **5**, 369–378. Full details are given of investigations into molasses toxicity in bulls fed molasses *ad lib.* plus urea, fish meal or torula yeast. Thiamine treatment did not reduce the incidence or severity of toxicity symptoms nor did it affect the blood pyruvate levels. It is concluded that the pattern of rumen fermentation changes with molasses toxicity, so that very little propionic acid is produced. Brain damage found in affected animals may be due to an inadequate supply of glucose and/or its precursors.

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**A review of production of MSG (monosidum glutamate) from sugar cane molasses and prospects in Pakistan.** Z. SAID. *Proc. 9th Conv. Pakistan Soc. Sugar Tech.*, 1971, 95–100.—Some information is given on mono-sodium glutamate production from cane molasses of 5–6% sugar concentration. Fermentation with a culture of *Micrococcus glutamicus*, *Brevibacterium flavum* or other microbacterium for 30–35 hours gives a thin broth containing 4–7% glutamic acid (30% on reducing sugars) which after subsequent treatment finally yields a glutamate of 99·5% purity. Yield is not mentioned.

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**Utilization of wastes and effluents as contribution towards soil fertility.** S. C. GUPTA and A. P. GUPTA. *Sugar News* (India), 1971, **3**, 19–21.—See *I.S.J.*, 1971, **73**, 123.

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**Influence of the new Cuban cane varieties on the pulp and paper industry.** E. BATLLE and J. A. ESPINOSA. *Bol. Azuc. Mex.*, 1971, (262), 13–20.—See *I.S.J.*, 1972, **74**, 349.

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**Preparation of monosaccharides from sucrose. I. Preparation of D-fructose and calcium D-gluconate.** M. KULHÁNEK and M. TADRA. *Listy Cukr.*, 1972, **88**, 31–35. **II. Preparation of D-mannitol and L-sorbose.** *idem ibid.*, 36–39.

I. The production of monosaccharides from sucrose is briefly examined and processes for preparation of D-fructose surveyed. A process is described in which

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a glucose-fructose mixture is fermented with *Aspergillus niger* as glucose oxidase source. The gluconic acid is crystallized as its calcium salt and 75% of the fructose in the fermentate isolated as a product of medicinal quality.

II. In the processes described, invert syrup is subjected to catalytic hydrogenation or fermentation with *Lactobacillus brevis* to yield D-mannitol and D-sorbitol in 1:3 ratio. After separation of the mannitol, the residual sorbitol (containing about 5% mannitol) may be fermented with *Acetobacterium suboxydans* CCM 1784 to yield 66·2% L-sorbose on initial syrup solids.

* * *

**Kinetic study of the hydrolysis of bagasse pentosans by the action of dilute nitric acid.** L. HERNÁNDEZ C. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (2), 3–26.—Studies have been made on bagasse treatment with dilute nitric acid, of about 30–52 g/litre concentration, at 70–90°C and the kinetics of the pentosan hydrolysis process investigated.

* * *

**Influence of technical oxytetracycline on the alcoholic fermentation of cane molasses.** D. O. FERNÁNDEZ and J. A. SICARD. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (2), 27–39.—From experiments in which oxytetracycline was added in various concentrations to the propagation (aerobic) and fermentation (anaerobic) stages, it was found that it stimulated yeast growth, reduced fermentation time by as much as 15% and controlled infection by other microorganisms, the most marked effect being found under the worst culture conditions. The technical grade antibiotic (8% a.i.) should be added in concentrations of 100 ppm at the propagation stage while the concentration in the fermenter should be about 25 ppm, varying according to the culture conditions.

* * *

**The problems and achievements of the world's largest bagasse board plant.** K. RUCKSTUHL. *Sugar y Azúcar*, 1972, **67**, (1), 14–16.—The equipment and processes used at the bagasse board factory operated by Standard Building Products Ltd. in Jamaica are described[1].

* * *

**Dried beet pulp as balanced feed.** ANON. *British Sugar Beet Rev.*, 1971, **40**, 93.—Dried molassed sugar beet pulp in a new form is being marketed by the British Sugar Corporation on a limited scale under the name "Triple Nuts". The product is described as a balanced feed containing 17% protein including 8% protein equivalent of urea and a high phosphorus, mineral/vitamin supplement. The product is claimed to be a safe and suitable way of feeding urea to ruminants.

* * *

**Sugar beet pulp for the dairy cow.** R. J. BURT. *British Sugar Beet Rev.*, 1971, **40**, 94–95.—Reasons why beet pulp is such a good stock feed are discussed. In the UK some 500,000 tons of dried molassed beet pulp, which has a high digestible fibre content, is made every year, more than half of which is bought by dairy farmers and used in shredded form or as pulp nuts. Methods of using beet pulp are discussed.

* * *

**Catalytic action of sea salt on the process of obtaining furfural from bagasse.** A. MILOVANOV and E. CORONA. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (3), 9–23.—See *I.S.J.*, 1971, **73**, 124.

* * *

**Influence of the sucrose concentration and the inoculation ratio on D.S.U. synthesis.** O. ALMAZÁN and R. RABELO. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (3), 39–48.—See *I.S.J.*, 1971, **73**, 187.

* * *

**Investigation of the reactivity of sugar cane bagasse cellulose by adiabatic acetylation.** Y. A. KOSTROV, C. J. TRIANA and I. F. GÓMEZ. *Sobre los derivados de la caña de azúcar*, 1972, **6**, (1), 14–19.—Two types of bagasse cellulose were studied: one obtained by the prehydrolysis-sulphate process and the other by nitric digestion. They were compared with a wood sulphite cellulose by treatment with glacial acetic acid at 80°C for one hour and recording of the heat curves. On this basis the nitric digestion bagasse cellulose was the most reactive. After neutralizing the acetic acid present in the acetylation syrups with triethanolamine, their characteristics were examined in respect of transparency, colour, filtration and viscosity. The poorest was from the bagasse sulphitation cellulose owing to the presence of impurities, particularly pentosans.

* * *

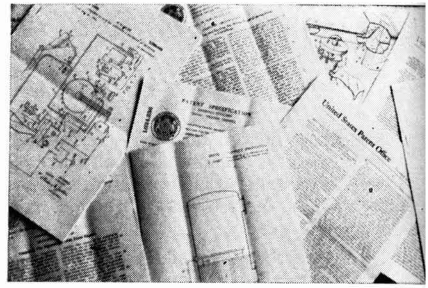
**Regeneration of lime from filter cake in the USA.** G. VERNOIS. *Zeitsch. Zuckerind.*, 1972, **97**, 324–326. Data obtained on a study tour in the USA are presented to show the economic advantage of natural gas used to fire a lime kiln at Carlton (California); but the waste gas $CO_2$ content is so low at 18% that, without the $CO_2$ from a coke-fired kiln at the same factory which yields a waste gas containing 35% $CO_2$, there would be insufficient $CO_2$ for carbonatation. A description is given of the plant at Mendota for filter cake lime recovery which includes an oil-fired rotary kiln producing 120–130 tons of CaO/day, i.e. sufficient for a 5,000 tons/day factory (Mendota has a daily capacity of 3,500 tons/day). No difficulties have been experienced as a result of the low $CO_2$ content of the waste gas, which averages 15%. The calcined lime costs about half that from a conventional kiln.

* * *

**Graphs of dried beet pulp pressing.** V. P. BORODYANSKII, N. N. DOVGAL' and G. A. PETRIK. *Sakhar. Prom.*, 1972, (6), 15–18.—Graphs, plotted from experimental data, are presented which relate pulp bulk weight, temperature and pressure in briquetting. Calculated values obtained from the associated formulae deviated from experimental values by no more than 10%.

[1] *I.S.J.*, 1972, **74**, 158.

# Patents



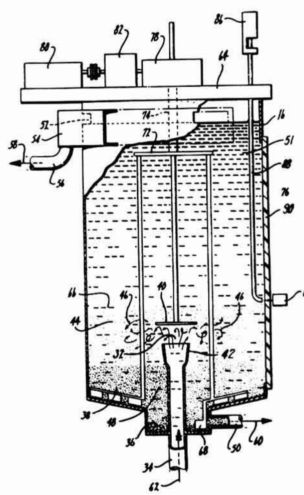
## UNITED KINGDOM

**Improvements in screw presses.** THE FRENCH OIL MILL MACHINERY CO., of Piqua, Ohio, USA. **1,266,055.** 23rd May 1969; 8th March 1972.—See US Patent 3,592,128[1].

* * *

**Clarification.** AMERICAN SUGAR CO., of New York, N.Y., USA. **1,267,106.** 20th November 1969; 15th March 1972.

Separation of solids from e.g. first carbonatation juice in a beet sugar factory is achieved by passing it through a deaerator and treating with an organic polyelectrolyte settling aid (a copolymer of acrylamide of M.W. 2–3 million, added in a proportion of 0·1–30 parts per million). After adequate mixing the settling aid forms agglomerates with the insoluble particles which are present in the juice entering the settling tank 16 by the feed pipe 34.

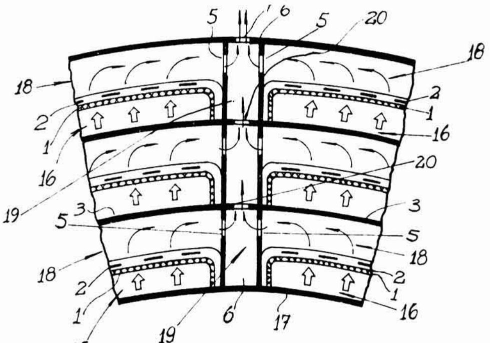


Upward juice movement is arrested by baffle 40 and its velocity reduced by widening the exit port 42 of pipe 34. The juice is deflected radially and further agglomeration of particles occurs within the settling zone 44. The larger agglomerates sink into the sludge zone 48 while clarified juice rises and is withdrawn through an overflow 51. The sludge is directed by rakes 68 into a central well 36 from which it is withdrawn through pipe 50. The depth of the settling bed may be regulated by means of a photoelectric cell 84 which gauges the clarity of the liquor as a function of light reaching it from a source 86 reflected within tube 88; the cell may be linked with the sludge discharge pump.

* * *

**Centrifugal.** F. URBANO G., of Buenos Aires, Argentina. **1,267,279.** 26th June 1970; 15th March 1972.

A horizontal rotating drum is provided with a number of concentric frustro-conical units, the innermost having a solid inner wall 17. Outside this in turn are a series of sections formed by filter grids 1 of wire, etc., supported by a perforated backing plate 2 held in place by fins extending from the solid back plate 3. Between each section is a channel element 6 of rectangular section having perforations 5 in the sides and end, the outermost channel's end perforations corresponding to perforations in the outermost solid frustro-conical shell.



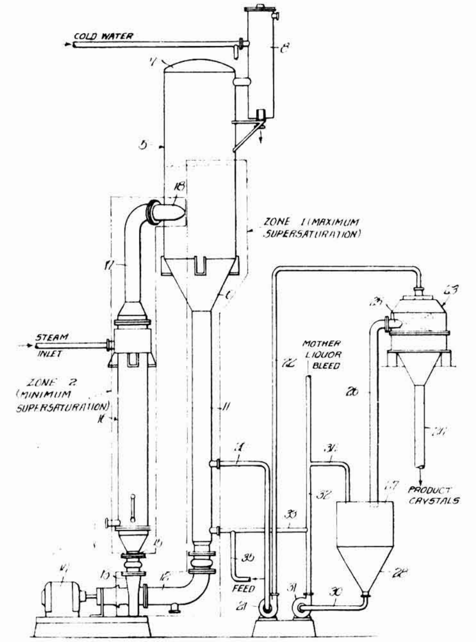
A manifold is provided on the stationary housing such that massecuite is delivered into the smaller end of the rotating frustro-conical unit. It enters the cavities 16 and is directed towards the wider end of the cavities. The molasses is directed by centrifugal force through the grids 1 and perforations in plates 2, entering the chambers 18. From these it passes through perforations 5 into the chambers 19 formed by elements 6 and so eventually through perforations 7 to the outside of the drum. The crystals meanwhile pass along the length of the grids and are discharged at the wider end of the drum, appropriate collecting equipment being provided for both sugar and molasses. The separating surface within the unit is much greater than in a single-cone centrifugal.

[1] *I.S.J.*, 1973, **75**, 91.

**Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price 25p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. 20231 USA (price 50 cents each)**

**Continuous sugar crystallization.** WHITING CORPORATION, of Harvey, Ill., USA. **1,268,563.** 17th March 1969; 29th March 1972.

The crystallizer vessel 5 is closed by a lid 7 and connected through a conical section 6 to a downpipe 11. This is connected by an elbow 12 to the inlet of a circulating pump 13 driven by a motor 14. The pump discharges to a tubular heat exchanger 16 fitted with a steam jacket and delivering to an elbow 17 connected at 18 to the bottom portion of vessel 5. Vapour withdrawn from the vessel is cooled by condenser 8. Near the bottom of column 11 is a withdrawal pipe 20 delivering to a pump 21 which feeds a continuous centrifuge 23 by way of pipe 22; in the centrifuge larger crystals of adequate product size are separated and the fine crystals and mother liquor are delivered through pipe 26 to tank 27.




The contents of the latter may be recirculated through pipes 30, 32 and 34 by pump 31; alternatively they may be returned to column 11 through pipe 33, with additional feed through pipe 35. The last is used for the initial feed of syrup which is brought to the desired level in vessel 5 and circulated by pump 13 while heated by steam admitted to heat exchanger 16. Vapour is evolved and withdrawn by condenser 8 while additional feed is supplied by way of pipe 35. When the supersaturation has reached the appropriate level a seed slurry is admitted with the feed and the crystals start to develop. A proportion of the massecuite is withdrawn through pipe 20, product crystals separated and the mother liquor with fines returned to the crystallizing system to act as nuclei for further growth. Sufficient mother liquor is discharged to prevent the impurities level in the liquor rising above 10% on total solids. Further nuclei may be introduced by other means including a high-speed rotating saw blade held within the crystallizer vessel 5, or a high-frequency sonic generator.

* * *

**Method of cleaning sugar crystals.** BIRD MACHINE COMPANY, of South Walpole, Mass., USA. **1,268,972.** 18th August 1969; 29th March 1972.—See US Patent 3,575,709[1].

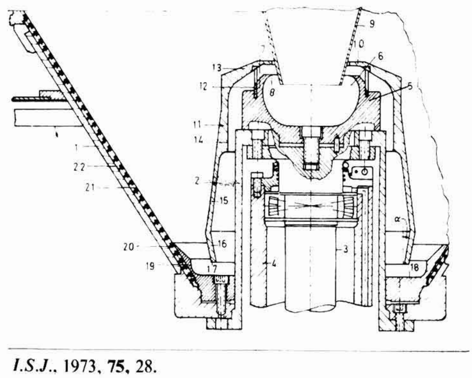
* * *

**Method of skimming sugar juices in countercurrent cossette machines.** BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **1,270,237.** 23rd November 1970; 12th April 1972.—Scum is formed in cossette scalders, as a result of liberation of inter-cellular air or gas during heating, as well as air carried with the supply of cossettes. This scum is a source of possible loss by spillage and can stagnate, encouraging microbial infection. To avoid such loss the scum carried by a minor juice stream (50–100% on beets) is skimmed off the surface of the major juice/cossette flow and transferred to an expander chamber where finely-divided steam is admitted through jets to the surface, so destroying the scum. Steam injected into the juice in the expander chamber or in a following separate chamber raises the temperature of the scum-free juice by 5–10°C and it is recycled to the scalder. Small quantities of scum-inhibiting materials may additionally be added to the juice entering the expander chamber.

* * *

**Continuous centrifugal.** BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **1,270,904.** 5th June 1970; 19th April 1972.

Uniform feeding of the continuous centrifugal 1 is achieved even with highly viscous massecuites by subjecting the feed to disturbance and partial "damming" in its passage through the accelerator cone 11. The massecuite is delivered by pipe 9 through an aperture 10 in the accelerating cone and enters the recess 6 within the feed plate 5. It fills this and overflows through the constriction formed by the upper surface 8.



[1] *I.S.J.*, 1973, **75**, 28.

It passes to the top portion 13 of the cone, being swirled to some extent after passing the struts 12 linking the cone to the plate (and thus the hub of the centrifugal). It continues to a cylindrical section 14 and a further conical section 15 and is then partially "dammed" by inward cone section 16 from which it is discharged over rim 17 to the bottom 18 of the centrifugal drum and thence onto the screen 19.

* * *

**Ion exchange treatment of sugar solutions.** N.V. OCTROOIEN MIJ. ACTIVIT, of Amsterdam, Holland. **1,273,911.** 4th June 1970; 10th May 1972.—Sugar solution is treated for removal of impurities by contacting with a macroporous insoluble polymer of one or more vinyl-aromatic or divinyl-aromatic compounds (in the form of beads), the polymer containing polar or polarizable, non-dissociable active groups which may be nitro, halogeno or acetyl groups [a copolymer of styrene and (20–80% w/w) divinylbenzene (having nitro groups)]. (The active groups may be introduced into the polymer after it has been formed from the monomeric constituents.)

* * *

**Sugar syrup.** TATE & LYLE LTD., of London E.C.3, England. **1,274,356.** 3rd February 1970; 17th May 1972.—A partially solidified sugar syrup, for household use as a spread, is produced by adding a fine particulate reducing sugar (invert sugar or glucose) to a (sucrose-containing) syrup, saturated or supersaturated with the reducing sugar (partially inverted refiners' syrup), and allowing the mixture to set.

* * *

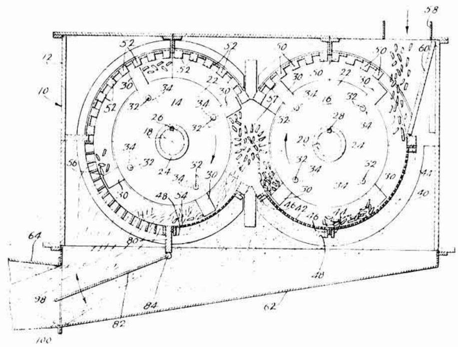
## UNITED STATES

**Cellulose pulp manufacture.** E. C. MILLS, of Seattle, Wash., USA, *assr.* ALSCOPE LTD. **3,461,028.** 1st February 1968; 12th August 1969.—Lignins present in a vegetable raw material, including bagasse, are broken down by presteaming to decrease the moisture content (thereby increasing the capacity of the raw material to absorb aqueous solutions) and then impregnating with dilute nitric acid containing 1 part by weight of $NH_4OH$ per 100–250 parts of $HNO_3$. The excess solution is removed and the raw material heated to initiate an exothermic reaction between the lignins and the $HNO_3$. The temperature is controlled so that it does not exceed 97°C. Alternatively the raw material may be impregnated first with dilute aqueous $NH_4OH$ (at 45–60°C), excess of the latter removed, and the raw material impregnated a second time with dilute $HNO_3$ (at $< 45$°C) before continuing the process.

* * *

**Bagasse defibring hammer mill.** K. RUCKSTUHL, of Basel, Switzerland, *assr.* FIBRELITE CORPORATION. **3,490,705.** 10th August 1967; 20th January 1970.

Within casing 12 are mounted two horizontal driven shafts 18, 20, each supported by bearings and carrying a rotor 14, 16 in the form of a series of discs 22 held apart by spacers 24 and prevented from rotating relative to the shafts by keys 26, 28. At intervals around the discs are horizontal rods 32 with spacers 34 and carrying hammers 30. Around the lower sector of rotor 16 are arcuate screens 40 and 42 supported by frames 44 and 46; above rotor 16 are arcuate toothed attrition plates 50. Similar plates 52 are located above rotor 14 but the lower sector includes only a small screen 54 and a screen 56.



The rotors are driven in the same sense, as indicated by the arrows, and bagasse is delivered through inlet port 58 and guided by plate 60 to the space between rotor 16 and the screens. The fines which separate drop through the screens into the discharge housing 62 while the remaining material is carried over to the zone of rotor 14, passes over screen 54 where more fines are separated, and thence to the screen 56 where the fibrous fraction is passed into the housing 62. Material which is not discharged is carried round by rotor 14, past the attrition plates 52 and collides in zone 57 with material discharged from rotor 16. By limiting the path swept by the hammers to less than 12% of the grinding zone (by restricting the width of the individual hammers to 2½% of the axial distance between them and restricting the width of the zone swept by the hammers to <12% of the screen width) and by allowing interaction of the two streams of fibrous material in zone 57, separation of the two fractions is aided. In addition, a suction control plate 82, pivoting about horizontal axis 84 in response to an external control mechanism, governs the suction applied to either side and thus to the screens 40, 42, 54 relative to the screen 56. This governs the length of time in which the raw material stays within the various grinding zones and thus the separation of its constituents.

* * *

**Beet or cane diffuser.** M. J. C. BARRE, of Faches Thumesnil, France, *assr.* SOCIÉTÉ SUCRIÈRE DE L'ATLANTIQUE (ENGINEERING). **3,632,445.** 10th March 1969; 4th January 1972.—See UK Patent 1,218,870[1].

[1] *I.S.J.*, 1972, **74**, 284.

**Dry cane cleaner.** M. W. Chapman, of Middle Cove, N.S.W., Australia, *assr.* Colonial Sugar Refining Co. Ltd. **3,635,336.** 15th January 1969; 18th January 1972.—See UK Patent 1,243,463[1].

* * *

**Apparatus for stirring, measuring viscosity and boiling of sugar.** H. Thiele, T. von Doring and G. Wegner, of Wevelinghoven, Germany, *assrs.* Pfeifer & Langen. **3,636, 753.** 29th July 1968; 25th January 1972.—See UK Patent 1,221,124[2].

* * *

**Sugar crystallization method.** J. de Cremoux, of Lille, France, *assr.* Soc. Fives Lille-Cail. **3,642,534.** 5th December 1969; 15th February 1972.—The method includes preparation of a magma of sugar crystals of predetermined size and adding this magma to syrup where it acts as seed for the crystallization of sugar from the syrup, the magma being prepared by comminution of sugar crystals in a massecuite, the latter or the magma being diluted with water. The syrup and magma are fed continuously to a crystallizer vessel while massecuite is withdrawn and the crystals comminuted in a rotary mill containing grinding bodies (e.g. a ball mill) having a surrounding screen which retains the latter but allows the comminuted crystals to pass. A temporary storage vessel may be provided for the treated massecuite.

* * *

**Tabletting sugar.** C. P. Graham, L. Fonti and A. M. Martinez, *assrs.* American Sugar Co., of New York, N.Y., USA. **3,642,535.** 21st January 1970; 15th February 1972.—Stable, substantially non-hygroscopic tablet sugar may be made by direct compaction into the desired shape of a free-flowing sugar composition consisting essentially of (98%) finely-divided (through 35 Tyler mesh) agglomerates of fondant-size sugar crystals (3–50 μ), these crystals being uniformly mixed or coated with 0·5–7·5% (2%) malto-dextrin (by co-crystallization), the sugar composition having a moisture content of $\not>$1%.

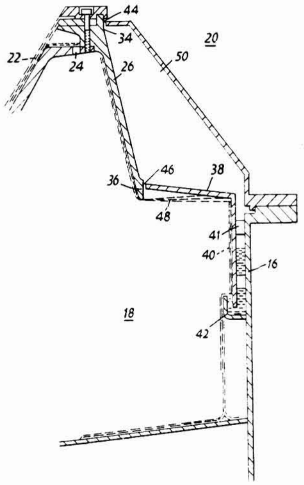
* * *

**Cane harvester.** F. P. Gomes and D. K. Andrews, of Hawi, Hawaii, USA, *assrs.* Kohala Sugar Co. **3,645,073.** 2nd June 1970; 29th February 1972.

* * *

**Continuous centrifugal.** A. Mercier, of La Madeleine, France, *assr.* Fives Lille-Cail. **3,647,135.** 8th December 1969; 7th March 1972.

The molasses passing through the screen surface 22 of the conical type continuous centrifugal travels up the space between it and the solid cone. The latter carries a flange 24 to which is bolted a skirt 26, and ducts machined in the two allow the molasses to pass into the chamber beneath the cone. It travels down the underside of the skirt and is discharged as a horizontal sheet 48 at the rim, thence draining along the inside of the housing under truncated cone 38 and baffle 40 through a hydraulic seal 42 and so to the discharge duct. Flat surfaces 34 and 36 on the




skirt correspond to cylindrical surfaces on the housing and with a narrow clearance prevent passage of the molasses into the chamber where the discharged sugar collects.

* * *

**Method of reducing the raffinose content of beet molasses.** H. Suzuki, Y. Ozawa and O. Tanabe, of Chiba-shi, Japan, *assrs.* Agency of Industrial Science & Technology. **3,647,625.** 5th March 1968; 7th March 1972.—The raffinose content of beet juice or molasses is reduced by treatment with the mycelium formed on culturing the mould *Mortierella vinacea* var. *raffinoseutilizer* on a medium containing galactose or an oligosaccharide having an α- or β-galactoside bond. The mixture of mycelium and juice or molasses is maintained under suitable conditions (20–70°C, pH 3–7) until the α-galactosidase present in the mycelium decomposes part of the raffinose present to give sucrose, increasing the yield of the latter.

* * *

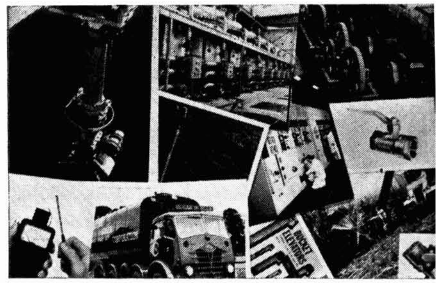
**Combating pigweed in sugar beet fields.** W. C. Doyle and J. L. Ahle, *assrs.* Gulf Research & Development Co., of Pittsburgh, Pa., USA. **3,650,728.** 18th December 1969; 21st March 1972.—Pigweed is controlled by post-emergence application of a herbicidally-effective amount of a mixture of 1 part of methyl 3-(N′-*m*-tolylcarbamoyl) carbanilate and $\frac{1}{4}$–2 parts ($\frac{1}{2}$–1 part) of 2-(*m*-chlorophenyl)-4H-3,1-benzoxazin-4-one, in combination with an organic solvent and surface-active agent.

* * *

**Cane grab for a windrow loader.** H. A. Willett, of Thibodaux, La., USA, *assr.* Cane Machinery & Engineering Co. **3,651,966.** 11th June 1970; 28th March 1972.

[1] *I.S.J.*, 1972, **74**, 189.
[2] *ibid.*, 1971, **73**, 381.

# Trade notices



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**Tractors for cane plantations.** Muir-Hill, Bristol Rd., Gloucester, England.

The illustration shows a 110-hp, 4-wheel drive Muir-Hill tractor pulling a 3-shank subsoiler to a depth of 25–27 in (63·5–68·6 cm) on a cane plantation in Barbados. No wheel slip was experienced in 2nd and 3rd gears. The soil had already been turned by a disc plough pulled by the same tractor on overgrown ground with the disc at maximum depth. Properties of the Muir-Hill tractors which have proved invaluable under such conditions are the wheel track adjustment possibility, small turning circle at the end of rows, low overall weight (important during flood irrigation when cultivating between rows) and high tractive effort.

Excessive tyre wear is avoided by permitting the front-wheel drive to be disconnected for fast pulling of up to 60 tons of cane in a string of trailers from the field to the factory and by the use of disc brakes on all four wheels. The possibility of using Muir-Hill tractors to haul fire trucks when burning cane is being considered. Muir-Hill is a member of the Babcock & Wilcox Ltd. Construction Equipment Division.

* * *

**RT beet washer.** Soc. Sucrière d'Etudes et de Conseils S.A., 1 Aandorenstraat, Tienen, Belgium.

The RT beet washer comprises two troughs in series, the second one at a lower level than the first. The bottom sections slope to permit discharge of muddy water. The beet are washed by water sprayed from above and below them as they travel over a series of stepped flexible plates. The troughs undergo a slow oscillating movement, causing the beet to progress at a controlled rate along each. Total washing time is 16 sec, and maximum soil removal is obtained at a consumption of only 1·3 litres of recycled water per kg of beet (the water is returned from the muddy water basin via a filter). All parts in contact with the beet are of stainless steel.

* * *

## PUBLICATIONS RECEIVED

**WATER JETTING ACCESSORIES.** F. A. Hughes & Co. Ltd., Blenheim Rd., Longmead, Epsom, Surrey, England.

Publication No. 3005 is an illustrated catalogue of water jetting accessories for pressures up to 1000 kg.cm$^{-2}$ (15,000 lb in$^{-2}$) of use in cleaning external and internal surfaces such as tubes, drains, etc. with flexible or rigid lances, and with jet guns or hydraulically-assisted foot valves.

* * *

**Molasses sugar extraction.**—Shown in the illustration is the Salzgitter Maschinen molasses sugar extraction plant supplied to Miandoab sugar factory in Iran and mentioned earlier[1].

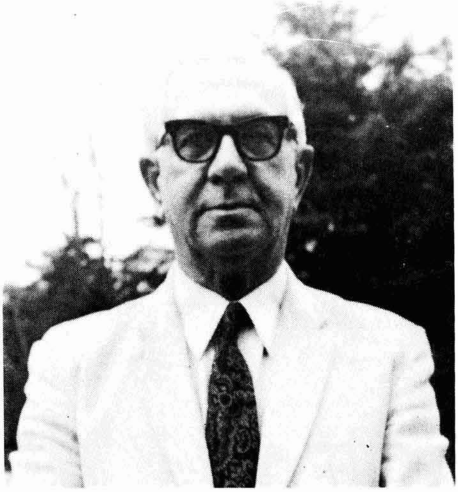
* * *

**Toft Bros. Industries Ltd.**—The Don Mizzi Harvester and Don Implement Division of Wyper Bros. Ltd., of Bundaberg, Queensland, Australia, has been acquired by Toft Bros. Industries Ltd., also of Bundaberg, specialists in cane harvesting and handling equipment. The merger will greatly increase the company's production facilities and its capacity for future expansion, while also providing for the continuation of manufacture and sale of tractor-mounted cane harvesters and the well-known "Don" cane farming implements. The announcement was made early in May by MILTON H. PICKUP, Chairman of Toft Bros. Industries Ltd. and President of Theo. H. Davies & Co. Ltd., of Hawaii.

[1] *I.S.J.*, 1973, **75**, 158.

# ISJ Panel of Referees

WE are happy to announce that Dr. HARRY EVANS, O.B.E., has consented to join our Panel of Referees. Dr. EVANS graduated from the University of Wales in 1928 and was subsequently awarded a Ph.D. for crop physiological research in 1931. After working in the Physiology Department of East Malling Research Station during 1931–32 he joined the regional staff of the newly-formed Sugar Cane Research Station in Mauritius in 1932 as Physiological Botanist, remaining there until he was seconded for war-time duties during 1940-45.



He rejoined the Station in 1946 and was Agricultural Officer-in-Charge during 1947 and 1948. In December 1948 he was appointed Senior Plant Physiologist in the newly-formed Cocoa Research Scheme and continued in this post until 1952 when he accepted an offer from Booker Sugar Estates Ltd. to become Agricultural Director in Guyana. He served in this position until 1967 when he retired from Guyana and became a Director of Booker Agricultural and Technical Services Ltd. He has served in a specialist capacity on many Commissions related to the sugar industry in several countries and in a consultative capacity almost continuously during the past six years. He was awarded the degree of Doctor of Science by the University of Wales for his researches in Tropical Agriculture and appointed O.B.E. for services to tropical agriculture by H.M. The Queen in 1961.

This Journal is most appreciative of its good fortune that Dr. EVANS is willing to make available his experience and expertise in examination of submitted manuscripts and thus ensure the continuing high standard of work published in our pages.

# US sugar supply quotas, 1973

| | *Initial quotas before changes* | *Quota changes dated* 25th April | 25th May | *Quotas in effect* |
|---|---|---|---|---|
| | *(short tons, raw value)* | | | |
| Domestic Beet | 3,500,000 | — | — | 3,500,000 |
| Mainland Cane | 1,591,000 | — | — | 1,591,000 |
| Texas Cane .... | 20,000 | — | — | 20,000 |
| Hawaii ........ | 1,185,000 | — | — | 1,185,000 |
| Puerto Rico .... | 205,000 | −50,000 | −20,000 | 135,000 |
| Philippines .... | 1,347,591 | 15,040 | 26,896 | 1,389,527 |
| Argentina ...... | 77,182 | 881 | 3,105 | 81,168 |
| Australia ...... | 205,209 | — | −1,193 | 204,016 |
| Bolivia ........ | 6,558 | 75 | 264 | 6,897 |
| Brazil ........ | 556,916 | 6,355 | 22,413 | 585,684 |
| British Honduras | 34,303 | 391 | 1,380 | 36,074 |
| Colombia ...... | 68,605 | 783 | 2,762 | 72,150 |
| Costa Rica .... | 69,615 | 794 | 6,532 | 76,941 |
| Dominican Rep. | 645,698 | 7,368 | 25,987 | 679,053 |
| Ecuador ...... | 82,226 | 938 | 3,311 | 86,475 |
| Fiji .......... | 44,967 | — | − 262 | 44,705 |
| Guatemala .... | 59,525 | 679 | 5,586 | 65,790 |
| Haiti ........ | 31,276 | 357 | 1,258 | 32,891 |
| Honduras ...... | 12,107 | 138 | −12,245 | 0 |
| India .......... | 82,165 | — | − 477 | 81,688 |
| Ireland ........ | 5,351 | — | — | 5,351 |
| Malagasy Republic | 12,264 | — | − 72 | 12,192 |
| Mauritius ...... | 30,250 | — | −176 | 30,074 |
| Mexico ...... | 571,040 | 6,517 | 22,981 | 600,538 |
| Nicaragua .... | 65,075 | 743 | 6,104 | 71,922 |
| Panama ...... | 65,075 | 743 | −15,818 | 50,000 |
| Paraguay ...... | 6,558 | 75 | 264 | 6,897 |
| Peru .......... | 398,517 | 4,548 | 16,039 | 419,104 |
| Salvador ...... | 43,382 | 495 | 4,072 | 47,949 |
| South Africa.... | 58,047 | — | − 338 | 57,709 |
| Swaziland ...... | 30,250 | — | − 176 | 30,074 |
| Taiwan ...... | 85,436 | — | − 497 | 84,939 |
| Thailand ...... | 18,804 | — | − 110 | 18,694 |
| Venezuela ...... | 62,048 | 708 | 2,498 | 65,254 |
| West Indies .... | 207,835 | 2,372 | − 100,000 | 110,207 |
| | 11,500,000 | | | 11,500,000 |

# Brevities

**New sugar factory for Spain**[1].—The 1200 sugar beet growers of the "Onésimo Redondo" cooperative in Valladolid are planning to build a sugar factory with a daily processing capacity of 4000 tons.

* * *

**Environmental chemistry symposium**.—More than 200 specialists from Europe, the US and Japan are expected to attend a symposium on environmental chemistry organized by the i.b./c.c. (International Business Contact Club), which will take place during the 24th–25th October 1973 in the Hotel Atlanta, Brussels. Papers are to be presented by representatives of a number of companies and will cover filtration, ion exchange resins, water treatment, visible stack emissions, etc. The programme is available from the i.i./b.c. Administration, Nieuwelaan 65, B 1820 Strombeek, Belgium.

* * *

**Microbiology courses**.—The Department of Microbiology of University College, Cardiff, South Wales is holding two courses for chemists and engineers in industry in order to provide them with training in this speciality. The courses will be held during 16th–21st September and will be on the "Microbiology of Effluent Treatment" and an "Applied Microbiology Course", respectively. Further details may be obtained from Dr. C. F. FORSTER at the Department.

* * *

**New USSR sugar factory**[2].—One of the largest sugar factories in the Russian Federal Republic has started operations in Valuiki in the Belgorod district. It is the eleventh of a series of factories provided with full automation and electronic controls.

[1] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (5), 7.
[2] *ibid.*, (4), 5.

# Brevities

**The late Niels B. Bach.**—The death occurred recently of NIELS B. BACH, at his home in Vestervig, Denmark. He was 87. He studied chemical engineering in Copenhagen and Braunschweig, and subsequently travelled to Java and the Philippines where he owned and operated sugar factories. During his career, Mr. BACH obtained several patents on cane juice clarification and, in conjunction with The Mirrlees Watson Co. Ltd., installed close on two hundred Bach-Mirrlees subsiders and fifty Bach-Mirrlees "Poly-Cell" clarifiers around the world. His last patent, on an improved version of the "Poly-Cell" clarifier, was granted just two weeks before his death.

* * *

**Egyptian cane expansion**[1].—According to reports from Egypt, sugar production is to be increased by some 40,000 tons to 630,000 tons in 1974. This is to be achieved by opening up new cane areas in Central Egypt, involving extension of the area by 9–12%.

* * *

**Brazil sugar export finances**[2].—Decree-Law No. 1266 of the 26th March establishes that the proceeds from the Fundo Especial de Exportação de Açúcar will be used primarily to guarantee to producers the official export price for sugar and the operational and administrative costs involved in exporting. The balance will be channelled to providing finance for mergers, take-overs, relocations and modernization programmes for mills; the working capital requirements of cooperatives of producers and growers; the purchase of machinery and equipment by growers' cooperatives and companies formed with capital subscribed by them; the equalization of sugar cane and sugar prices throughout the country; and programmes to expand terminals and other facilities for exports and to improve quality standards of sugar cane and its cultivation. The Minister of Industry and Commerce announced in mid-April that financing of 800 million cruzeiros would be made available to sugar producers. It is proposed to raise sugar exports to 6 million tons a year by 1980; exports in 1972 amounted to 2,600,000 tons, valued at US$421,000,000, compared with 1,200,000 tons (US$153,000,000) in 1971. First official estimates show 1973/74 sugar production at 110 million bags (6·6 million metric tons); domestic consumption will amount to 70 million bags (4·2 million tons) and the remainder will be exported.

* * *

**New sugar factory for Lebanon**[3].—The Government of the Lebanon has authorized the construction of a second sugar factory which is to be completed by 1975 and, together with the existing beet sugar factory, will give a domestic production of 50–55,000 tons, compared with consumption of about 64,000 tons.

* * *

**Nigerian cube sugar plant closure**[4].—About 400 workers of the Tate & Lyle (Nigeria) Ltd. factory in Ilorin were laid off early in March. A spokesman for the company stated that the controlled price of cube sugar made it impossible for the factory to operate profitably.

* * *

**Animal fodder plant in Louisiana**[5].—A new plant is to be built at Lockwood, Louisiana, to produce animal fodder which includes molasses and bagasse pith as components. It is expected to be in production in August.

* * *

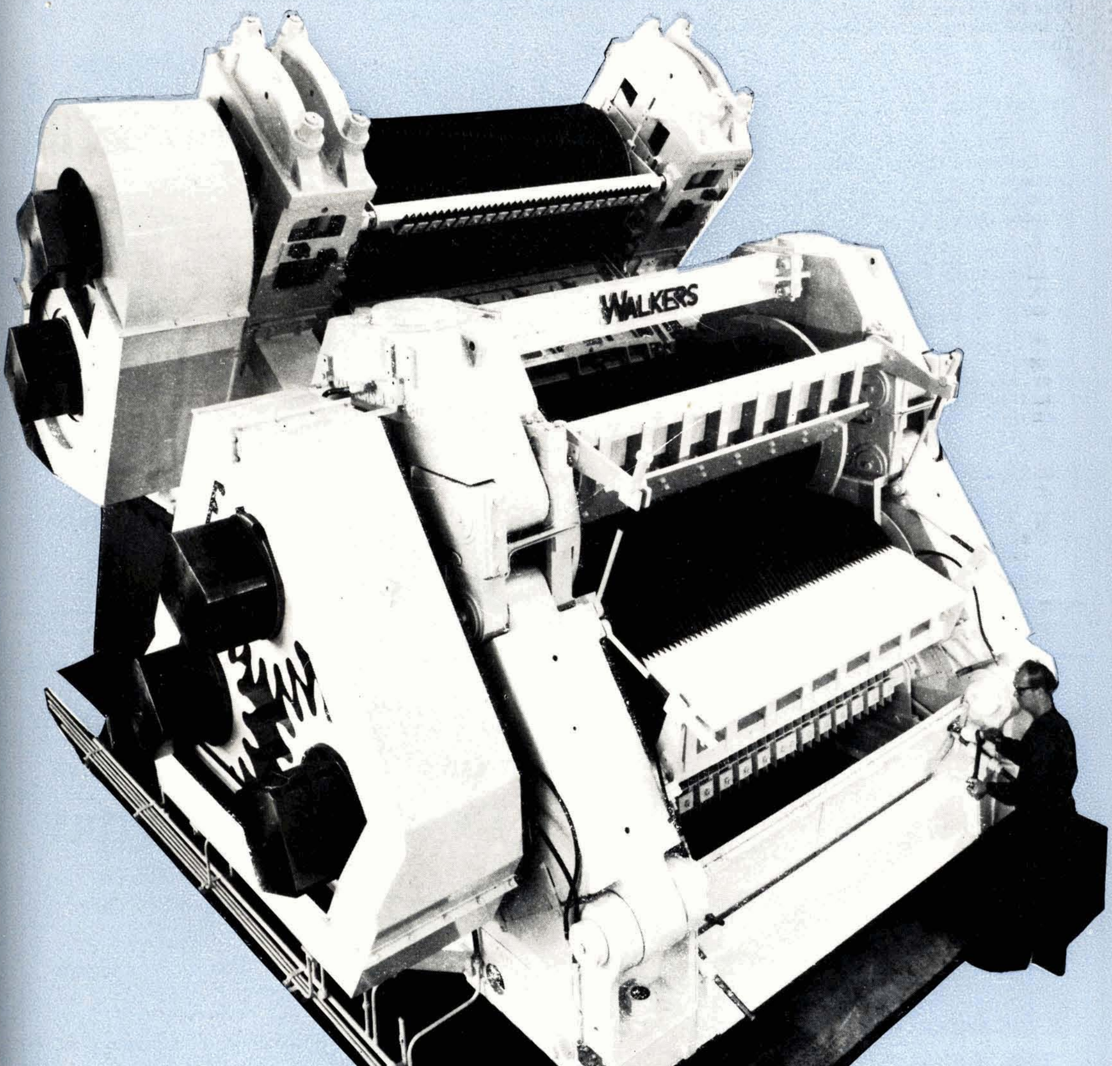
**Sri Lanka sugar development**[6].—The Asian Development Bank has approved a US$2,800,000 loan for a sugar industry project in Sri Lanka. The project will be situated in the south-eastern part of the country and the loan will cover foreign exchange costs of machinery, equipment, spare parts, imported materials and consultant services.

## USSR sugar imports and exports[7]

| | 1972 | 1971 |
|---|---|---|
| | —(*metric tons, raw value*)— | |
| IMPORTS | | |
| Australia | 119,564 | 0 |
| Brazil | 299,755 | 0 |
| Colombia | 10,000 | 0 |
| Cuba | 1,101,379 | 1,535,709 |
| Czechoslovakia | 21,740 | 0 |
| Dominican Republic | 23,152 | 0 |
| Ecuador | 10,617 | 0 |
| France | 53,738 | 0 |
| Germany, East | 81,525 | 0 |
| Holland | 10,870 | 0 |
| Mauritius | 25,187 | 0 |
| Poland | 108,700 | 0 |
| El Salvador | 24,196 | 0 |
| Venezuela | 34,019 | 0 |
| | 1,924,442 | 1,535,709 |
| EXPORTS | | |
| Afghanistan | 18,446 | 44,677 |
| Algeria | 0 | 116,844 |
| Bulgaria | 0 | 94,297 |
| Cyprus | 0 | 6,521 |
| Egypt | 0 | 9,705 |
| Finland | 188 | 136,472 |
| Germany, East | 0 | 75,239 |
| Ghana | 0 | 16,638 |
| Guinea | 0 | 1,175 |
| Hungary | 0 | 76,377 |
| Indonesia | 0 | 82,322 |
| Iran | 5,870 | 66,377 |
| Iraq | 0 | 168,262 |
| Italy | 0 | 545 |
| Jordan | 0 | 48,275 |
| Korea, North | 5,452 | 12,825 |
| Kuwait | 0 | 11,271 |
| Lebanon | 0 | 30,265 |
| Mali | 0 | 6,691 |
| Malta | 0 | 165 |
| Mongolia | 23,484 | 20,074 |
| Nigeria | 0 | 38,007 |
| Saudi Arabia | 0 | 10,632 |
| Sierra Leone | 0 | 4,414 |
| Somalia | 0 | 6,522 |
| Southern Yemen | 0 | 13,265 |
| Sri Lanka | 0 | 45,815 |
| Sudan | 0 | 71,536 |
| Sweden | 0 | 30,593 |
| Togo | 0 | 1,332 |
| UK | 0 | 86,078 |
| Vietnam, North | 10,747 | 16,245 |
| Yemen | 0 | 41,475 |
| Other countries | 0 | 10,617 |
| | 64,187 | 1,401,548 |

**Pakistan sugar factory plans**[8].—The Ministry of Industry has announced that the West Pakistan Industrial Development Corporation is studying the possibility of erection of a sugar factory in the neighbourhood of Sukkur. Two further new factories are to be built in the Rohri and Khairpur districts, while further plants are likely to be erected in Kot-Adu, Kamalia and Daska.

[1] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (5), 8.
[2] *Bolsa Review*, 1973, 7, 243–244.
[3] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (6), 9.
[4] *Barclays International Review*, April 1973, 21.
[5] *Sugar y Azúcar*, 1973, **68**, (2), 32.
[6] *Commonwealth Producer*, 1973, (454), 30.
[7] *I.S.O. Stat. Bull.*, 1973, **32**, (3), 107–109.
[8] *Zeitsch. Zuckerind.*, 1973, **98**, 295.


WALKERS

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# BUYERS' GUIDE

**Certain of the classifications have sub-headings for individual types of equipment. Specialist makers appear under these sub-headings, while inclusion of manufacturers under the general headings implies that they supply all or most of the types of equipment described by the sub-headings.**

---

**Accumulators, Hydraulic**
M. Dedini S.A. Metalúrgica.
Edwards Engineering Corporation.
Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.

**Accumulators, Steam**
*see* Steam accumulators.

**Activated carbon**
CECA.
Chemviron S.A.
Lurgi Apparate-Technik G.m.b.H.-Bereich Chemotechnik.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Suchar.

**Air clutches**
Farrel Company.
Renold Ltd.

**Air compressors**
Peter Brotherhood Ltd.
Cotton Bros. (Longton) Ltd.
Fives Lille-Cail.
Nash Engineering Company.

**Air compressors, Oil-free**
Peter Brotherhood Ltd.
Elliott Turbomachinery Ltd.
Nash Engineering Company.

**Air coolers**
Carter Industrial Products Ltd.
E. Green & Son Ltd.

**Air heaters**
M. Dedini S.A. Metalúrgica.
E. Green & Son Ltd.

**Air-operated portable stitchers**
Thomas C. Keay Ltd.
Thames Packaging Equipment Co.

**Alcohol plant**
A.P.V. Co. Ltd.
Bescon.
BMA Braunschweigische Maschinenbauanstalt.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
F. C. Schaffer & Associates Inc.
SPEICHIM.
Tate & Lyle Enterprises Ltd.

**Alcohol plant consultancy services**
Basico G.m.b.H.
Bookers Agricultural and Technical Services Ltd.

**Ammonia removal from condensates**
Akzo Chemie B.V.–Imacti.
Plenty & Son Ltd.
Robert Reichling & Co. K.G.

**Anti-foam agents**
Hodag Chemical Corporation.
Mazer Chemicals Inc.
Tate & Lyle Enterprises Ltd.

**Automatic beet laboratories**
Venema Automation N.V.
Ingeniörsfirman Nils Weibull AB.

**Automatic refractometers**
Bellingham and Stanley Ltd.

**Automatic saccharimeters and polarimeters**
Bellingham and Stanley Ltd.
Dr. Wolfgang Kernchen Optik-Elektronik-Automation.
Perkin-Elmer Ltd.
Rudolph Research Inc.
Schmidt + Haensch.
Thorn Automation Ltd.
Carl Zeiss.

**Automatic tare rooms**
Venema Automation N.V.
Ingeniörsfirman Nils Weibull AB.

**Bactericides**
Tate & Lyle Enterprises Ltd.

**Bag**
*see* Sack.

**Bagasse analysis apparatus**
A. H. Korthof N.V.

**Bagasse baling presses**
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
A. & W. Smith & Co. Ltd.

**Bagasse depithing equipment**
Stedman Foundry & Machine Co. Inc.
S. A. Verkor.

**Bagasse furnaces**
Babcock & Wilcox Ltd
M. Dedini S.A. Metalúrgica.
Foster Wheeler John Brown Boilers Ltd.
SEUM.

**Bagasse preparation equipment for particle board manufacture**
C F & I Engineers Inc.
Gruendler Crusher & Pulverizer Co.
S. A. Verkor.

**Bagasse presses**
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
French Oil Mill Machinery Co.
Sucatlan Engineering.

**Beet diffusers, Continuous**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
Extraction De Smet S.A.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.
Sucatlan Engineering.

**Beet flume equipment**
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.

**Beet harvesters**
Ransomes Sims & Jefferies Ltd.

**Beet mechanical discharging and storage equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Fives Lille-Cail.
Jenkins of Retford Ltd.

**Beet molasses sugar recovery**
Akzo Chemie B.V.–Imacti (*Quentin process*).
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
Robert Reichling & Co. K.G. (*Quentin process*).
Stork-Werkspoor Sugar N.V.

**Beet pulp presses**
BMA Braunschweigische Maschinenbauanstalt.
Fletcher and Stewart Ltd
Hein, Lehmann A.G.
Salzgitter Maschinen A.G.
Simon-Heesen B.V.
Stord Bartz Industri A/S
Ingeniörsfirman Nils Weibull AB.

**Beet seed**
A/S De Danske Sukkerfabrikker.
Kleinwanzlebener Saatzucht AG.

**Beet slicers**
Dreibholz & Floering Ltd.
H. Putsch & Comp.

**Beet tail utilization plant**
BMA Braunschweigische Maschinenbauanstalt.
H. Putsch & Comp

**Beet tare house equipment**
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.
Venema Automation N.V.
Ingeniörsfirman Nils Weibull AB.

**Beet washing plant**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Salzgitter Maschinen A.G.
Sucatlan Engineering.

**Beet water-jet unloading equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.

**Belting**
*see* Conveyor belting *and* Transmission belting

**Boiler tube brushes, Spiral and expanding**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.
Schaefer Brush Mfg. Co. Inc.

**Boiler tube cleaners, Air and electric**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

**Boiler water treatment**
Babcock & Wilcox Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Fabcon Inc.
The Permutit Co. Ltd.
Robert Reichling & Co K.G.
Werkspoor Water N.V.

**Boilers, Shell**
Babcock & Wilcox Ltd.
Robey of Lincoln Ltd.

**Boilers, Water tube**
Babcock & Wilcox Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Foster Wheeler John Brown Boilers Ltd
International Combustion Ltd.
M.E. Boilers Ltd.
Riley Stoker Corporation.
SEUM.
Stork-Werkspoor Sugar N.V.
Takuma Co. Ltd.
Wabash Power Equipment Co.

**Bone char**
British Charcoals & Macdonalds Ltd.
*see also* Char.

**Brushes**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Nordon & Cie.
Rotatools (U.K.) Ltd.
Schaefer Brush Mfg. Co. Inc.

**Bulk handling**
*see* Conveyors and Elevators, *etc.*

**Bulk liquid sugar handling plants.**
T. Giusti & Son Ltd.

**Bulk storage hoppers**
A.P.V.-Kestner Ltd.
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T. Giusti & Son Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newman Fabrications Ltd.
A. & W. Smith & Co. Ltd.
Tecomatic Ltd.

**Bulk sugar containers, Transportable**
Tecomatic Ltd.

**Bunker discharge equipment.**
Newman Fabrications Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

**Burners, Sulphur**
*see* Sulphur furnaces, Continuous.

**Calciners, Fluidized bed**
A.P.V.-Mitchell (Dryers) Ltd.
Buell Ltd.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.

**Cane car tippers**
CAMECO.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Walkers Ltd.

**Cane cars and trailers**
CAMECO.
Fletcher and Stewart Ltd.
Tate & Lyle Enterprises Ltd.
Volvo BM AB.
Walkers Ltd.

**Cane carts**
CAMECO.
Fletcher and Stewart Ltd.
Martin-Markham (Stamford) Ltd.
Ransomes Sims & Jefferies Ltd.
Tate & Lyle Enterprises Ltd.

**Cane conveyor drives**
CAMECO.
M. Dedini S.A. Metalúrgica.
Edwards Engineering Corporation.

**Cane cultivation equipment**
CAMECO.
Gebr. Claas Maschinenfabrik G.m.b.H.
Massey-Ferguson (Export) Ltd.
Ransomes Sims & Jefferies Ltd.
Rome Industries.

**Cane diffusers, Continuous**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
CAMECO.
C F & I Engineers Inc.
A/S De Danske Sukkerfabrikker.
Extraction De Smet S.A.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Sucatlan Engineering.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Cane grapples**
CAMECO.
Mennesson & Cie.

**Cane harvesters**
CAMECO.
Gebr. Claas Maschinenfabrik G.m.b.H.
Massey-Ferguson (Export) Ltd.
Toft Bros. Industries Ltd.

**Cane infield transport units**
CAMECO
Toft Bros. Industries Ltd.

**Cane loaders**
CAMECO.
F. W. McConnel Ltd.
Tate & Lyle Enterprises Ltd.
Toft Bros. Industries Ltd.
Volvo BM AB.

**Cane maturity testers**
A. H. Korthof N.V.

**Cane planters**
CAMECO.
Massey-Ferguson (Export) Ltd.

**Cane preparation equipment for diffusion**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Gruendler Crusher & Pulverizer Co.
The Mirrlees Watson Co. Ltd
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.

**Cane shredders**
*see* Shredders.

**Cane slings**
Parsons Chain Co. Ltd.

**Cane trash shredders**
C F & I Engineers Inc.
Gruendler Crusher & Pulverizer Co.

**Cane washing plants**
CAMECO.
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Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Sucatlan Engineering.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

**Cane washing tables**
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M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Tate & Lyle Enterprises Ltd.

**Cane wash water cleaning systems**
Dorr-Oliver Inc., Cane Sugar Division.

**Cane wet disintegrators for analysis**
Jeffress Bros. Ltd.
Sugar Manufacturers' Supply Co. Ltd.

**Carbon, Decolorizing**
Chemviron S.A.
Lurgi Apparate-Technik G.m.b.H.-Bereich Chemotechnik.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Suchar.
The Sugar Manufacturers' Supply Co. Ltd.

**Carbon decolorizing systems**
CECA.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Suchar.
Tate & Lyle Enterprises Ltd.

**Carbon reactivation**
Chemviron S.A.
Pittsburgh Activated Carbon Division, Calgon Corporation.

**Carbonatation equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Neyrpic.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

**Castings**
Babcock & Wilcox Ltd.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
E. Green & Son Ltd.
Newell Dunford Engineering Ltd.
Stork-Werkspoor Sugar N.V.

**Castings, Non-ferrous**
Blundell & Crompton Ltd.
Fletcher and Stewart Ltd.

**Centrifugal backings**
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
Krieg & Zivy Industries.
The Western States Machine Co.

**Centrifugal clarifiers**
Dorr-Oliver Inc., Cane Sugar Division.

**Centrifugal motors**
ACEC.
Hinz Elektromaschinen und Apparatebau G.m.b.H.
Siemens A.G.
The Western States Machine Co.

**Centrifugal screens**
ASEA-Weibull.
Balco Filtertechnik G.m.b.H.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Cotton Bros. (Longton) Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Hein, Lehmann A.G.
Krieg & Zivy Industries.
The Mirrlees Watson Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
The Western States Machine Co.

**Centrifugals and accessories**
ACEC.
BMA Braunschweigische Maschin enbauanstalt.
A. Bosco S.p.A.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
Fives Lille-Cail.
Hein, Lehmann A.G.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
The Sugar Manufacturers' Supply Co. Ltd.
The Western States Machine Co

**Centrifugals—Complete electrical equipment**
ACEC.
Hinz Elektromaschinen und Apparatebau G.m.b.H.
Siemens A.G.

**Centrifugals, Continuous**
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Escher Wyss Ltd.
Fives Lille-Cail.
Hein, Lehmann A.G.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
Western States Machine Co

**Centrifugals—Fully automatic batch-type**
ASEA-Weibull.
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
The Western States Machine Co.

**Centrifugals—Semi-automatic batch-type**
ASEA-Weibull.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
The Mirrlees Watson Co. Ltd.
The Western States Machine Co.

**Chain cane slings**
Codistil–Construtora de Distilarias Dedini S.A.
Kettenfabrik Unna G.m.b.H. & Co. K.G.
Parsons Chain Co. Ltd.

**Chains**
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Kettenfabrik Unna G.m.b.H. & Co. K.G.
Parsons Chain Co. Ltd.
Renold Limited.

**Chemical plants**
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
T. Giusti & Son Ltd.
SPEICHIM.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

**Chemicals**
Allied Colloids Ltd.
Fabcon Inc.
Hodag Chemical Corporation.
May & Baker Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.

**Clarifiers**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Enviro-Clear Company Inc.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Tecomatic Ltd.

**Clarifiers, Tray-type**
Dorr-Oliver Inc., Cane Sugar Division.

**Collapsible containers for transporting sugar**
Tecomatic Ltd.

**Colorimeters**
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.

**Complete cane sugar factories**
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Condensers, Water jet ejector**
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Condensing plant, Barometric**
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

**Continuous belt weighing machines**
Herbert & Sons Ltd.
International Combustion Riley Ltd.
Neyrpic.
Siemens AG.

**Controls, Hydraulic**
Edwards Engineering Corporation.

**Conveyor belting**
Habasit A.G.

**Conveyor chains**
Codistil–Construtora de Distilerias Dedini S.A.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
Redler Conveyors Ltd.
Renold Limited.
A. & W. Smith & Co. Ltd.

**Conveyor cleaners**
Schaefer Brush Mfg. Co. Inc.

**Conveyors and elevators**
Babcock & Wilcox Ltd.
BMA Braunschweigische Maschin enbauanstalt.
British Ropeway Engineering Co. Ltd.
C F & I Engineers Inc.
Fives Lille-Cail.
Hein, Lehmann A.G.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Sucatlan Engineering
Techserve (Pty.) Ltd.
Walkers Ltd.
Ulrich Walter Maschinenbau.
Ingeniörsfirman Nils Weibull AB.

*Belt and bucket elevators*
Barry Henry & Cook Ltd.
Ewart Chainbelt Co. Ltd.
Jenkins of Retford Ltd.
Newman Fabrications Ltd.
Nordon & Cie.
Redler Conveyors Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Belt conveyors*
Barry Henry & Cook Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Codistil-Construtora de Distilarias Dedini S.A
Jenkins of Retford Ltd.
Newman Fabrications Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Bucket elevators*
Barry Henry & Cook Ltd.
Ewart Chainbelt Co. Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newman Fabrications Ltd.
Redler Conveyors Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Chain and bucket elevators*
Barry Henry & Cook Ltd.
Ewart Chainbelt Co. Ltd.
Jenkins of Retford Ltd.
Newman Fabrications Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Chain conveyors*
Barry Henry & Cook Ltd.
Codistil-Construtora de Distilarias Dedini S.A.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
Newman Fabrications Ltd.
Nordon & Cie.
Redler Conveyors Ltd.
Geo. Robson & Co. (Conveyors) Ltd.
The Thames Packaging Equipment Co.

*Feeder conveyors*
Barry Henry & Cook Ltd.
M. Dedini S.A. Metalúrgica.
Redler Conveyors Ltd.
*see also* Vibrating feeders.

*Grasshopper conveyors*
Barry Henry & Cook Ltd.
Thomas Broadbent & Sons Ltd
Buckau-Wolf Maschinenfabrik A.G.
The Mirrlees Watson Co. Ltd.

*Pneumatic conveyors*
Codistil-Construtora de Distilarias Dedini S.A.
Newell Dunford Engineering Ltd.
Newman Fabrications Ltd.
Nordon & Cie.
Tecomatic Ltd.

*Scraper conveyors*
Barry Henry & Cook Ltd.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart.
Jenkins of Retford Ltd.

*Screw conveyors*
Barry Henry & Cook Ltd.
Brencede Ltd.
Ewart Chainbelt Co. Ltd.
The Mirrlees Watson Co. Ltd.
Newman Fabrications Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Telescopic belt conveyors.*
Geo. Robson & Co. (Conveyors) Ltd.

*Vibratory conveyors*
Eriez Magnetics.
Ewart Chainbelt Co. Ltd.

**Conveyors and elevators, Mobile**
The Thames Packaging Equipment Co.

**Coolers, Fluidized bed**
A.P.V.-Mitchell (Dryers) Ltd.
Buell Ltd.
Codistil-Construtora de Distilarias Dedini S.A.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.

**Coolers, Pellet**
Simon-Heesen B.V.

**Coolers, Sugar**
A.P.V.-Mitchell (Dryers) Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Codistil-Construtora de Distilarias Dedini S.A.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stansteel Corporation.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Ingeniörsfirman Nils Weibull AB.

**Coolers, Water**
Carter Industrial Products Ltd.
Codistil-Construtora de Distilarias Dedini S.A.
Film Cooling Towers (1925) Ltd.

**Cranes**
Babcock & Wilcox Ltd.
CAMECO.
Fives Lille-Cail.
John M. Henderson & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Stothert & Pitt Ltd.

**Crystallization aids**
Fabcon Inc.
Hodag Chemical Corporation.
Mazer Chemicals Inc.
Techserve (Pty.) Ltd.

**Crystallizers**
Barry Henry & Cook Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Geo. Robson & Co. (Conveyors) Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division

**Crystallizers, Continuous**
C F & I Engineers Inc.
Fives Lille-Cail.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Cube-making machinery**
Buckau-Wolf Maschinenfabrik A.G.
Chambon Ltd.
Elba Machinefabrieken B.V.
Stansteel Corporation.
Stork-Amsterdam B.V.
Ingeniörsfirman Nils Weibull A.B.

**Cube sugar moulding, ranging and packeting plant**
Buckau-Wolf Maschinenfabrik A.G.
Chambon Ltd.
Elba Machinefabrieken B.V.
Stork-Amsterdam B.V.

**Cube wrapping machines**
SAPAL.

**Deaerators**
The Permutit Co. Ltd.
Robert Reichling & Co. KG..
Stork-Werkspoor Sugar N.V.

**Decolorizing agents**
Tate & Lyle Enterprises Ltd.

**Decolorizing plants**
Akzo Chemie B.V.-Imacti.
BMA Braunschweigische Maschinenbauanstalt.
Chemviron S.A.
The Permutit Co. Ltd.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Robert Reichling & Co. K.G.
Tate & Lyle Enterprises Ltd.

**Decolorizing resins**
Akzo Chemie B.V.-Imacti.
Diamond Shamrock Chemical Co., Nopco Chemical Division.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Rohm and Haas Company.

**Deliming plants**
Akzo Chemie B.V.-Imacti.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Division.
Robert Reichling & Co. K.G.

**Demineralization plants**
Akzo Chemie B.V.-Imacti.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Division.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Werkspoor Water N.V.

**Diatomaceous earth**
*see* Filter-aids.

**Diesel alternator sets**
ACEC.
Stork-Werkspoor Sugar N.V.

**Distillery plant**
*see* Alcohol plant.

**Drives, Chain**
Ewart Chainbelt Co. Ltd.
Renold Limited.

**Drives, Hydraulic**
Edwards Engineering Corporation.

**Drives, Variable speed**
Mawdsleys Ltd.
Renold Limited.
Thorn Automation Ltd.

**Drives**
*see also* Cane conveyor drives, Flexible drives, Knives, Milling—Drives *and* Shredder drives.

**Dryers**
A.P.V.-Mitchell (Dryers) Ltd.
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
Codistil-Construtora de Distilarias Dedini S.A.
Escher Wyss Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
Stansteel Corporation.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

**Dryers, Fluidized bed**
A.P.V.-Mitchell (Dryers) Ltd.
A. Bosco S.p.A.
Buell Ltd.
Escher Wyss Ltd.
Fives Lille-Cail.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.
Stork-Werkspoor Sugar N.V.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

**Dust control equipment**
Buell Ltd.
Carter Industrial Products Ltd.
Dust Control Equipment Ltd.
Mikropul Ltd.
Newell Dunford Engineering Ltd.
Stansteel Corporation.
Takuma Co. Ltd.
Tecomatic Ltd.
Zurn Air Systems.

**Dust sleeves and bags**
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
JK Industrial Fabrics.
Lainyl Filter Cloths.
P. & S. Textiles Ltd.
Weco Filter Sleeve Manufacturing Co. Ltd.

**Economizers**
E.Green & Son Ltd.
International Combustion Ltd.

**Effluent treatment**
The Davenport Engineering Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Film Cooling Towers (1925) Ltd.
Foster Wheeler John Brown Boilers Ltd.
International Combustion Ltd.
Perkin-Elmer Ltd.

**Effluent treatment**—*continued*
The Permutit Co. Ltd.
Plenty & Son Ltd.
Tate & Lyle Enterprises Ltd.
Werkspoor Water N.V.

**Electric heaters for pipes**
Stabilag Engineering Ltd.

**Electric heaters for vessels**
Stabilag Engineering Ltd.

**Electric motors**
ACEC.
Weir Pumps Ltd.

**Electric motors, Fractional horsepower**
The Thames Packaging Equipment Co.

**Electric power generators**
ACEC.
Stork-Werkspoor Sugar N.V.

**Electric tube cleaning machines**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Nordon & Cie.
Rotatools (U.K.) Ltd.

**Electronic control systems for process plant**
Bailey Meters & Controls Ltd.
C F & I Engineers Inc.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
Tate & Lyle Enterprises Ltd.
Taylor Instrument Companies (Europe) Ltd.

**Electronic equipment**
ACEC.
Bailey Meters & Controls Ltd.

**Engineering design and contracting services**
Basico G.m.b.H.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
CAMECO
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
Jenkins of Retford Ltd.
Lucks & Co. G.m.b.H.
The Mirrlees Watson Co. Ltd.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Sucatlan Engineering.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Tecomatic Ltd.

**Engines, Diesel**
Stork-Werkspoor Sugar N.V.

**Engines, Steam**
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Entrainment separators**
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Plenty & Son Ltd.
A. & W. Smith & Co. Ltd.
Techserve (Pty.) Ltd.
York Export Corporation.

**Enzymes**
A.B.M. Industrial Products Ltd.
Tate & Lyle Enterprises Ltd.

**Evaporator additives**
Allied Colloids Ltd.
M. Dedini S.A. Metalúrgica.
Fabcon Inc.
Hodag Chemical Corporation.

**Evaporator tube cleaners**
*see* Tube cleaners.

**Evaporators and condensing plant**
Alfa-Laval AB.
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Escher Wyss Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
A. & W. Smith & Co. Ltd.
SPEICHIM.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.
Wiegand Karlsruhe G.m.b.H.

**Evaporators, Falling film**
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division
Wiegand Karlsruhe G.m.b.H.

**Expanders, Tube**
*see* Tube expanders.

**Fans, Induced and forced draft**
M. Dedini S.A. Metalúrgica.
Stork-Werkspoor Sugar N.V.
Zurn Air Systems.

**Feasibility studies for sugar projects**
F. C. Schaffer & Associates Inc.

**Filter aids**
CECA.
Dicalite/GREFCO Inc., International Division.
Fabcon Inc.
Sil-Flo Incorporated.
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.
Witco Chemical Corp.—Kenite Division.

**Filter cloths**
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
N. Greening (Warrington) Ltd.
JK Industrial Fabrics.
Lainyl Filter Cloths.
P. & S. Textiles Ltd.
Sankey Green Wire Weaving Co. Ltd.
A. & W. Smith & Co. Ltd.
Weco Filter Sleeve Manufacturing Co. Ltd.

**Filter leaves**
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Sankey Green Wire Weaving Co. Ltd.
Stockdale Engineering Ltd.

**Filter papers**
Evans, Adlard & Co. Ltd.
A. H. Korthof N.V.
H. Reeve Angel & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

**Filter screens**
Cotton Bros. (Longton) Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
JK Industrial Fabrics.
Krieg & Zivy Industries.
Paxman Process Plant Division.
J. & F. Pool Ltd.
Sankey Green Wire Weaving Co. Ltd.
Stockdale Engineering Ltd.
Weco Filter Sleeve Manufacturing Co. Ltd.

**Filters**
Fives Lille-Cail.
SPEICHIM.
Sucatlan Engineering.
Werkspoor Water N.V.
Wire Weaving Co. Ltd.

*Automatically controlled filters*
Chemap A.G.
Paxman Process Plant Division.
Schumacher'sche Fabrik.
Stella Meta Filters.
Stockdale Engineering Ltd.
U.S. Filter Systems.

*Bag pressure filters*
A. F. Craig & Co. Ltd.

*Candle filters*
BMA Braunschweigische Maschinenbauanstalt.
H. Putsch & Comp.
Schumacher'sche Fabrik.
Stella Meta Filters.
Stockdale Engineering Ltd.

*Diatomite filters*
Chemap A.G.
The Mirrlees Watson Co. Ltd.
Paxman Process Plant Division.
Schumacher'sche Fabrik.
Stockdale Engineering Ltd.
U.S. Filter Systems.

*Filter presses*
BMA Braunschweigische Maschinenbauanstalt.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.

*Filter thickeners*
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc., Cane Sugar Division.
Paxman Process Plant Division.
H. Putsch & Comp.
Schumacher'sche Fabrik.
Stockdale Engineering Ltd.

*Gravity and pressure filters*
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.
Stockdale Engineering Ltd.

*Iron removal filters*
Rapid Magnetic Ltd.
Stockdale Engineering Ltd.

*Laboratory filters*
*see* Laboratory filters.

*Leaf filters*
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Sankey Green Wire Weaving Co. Ltd.
A. & W. Smith & Co. Ltd.
Stockdale Engineering Ltd.
Stork-Werkspoor Sugar N.V.
Suchar.
U.S. Filter Systems.

*Plate and frame filters*
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.

*Pressure filters*
BMA Braunschweigische Maschinenbauanstalt.
Chemap A.G.
Dorr-Oliver Inc., Cane Sugar Division.
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.
Plenty & Son Ltd.
H. Putsch & Comp.
Schumacher'sche Fabrik.
A. & W. Smith & Co. Ltd.
Stockdale Engineering Ltd.
Suchar.
U.S. Filter Systems.

*Rotary vacuum filters*
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Paxman Process Plant Division.
H. Putsch & Comp.
Stockdale Engineering Ltd.

**Flanges, Non-Ferrous**
Blundell & Crompton Ltd.

**Flexible drives**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

**Flexible shaft couplings**
David Brown Gear Industries Ltd.
Renold Limited.

**Flexible shafting**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

**Flocculants**
Allied Colloids Manufacturing Co. Ltd.
The Dow Chemical Company.
Hodag Chemical Corporation.
Tate & Lyle Enterprises Ltd.

**Flotation agents**
Tate & Lyle Enterprises Ltd.

**Flotation equipment**
Tate & Lyle Enterprises Ltd.

**Flowmeters**
Bailey Meters & Controls Ltd.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
Negretti & Zambra Ltd.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
Wallace & Tiernan Ltd.
Ulrich Walter Maschinenbau.

**Gas purifying equipment**
Maschinenfabrik H. Eberhardt.
Newell Dunford Engineering Ltd.
Plenty & Son Ltd.
Stork-Werkspoor Sugar N.V.

**Gear couplings**
David Brown Gear Industries Ltd.
M. Dedini S.A. Metalúrgica.
Renold Limited.

**Gearing**
*see* Reduction gears.

**Gearmotors**
David Brown Gear Industries Ltd.
Renold Limited.

**Granulators**
*see* Dryers.

**Harvesters**
*see* Beet harvesters *and* Cane harvesters.

**Heat exchangers, Air-cooled**
E. Green & Son Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.

**Heat-exchangers, Lamella-type**
Alfa-Laval AB.

**Heat exchangers, Plate-type**
Alfa-Laval AB.
A.P.V. Co. Ltd.

**Heat exchangers, Spiral-type**
Alfa-Laval AB.

**Heat exchangers, Tubular**
Alfa-Laval AB.
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
International Combustion Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
A. & W. Smith & Co. Ltd.
SPEICHIM.
Ingeniörsfirman Nils Weibull A.B.

**Heat sealers**
The Thames Packaging Equipment Co.

**Herbicides**
Tate & Lyle Enterprises Ltd.

**Instruments, Process control**
Bailey Meters & Controls Ltd.
Bellingham & Stanley Ltd.
Chemap A.G.
A/S De Danske Sukkerfabrikker.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
Negretti & Zambra Ltd.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
Ronald Trist Controls Ltd.
Ulrich Walter Maschinenbau.
Westinghouse Brake and Signal Co. Ltd.
G. H. Zeal Ltd.

**Ion exchange plants**
Akzo Chemie B.V.–Imacti.
BMA Braunschweigische Maschinenbauanstalt.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Tate & Lyle Enterprises Ltd.
Werkspoor Water N.V.

**Ion exchange resins**
Akzo Chemie B.V.–Imacti.
Diamond Shamrock Chemical Co., Nopco Chemical Division.
The Dow Chemical Company.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Rohm and Haas Company.

**Irrigation equipment**
Evenproducts Ltd.
Farrow Irrigation Ltd.
Irrigation & Industrial Development Corp.
SPP Systems Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.
Wright Rain Irrigation (Pty.) Ltd.

**Juice heaters**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.

**Juice scales**
Fletcher and Stewart Ltd.
N.V. Servo-Balans.
*see also* Weighing Machines.

**Juice strainers and screens**
C F & I Engineers Inc.
The Deister Concentrator Co. Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Farrel Company.
Ferguson Perforating & Wire Co.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fontaine & Co. G.m.b.H.
Fulton Iron Works Company.
N. Greening (Warrington) Ltd.
The Mirrlees Watson Co. Ltd.
Plenty & Son Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
Walkers Ltd.

**Juice and syrup mixers**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
The Mirrlees Watson Co. Ltd.
Plenty & Son Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.

**Knives, Beet**
Dreibholz & Floering Ltd.
H. Putsch & Comp.

**Knives, Milling**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Knives, Milling—Drives**
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fletcher and Stewart Ltd.
Mawdsleys Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Thorn Automation Ltd.

**Laboratory apparatus and equipment**
Bellingham & Stanley Ltd.
Chemap A.G.
A. H. Korthof N.V.
The Permutit Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.
Carl Zeiss.
*see also* Laboratory instruments, *etc.*

**Laboratory cane grinders**
Jeffress Bros. Ltd.

**Laboratory filters**
Paxman Process Plant Division.
H. Reeve Angel & Co. Ltd.
Stockdale Engineering Ltd.

**Laboratory glassware**
Fischer & Porter Ltd.

**Laboratory instruments**
Bellingham & Stanley Ltd.
A. H. Korthof N.V.
The Sugar Manufacturers' Supply Co. Ltd.
G. H. Zeal Ltd.
*see also* Automatic saccharimeters and polarimeters, Laboratory apparatus and equipment, Refractometers, Saccharimeters and polarimeters, *etc*

**Laboratory reagents**
A. H. Korthof N.V.
May & Baker Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

**Level indicators and controllers**
von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke.
Bailey Meters & Controls Ltd.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
Negretti & Zambra Ltd.
Siemens A.G.
Ronald Trist Controls Ltd.

**Lime kilns**
A.P.V.-Mitchell (Dryers) Ltd.
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Maschinenfabrik H. Eberhardt.
Koppers-Wistra-Ofenbau G.m.b.H.
Newell Dunford Engineering Ltd.

**Lime slaking equipment**
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Maschinenfabrik H. Eberhardt.
Stork-Werkspoor Sugar N.V.
Wallace & Tiernan Ltd.

**Liming equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Maschinenfabrik H. Eberhardt.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
Techserve (Pty.) Ltd.

**Locomotives, Battery-electric**
International Combustion Ltd.

**Locomotives, Diesel**
International Combustion Ltd.

**Locomotives, Diesel-hydraulic**
Plymouth Locomotives Division.

**Magnetic lifting equipment**
Brimag Ltd.
Electromagnets Ltd.
Eriez Magnetics.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.

**Magnetic separators**
Brimag Ltd.
Electromagnets Ltd.
Eriez Magnetics.
Fletcher and Stewart Ltd.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.
Ulrich Walter Maschinenbau.

**Massecuite heat treating equipment**
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
E. Green & Son Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.)Ltd.
Walkers Ltd.
The Western States Machine Co.

**Mill hydraulics**
M. Dedini S.A. Metalúrgica.
Edwards Engineering Corporation.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Mill roll movement indicators and recorders**
Edwards Engineering Corporation.

**Mill rolls**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Milling plant**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.). Ltd.
Walkers Ltd.

**Mill sanitation agents**
Tate & Lyle Enterprises Ltd.

**Mixing machines**
Babcock & Wilcox Ltd.

**Moisture expellers**
Richard Simon & Sons Ltd.
Sucatlan Engineering.

**Molasses addition plants for beet pulp**
Amandus Kahl Nachf.
Ulrich Walter Maschinenbau.

**Molasses scales, Fully automatic**
N.V. Servo-Balans.

**Molasses tanks**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Codistil–Construtora de Distilarias Dedini S.A.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
KIW Construction Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.

**Molasses water blending units**
Bescon.

**Muds sugar recovery systems**
Tate & Lyle Enterprises Ltd.

**Packeting machinery**
Thomas C. Keay Ltd.

**Pan boiling aids**
Allied Colloids Ltd.
Fabcon Inc.
Hodag Chemical Corporation.
Techserve (Pty.) Ltd.

**Pan boiling automatic control**
Siemens A.G.

**Pan circulators**
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

**Pans, Vacuum**
A.P.V.-Mitchell (Dryers) Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Fives Lille-Cail.

**Pans, Vacuum**—*continued*
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division

**Pelleting presses for bagasse and pith**
Amandus Kahl Nachf.
Simon-Heesen B.V.

**Pelleting presses for dried pulp**
Amandus Kahl Nachf.
Simon-Heesen B.V.

**Perforated metals**
Ferguson Perforating & Wire Co.
N. Greening (Warrington) Ltd.
Krieg & Zivy Industries.
J. & F. Pool Ltd.
Ulrich Walter Maschinenbau.

**Pipe fittings**
*see* Tube fittings

**Pipes, Non-ferrous**
Birmingham Battery Tube Company.

**Pipework installation**
Babcock & Wilcox Ltd.
Blundell & Crompton Ltd.
Nordon & Cie.

**Polythene bag sealers**
The Thames Packaging Equipment Co.

**Power plants**
Stork-Werkspoor Sugar N.V.

**Power transmission equipment**
Thomas Broadbent & Sons Ltd.
David Brown Gear Industries Ltd.
Farrel Company.
Renold Limited.

**Preliming equipment**
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc., Cane Sugar Division.
Stork-Werkspoor Sugar N.V.

**Pressure feeders**
Walkers Ltd.

**Pressure gauges**
The British Rototherm Co. Ltd.
Negretti & Zambra Ltd.
Serseg (Seguin-Sergot).
Wallace & Tiernan Ltd.
G. H. Zeal Ltd.

**Pressure vessels**
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
International Combustion Ltd.
Robey of Lincoln Ltd.
SEUM.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

**Printing machinery for sugar cartons, etc.**
Chambon Ltd.

**Pulp screens**
C F & I Engineers Inc.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.

**Pulverizers, Sugar**
Mikropul Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

**Pumps**
Dorr-Oliver Inc., Cane Sugar Division.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
Weir Pumps Ltd.

*Beet pumps*
Ateliers de Construction d'Ensival S.A.
FosterPump Works Inc.
KSB Klein, Schanzlin & Becker A.G.
Weise & Monski, Weise Soehne G.m.b.H.

*Boiler feed pumps*
Ateliers de Construction d'Ensival S.A.
Howard Pneumatic Engineering Co. Ltd.
KSB Klein, Schanzlin & Becker A.G.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski. Weise Soehne G.m.b.H.

*Centrifugal pumps*
ACEC.
A.P.V. Co. Ltd.
A.P.V.-Kestner Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
Irrigation & Industrial Development Corp.
KSB Klein, Schanzlin & Becker A.G.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski, Weise Soehne G.m.b.H.

*Corrosion-proof pumps*
The Albany Engineering Co. Ltd.
A.P.V.-Kestner Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
KSB Klein, Schanzlin & Becker A.G.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.

*Dosing pumps*
BMA Braunschweigische Maschinenbauanstalt.
Fabcon Inc.
Howard Pneumatic Engineering Co. Ltd.
The Permutit Co. Ltd.
Tate & Lyle Enterprises Ltd.
Wallace & Tiernan Ltd.

*Filtrate pumps*
A.P.V.-Kestner Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
KSB Klein, Schanzlin & Becker A.G.
Mono Pumps Ltd.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski, Weise Soehne G.m.b.H.

*Gas pumps*
George Waller & Son Ltd.

*Irrigation pumps*
Ateliers de Construction d'Ensival S.A.
Farrow Irrigation Ltd.
Irrigation & Industrial Development Corp.
KSB Klein, Schanzlin & Becker A.G.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.
Wright Rain Irrigation (Pty.) Ltd.

*Massecuite pumps*
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Deplechin.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Mirrlees Pumps Ltd.
A. & W. Smith & Co. Ltd.
Techserve (Pty.) Ltd.

*Membrane pumps*
Saunders Valve Co. Ltd.

*Molasses pumps*
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
Fletcher and Stewart Ltd.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
Irrigation & Industrial Development Corp.
Amandus Kahl Nachf.
KSB Klein, Schanzlin & Becker A.G.
Mirrlees Pumps Ltd.
The Mirrlees Watson Co. Ltd.
Mono Pumps Ltd.
A. & W. Smith & Co. Ltd.
Stothert & Pitt Ltd.
Ulrich Walter Maschinenbau.

*Positive-action pumps*
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Fletcher and Stewart Ltd.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
Mirrlees Pumps Ltd.
Mono Pumps Ltd.
Stothert & Pitt Ltd.

*Rotary pumps*
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
Irrigation & Industrial Development Corp.
Mono Pumps Ltd.
Stothert & Pitt Ltd.

*Self-priming pumps*
The Albany Engineering Co. Ltd.
Flexible Drives (Gilmans) Ltd.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
KSB Klein, Schanzlin & Becker A.G.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.
Stothert & Pitt Ltd.

*Sump pumps*
The Albany Engineering Co. Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
KSB Klein, Schanzlin & Becker A.G.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski, Weise Soehne G.m.b.H.

*Syrup pumps*
Foster Pump Works Inc.
KSB Klein, Schanzlin & Becker A.G.
Mirrlees Pumps Ltd.

*Vacuum pumps*
*see* Vacuum pumps.

**Railway**
*see* Cane cars *and* Locomotives.

**Raw sugar scales, Fully automatic**
N.V. Servo-Balans.
Ingeniörsfirman Nils Weibull A.B.

**Rectifiers**
ACEC.

**Reduction gears**
David Brown Gear Industries Ltd.
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
The Mirrlees Watson Co. Ltd.
Renold Limited.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Refinery equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Dorr-Oliver Inc., Cane Sugar Division.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.

**Refinery equipment**—*continued*
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Suchar.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

**Refractometers**
Bellingham & Stanley Ltd.
Dr. Wolfgang Kernchen Optik-Elektronik-Automation.
A. H. Korthof N.V.
Schmidt + Haensch.
Carl Zeiss.

**Refractory bricks**
GR–Stein Refractories Ltd.
Lucks & Co. G.m.b.H.

**Refractory cement**
GR–Stein Refractories Ltd.

**Roller chain**
Ewart Chainbelt Co. Ltd.
Renold Limited.

**Rubber belt cane carriers**
Codistil–Construtora de Distilarias Dedini S.A.
Farrel Company.

**Saccharimeters and polarimeters**
Bellingham & Stanley Ltd.
Dr. Wolfgang Kernchen Optik-Elektronik-Automation.
A. H. Korthof N.V.
Perkin-Elmer Ltd.
Rudolph Research Inc.
Schmidt + Haensch.
The Sugar Manufacturers' Supply Co. Ltd.
Thorn Automation Ltd.
Carl Zeiss.

**Sack closing machines**
Greif-Werk Maschinenfabrik.
Thomas C. Keay Ltd.
Librawerk Pelz & Nagel K.G.
Reed Darnley Taylor Ltd.
The Thames Packaging Equipment Co.

**Sack counting equipment**
The Thames Packaging Equipment Co.

**Sack filling machines**
Cellier S.A.
Greif-Werk Maschinenfabrik.
Thomas C. Keay Ltd.
Librawerk Pelz & Nagel K.G.
Reed Darnley Taylor Ltd.
Richard Simon & Sons Ltd.
Ingeniörsfirman Nils Weibull AB.

**Sack openers**
Thames Packaging Equipment Co

**Sack printing machines**
Thomas C. Keay Ltd.

**Sampling equipment**
Cocksedge & Co. Ltd.
The Thames Packaging Equipment Co.
Ingeniörsfirman Nils Weibull AB.

**Sand removal systems for juice and effluent**
Dorr-Oliver Inc., Cane Sugar Division.

**Scale removal and prevention**
Allied Colloids Ltd.
Fabcon Inc.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd
Hodag Chemical Corporation.
Rotatools (U.K.) Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
*see also* Tube cleaners.

**Screens, Centrifugal**
*see* Centrifugal screens.

**Screens, Filter**
*see* Filter screens.

**Screens, Rotary**
J. & F. Pool Ltd.

**Screens, Vibrating**
BMA Braunschweigische Maschinenbauanstalt.
The Deister Concentrator Co. Inc.
Electromagnets Ltd.
Eriez Magnetics.
Fletcher and Stewart Ltd.
Hein, Lehmann A.G.
The Sugar Manufacturers' Supply Co. Ltd.
*see also* Juice strainers and screens

**Screens, Wire**
Dorr-Oliver Inc., Cane Sugar Division.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.

**Sedimentation accelerators**
Allied Colloids Ltd.
Fabcon Inc.
Hodag Chemical Corporation.
Tate & Lyle Enterprises Ltd.

**Sedimentation tanks and clarifiers**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Enviro-Clear Company Inc.
Fletcher and Stewart Ltd.
Werkspoor Water N.V.

**Settling basins for flume water treatment**
Lucks & Co. G.m.b.H.

**Sewing threads, Heavy grade**
Thames Packaging Equipment Co.

**Ship loading installations**
Babcock & Wilcox Ltd.
British Ropeway Engineering Co. Ltd.
Stothert & Pitt Ltd.
Tate & Lyle Enterprises Ltd.

**Shredder drives**
M. Dedini S.A. Metalúrgica.
Farrel Company.
Mawdsleys Ltd.
Stork-Werkspoor Sugar N.V.

**Shredders**
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gruendler Crusher & Pulverizer Company.
The Mirrlees Watson Co. Ltd.
Stedman Foundry & Machine Co. Inc.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Silos**
Lucks & Co. G.m.b.H.
Tecomatic Ltd.
Ingeniörsfirman Nils Weibull AB.

**Slats for slat conveyors**
William Bain & Co. Ltd.
Ewart Chainbelt Co. Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

**Spectrophotometers**
Perkin-Elmer Ltd.
Tate & Lyle Enterprises Ltd.

**Spectropolarimeters**
Bellingham & Stanley Ltd.
Dr. Wolfgang Kernchen Optik-Elektronik-Automation.
Perkin-Elmer Ltd.
Rudolph Research Inc.
Schmidt + Haensch.

**Sprockets**
Ewart Chainbelt Co. Ltd.
Renold Ltd.

**Stainless steel pipelines, Large diameter**
Welding Technical Services Ltd.

**Starch removal enzymes for cane juice**
A.B.M. Industrial Products Ltd.
Tate & Lyle Enterprises Ltd.

**Steam accumulators**
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.

**Steam storage equipment**
*see* Steam accumulators.

**Steam superheaters**
Babcock & Wilcox Ltd.
Foster Wheeler John Brown Boilers Ltd.
International Combustion Ltd.
M.E. Boilers Ltd.
Stork-Werkspoor Sugar N.V.

**Steam turbines for mill drives, etc.**
Peter Brotherhood Ltd.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Elliott Turbomachinery Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hiro Zoki Co. Ltd.
A.G. Kühnle, Kopp & Kausch.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Steam turbo-alternator sets**
ACEC.
Peter Brotherhood Ltd.
M. Dedini S.A. Metalúrgica.
Elliott Turbomachinery Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hiro Zoki Co. Ltd.
A.G. Kühnle, Kopp & Kausch.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Wabash Power Equipment Co.

**Steel framed buildings**
William Bain & Co. Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Lucks & Co. G.m.b.H.

**Stokers**
Riley Stoker Corporation.

**Storage vessels, Stainless steel**
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
T. Giusti & Son Ltd.
SEUM.
Stork-Werkspoor Sugar N.V.
Tecomatic Ltd.

**Strainers**
Elliott Turbomachinery Ltd.

**Sugar agronomy consultancy services**
Basico G.m.b.H.
Bookers Agricultural & Technical Services Ltd.
Hawaiian Agronomics Company (International).
F. C. Schaffer & Associates Inc.
Soc. Sucrière d'Etudes et de Conseils S.A.
Tate & Lyle Technical Services Ltd.

**Sugar factory consultancy services**
Basico G.m.b.H.
Bescon.
Bookers Agricultural & Technical Services Ltd.
C F & I Engineers Inc.
Cowiconsult.
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
Industrieprojekt A.G.
Chr. Ostenfeld & W. Jonson.
F. C. Schaffer & Associates Inc.
Soc. Sucrière d'Etudes et de Conseils S.A.
Tate & Lyle Technical Services Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Sugar factory design and erection (Cane and Beet)**
Basico G.m.b.H.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Waschinenfabrik A.G
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Lucks & Co. G.m.b.H.
The Mirrlees Watson Co. Ltd.
Reggiane O.M.I. S.p.A.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.)

**Sugar machinery, General**
Babcock & Wilcox Ltd.
Barry Henry & Cook Ltd.
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Dorr-Oliver Inc., Cane Sugar Division.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.

**Sugar machinery, General**—*continued*
Kay Iron Works (Pvt.) Ltd.
K.I.W. Construction Ltd.
The Mirrlees Watson Co. Ltd.
Reggiane O.M.I. S.p.A.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Sugar refinery consultancy services**
Basico G.m.b.H.
C F & I Engineers Inc.
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
Industrieprojekt A.G.
F. C. Schaffer & Associates Inc.
Tate & Lyle Technical Services Ltd.
Techserve (Pty.) Ltd.

**Sugar refinery design and erection**
Basico G.m.b.H.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Lucks & Co. G.m.b.H.
The Mirrlees Watson Co. Ltd.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

**Sugar silos**
Cowiconsult.
A/S De Danske Sukkerfabrikker.
Fives Lille-Cail.
Lucks & Co. G.m.b.H.
Chr. Ostenfeld & W. Jonson.
Tecomatic Ltd.
Ingeniörsfirman Nils Weibull A.B.

**Sugar tabletting machinery**
Chambon Ltd.
Elba Machinefabrieken B.V.
Stansteel Corporation.
Ingeniörsfirman Nils Weibull A.B.

**Sulphur furnaces, Continuous**
Buckau-Wolf Maschinenfabrik A.G.
Cocksedge & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Maschinenfabrik H. Eberhardt.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Switchgear**
ACEC.

**Temperature recorders and controllers**
Bailey Meters and Controls Ltd.
The British Rototherm Co. Ltd.
Chemap A.G.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
A. H. Korthof N.V.
Negretti & Zambra Ltd.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
G. H. Zeal Ltd.

**Test sieves, B.S. and A.S.T.M.**
International Combustion Riley Ltd.
A. H. Korthof N.V.

**Thermometers**
The British Rototherm Co. Ltd.
A. H. Korthof N.V.
Negretti & Zambra Ltd.
G. H. Zeal Ltd.

**Thickeners, Tray-type**
Dorr-Oliver Inc., Cane Sugar Division.

**Trailers**
Martin-Markham (Stamford) Ltd.
Ransomes Sims & Jefferies Ltd.
Tate & Lyle Enterprises Ltd.
Toft Bros. Industries Ltd.

**Transmission belting**
Habasit A.G.

**Tube brushes, Wire**
Flexible Drives (Gilmans) Ltd.
Rotatools (U.K.) Ltd.

**Tube cleaners, Rotary (Electric and air)**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool)Ltd.
Nordon & Cie.
Rotatools (U.K.) Ltd.
*see also* Scale removal and prevention.

**Tube expanders**
Rotatools (U.K.) Ltd.

**Tube fittings**
Realm Engineering Works Ltd. (*stainless steel*).

**Tubes, Bimetal**
Birmingham Battery Tube Company.

**Tubes for boilers, evaporators, juice heaters, vacuum pans, etc.**
Babcock & Wilcox Ltd.
Birmingham Battery Tube Company.
Fives Lille-Cail.
General Tubing Pty. Ltd.

**Tubes, Stainless steel**
General Tubing Pty. Ltd.
Welding Technical Services Ltd.

**Urea addition plant for molasses fodder mixtures**
Bescon.
Ulrich Walter Maschinenbau.

**Used sugar machinery**
Brill Equipment Company.
Wabash Power Equipment Company.

**Used sugar refinery machinery**
Brill Equipment Company.
Wabash Power Equipment Company.

**Vacuum conveying systems for sugar**
Tecomatic Ltd.

**Vacuum pans**
*see* **Pans.**

**Vacuum pumps**
Ateliers de Construction d'Ensival S.A.
A. Bosco S.p.A.
Cotton Bros (Longton) Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
KSB Klein, Schanzlin & Becker A.G.
The Mirrlees Watson Co. Ltd.
Nash Engineering Company.
Neyrpic.
Siemens A.G.
A. & W. Smith & Co. Ltd.

**Vacuum pumps, Oil-free**
Nash Engineering Company.
Siemens A.G.
George Waller & Son Ltd.

**Valve actuators, Hydraulic**
Edwards Engineering Corporation.
Kent Instruments Ltd.

**Valves**
von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke.
Chemap A.G.
M. Dedini S.A. Metalúrgica.
George Waller & Son Ltd.

*Ball valves*
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot).

*Diaphragm valves*
Negretti & Zambra Ltd.
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot)

*Diverter valves*
Tecomatic Ltd.
Westinghouse Brake and Signal Co. Ltd.

*Glass ball valves*
Fischer & Porter Ltd.

*Relief valves*
Blundell & Crompton Ltd.

*Rotary valves*
Tecomatic Ltd.
Westinghouse Brake and Signal Co. Ltd.

*Slide valves*
The Reiss Engineering Co. Ltd.

*Stainless steel valves*
A.P.V. Co. Ltd.
Realm Engineering Works Ltd.
The Reiss Engineering Co. Ltd.
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot).

*Vacuum pan discharge valves*
Fletcher and Stewart Ltd.
The Reiss Engineering Co. Ltd.

**Vibrating feeders**
Electromagnets Ltd.
Eriez Magnetics.
International Combustion Riley Ltd.

**Vibrators**
Electromagnets Ltd.
Eriez Magnetics.
International Combustion Riley Ltd.

**Water cooling towers**
The Davenport Engineering Co. Ltd.
Film Cooling Towers (1925) Ltd.
Foster Wheeler John Brown Boilers Ltd.
*see also* Coolers, Water

**Water treatment**
Babcock & Wilcox Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Fabcon Inc.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Wallace & Tiernan Ltd.

**Weed control chemicals**
May & Baker Ltd.
Tate & Lyle Enterprises Ltd.

**Weighing machines**
Cellier S.A.
Fletcher and Stewart Ltd.
Greif-Werk Maschinenfabrik.
Herbert & Sons Ltd.
Librawerk Pelz & Nagel K.G.
N.V. Servo-Balans.
Richard Simon & Sons Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
*see also* Juice scales.

**Wire brushes, Rotary and manual**
Flexible Drives (Gilmans) Ltd
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

**Wire cloth**
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Sankey Green Wire Weaving Co. Ltd.
Wire Weaving Co Ltd.

**Wire gauze strainers**
N. Greening (Warrington) Ltd.

**Wire tying sack tool**
Thames Packaging Equipment Co.

**Woven wire**
N. Greening (Warrington) Ltd.
Sankey Green Wire Weaving Co. Ltd.

**Wrapping machines**
SAPAL.

**Yeast plants**
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Hitachi Shipbuilding & Engineering Co. Inc.
Nordon & Cie.
SPEICHIM.
Tate & Lyle Enterprises Ltd.

# BUYERS' GUIDE–ADDRESS LIST

**A.B.M. Industrial Products Ltd.,**
Woodley, Stockport, Cheshire, England.
*Tel.:* 061–430 4391. *Cable:* Chrievan, Stockport.
*Telex:* 667835.

**ACEC Ateliers de Constructions Electriques de Charleroi SA.,**
Boite Postale 4, B 6000 Charleroi, Belgium.
*Tel.:* 07/36.20.20. *Cable:* Ventacec, Charleroi.
*Telex:* Acec Charleroi 51.227.

**Azko Chemie B.V.–Imacti,**
P.O. Box 4038, Amsterdam, Holland.
*Tel.:* (20) 918918. *Cable:* Chemsales, Amsterdam.
*Telex:* 16532.

**The Albany Engineering Co. Ltd.,**
Church Road, Lydney, Glos., GL15 5EQ England.
*Tel.:* Lydney 2275. *Cable:* Bolthead, Lydney.
*Telex:* 43363.

**Alfa-Laval AB.,**
Box 1008, S-221 03 Lund 1, Sweden.
*Tel.:* 046-14 03 20. *Cable:* Alfalaval, Lund.
*Telex:* 3145.

**Allied Colloids Ltd.,**
P.O. Box 38, Low Moor, Bradford, Yorkshire, BD12 0JZ England.
*Tel.:* Bradford 671267. *Cable:* Colloidall, Bradford.
*Telex:* 51646.

**The A.P.V. Co. Ltd.,**
P.O. Box 4, Crawley, Sussex, RH10 2QB England.
*Tel.:* Crawley 27777. *Cable:* Anaclastic, Crawley, Telex.
*Telex:* 87237.

**A.P.V.-Kestner Ltd.,**
Greenhithe, Kent, England.
*Tel.:* Greenhithe 3281. *Cable:* Kestnerato, Dartford.
*Telex:* 896356.

**A.P.V.-Mitchell (Dryers) Ltd.,**
Denton Holme, Carlisle, Cumberland, CA2 5DU England.
*Tel.:* Carlisle 24205. *Cable:* Dryers, Carlisle.
*Telex:* 64139.

**von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke,**
605 Offenbach/Main, Friedrichsring 32–34, Germany.
*Tel.:* 83 20 54. *Cable:* Kondenstopf, Offenbachmain.
*Telex:* 04 152899 shof.

**ASEA-Weibull,**
P.O. Box 4015, S-28104 Hässelholm 4, Sweden.
*Tel.:* (0451) 83000. *Cable:* Nilswei, Hässelholm.
*Telex:* 48086.

**Ateliers de Construction d'Ensival S.A.,**
44 rue Hodister, B-4851 Wegnez, Belgium.
*Tel.:* 087-60166. *Cable:* Pompensi, Pepinster.
*Telex:* 49058.

**Babcock & Wilcox Ltd.,**
Cleveland House, St. James's Square, London, SW1Y 4LN England.
*Tel.:* 01–930 9766. *Cable:* Babcock, London S.E.1.
*Telex:* 884151/2/3.

**Bailey Meters & Controls Ltd.,**
218 Purley Way, Croydon, CR9 4HE England.
*Tel.:* 01–686 0400. *Cable:* Bailemeta, London.
*Telex:* 262335.

**William Bain & Co. Ltd.,**
Lochrin Works, Coatbridge, Lanarkshire, Scotland.
*Tel.:* Coatbridge 23471. *Cable:* Lochrin, Coatbridge.
*Telex:* 778809.

**Balco-Filtertechnik G.m.b.H.,**
3300 Braunschweig, Am Alten Bahnhof 5, Germany.
*Tel.:* 830 71–2. *Cable:* Balco, Braunschweig.
*Telex:* 952509.

**Barry Henry & Cook Ltd.,**
West North St., Aberdeen, AB9 2TD Scotland.
*Tel.:* 0224–26333. *Cable:* Barry, Aberdeen.

**Basico Gesellschaft fur internationale Projekte der Landwirtschaft, Forstwirtschaft und Agrarindustrie m.b.H.,**
D-6370 Oberursel, Postbox 547, Germany.
*Tel.:* (06171) 51054. *Cable:* Basico, Oberursel.
*Telex:* 4-10 730.

**Bellingham & Stanley Ltd.,**
61 Markfield Rd., London N.15, England.
*Tel.:* 01–808 2675. *Cable:* Polyfract, London, N.15.
*Telex:* 23784.

**Bescon,**
Hambridge Road, Newbury, Berks., England.
*Tel.:* Newbury 2363. *Cable:* Plenty, Newbury.
*Telex:* 848110.

**Birmingham Battery Tube Company,**
Selly Oak, Birmingham 29, England.
*Tel.:* 021–472 1151. *Cable:* Batmetco, Birmingham, Telex.
*Telex:* 338285.

**Blundell & Crompton Ltd.,**
West India Dock Road, London, E14 8HA England.
*Tel.:* 01–987 6001. *Cable:* Blundell, London, E14 8HA

**BMA Braunschweigische Maschinenbauanstalt,**
33 Braunschweig, Am Alten Bahnhof 5, Postfach 3225, Germany.
*Tel.:* (0531) 804-1. *Cable:* Bema, Braunschweig.
*Telex:* 952 456.

**Bookers Agricultural & Technical Services Ltd.,**
Bucklersbury House, 83 Cannon St., London EC4N 8EJ England.
*Tel.:* 01–248 8051. *Cable:* Considerer, London E.C.4.
*Telex:* 888169.

**A. Bosco S.p.A.,**
Piazzale A. Bosco 3, 05100 Terni, Italy.
*Tel.:* (0744) 55.341. *Cable:* Bosco, Terni.
*Telex:* 66032.

**Brencede Ltd.,**
23a Bridge Street, Saint Ives, Huntingdonshire, England.
*Tel.:* 0480–64406.

**Brill Equipment Company,**
35–65 Jabez Street, Newark, N.J., 07105 U.S.A.
*Tel.:* (201) 589-7420. *Cable:* Bristen, Newark, N.J.
*Telex:* 138944.

**Brimag Ltd.,**
Amington Colliery, Glascote Heath, Tamworth, Staffs, England.
*Tel.:* Tamworth 3581.
*Telex:* 27769 Minsep London for Brimag.

**British Charcoals & Macdonalds Ltd.,**
21 Dellingburn St., Greenock, Scotland.
*Tel:* 20273. *Cable*: Brimac, Greenock.

**British Ropeway Engineering Co. Ltd.,**
Tubs Hill House, London Rd., Sevenoaks, Kent, England.
*Tel.:* Sevenoaks 55233. *Cable:* Boxhauling, Sevenoaks
*Telex:* 95164.

**The British Rototherm Co. Ltd.,**
Margam, Port Talbot, Glamorgan, SA13 2PW S. Wales.
*Tel.:* 0656–740551. *Cable:* Rototherm, Margam.
*Telex:* 497341.

**Thomas Broadbent & Sons Ltd.,**
Queen Street South, Huddersfield, Yorkshire, HD1 3EA England.
*Tel.:* 0484–22111. *Cable:* Broadbent, Huddersfield.
*Telex:* 51515.

**Peter Brotherhood Ltd.,**
Peterborough, England.
*Tel.:* 71321. *Cable:* Brotherhoods, Peterborough
*Telex:* 32154 Brotherhd Pboro.

**David Brown Gear Industries Ltd.,**
Park Gear Works, Huddersfield, Yorkshire, HD4 5DD England.
*Tel.:* 0484–22180. *Cable:* Gearing, Huddersfield.
*Telex:* 51562/3.

**Buckau-Wolf Maschinenfabrik A.G.,**
D 4048 Grevenbroich, Postfach 69, Germany.
*Tel.:* 02181/421. *Cable:* Buckauwolf, Grevenbroich.
*Telex:* 0851 7111.

**Buell Ltd.,**
George Street Parade, Birmingham, B3 1QQ England.
*Tel.:* 021–236 5391. *Cable:* Buellon, Birmingham.
*Telex:* 338458.

**CAMECO Cane Machinery & Engineering Co. Inc.,**
P.O. Box 968, Thibodaux, La., 70301 U.S.A.
*Tel.:* (504) 447–7285. *Cable:* Cameco, Thibodaux.
*Telex:* 584183.

**John R. Carmichael Ltd.,**
Kenmore Works, Broad Lane, Liverpool, L11 1AE England.
*Tel.:* 051–226 1336/7. *Cable:* Filclo, Liverpool L11 1AE.

**Carter Industrial Products Ltd.,**
Redhill Road, Birmingham, B25 8EY England.
*Tel.:* 021–722 4300. *Cable:* Midheat, Birmingham.
*Telex:* 339219.

**CECA,**
11 Ave. Morane-Saulnier, B.P. 66, 78140 Velizy-Villacoublay, France.
*Tel.:* 946 96.35. *Cable:* Carbacti, Velizy.
*Telex:* 60–584.

**Cellier S.A.,**
B.P.58, 73102 Aix-les-Bains, France.
*Tel.:* (79) 35.05.65. *Cable:* noxel, Aix-les-Bains.
*Telex:* 32.053 F Inoxel.

**C F & I Engineers Inc.,**
3309 Blake Street, Denver, Colo., 80205 U.S.A.
*Tel.:* (303) 623-0211. *Cable:* Cfienginer, Denver.
*Telex:* 45-567.

**Chambon Ltd.,**
Riverside Works, Standish Rd., London W.6, England.
*Tel.:* 01–748 6086. *Cable:* Chambonted, London W.6.
*Telex:* 261476.

**Chemap A.G.,**
Alte Landstrasse 415, 8708 Männedorf/ZH, Switzerland.
*Tel.:* (01) 73 91 01. *Cable:* Servochemie, Männedorf.
*Telex:* 75 508.

**Chemviron S.A.,**
P.O. Box 17, Ixelles 1, B-1050 Brussels, Belgium.
*Tel.:* (02) 13 40 66. *Cable:* Chemviron, Brussels.
*Telex:* 22 481 Chemviron Bru B.

**Gebr. Claas Maschinenfabrik G.m.b.H.,**
4834 Harsewinkel/Westfalen, Postfach 140, Germany.
*Tel.:* 05247/41-325. *Cable:* Merkur, Harsewinkel.
*Telex:* 0933863.

**Cocksedge & Co. Ltd.,**
P.O. Box 41, Grey Friars Rd., Ipswich, Suffolk, IP1 1UW England.
*Tel.:* 56161. *Cable:* Cocksedge, Ipswich.
*Telex:* 98583.

**Codistil-Construtora de Distilarias Dedini S.A.,**
*see* M. Dedini S.A. Metalúrgica.

**Cotton Bros (Longton) Ltd.,**
Crown Works, Portland Rd., Longton, Stoke-on-Trent, ST3 1EN England.
*Tel.:* 0782-33021. *Cable:* Cotbro, Stoke-on-Trent.

**Cowiconsult,**
(formerly Chr. Ostenfeld & W. Jonson),
Skjoldsgade 8, 2100 Copenhagen, Denmark.
*Tel.:* (0176) TRIA 5050. *Cable:* Cowiconsult, Copenhagen.
*Telex:* 19705.

**A. F. Craig & Co. Ltd.,**
Caledonia Engineering Works, Paisley, PA3 2NA Scotland.
*Tel.:* 041–889 2191. *Cable:* Craig, Paisley.
*Telex:* 778051.

**A/S De Danske Sukkerfabrikker,**
(The Danish Sugar Corporation).
Langebrogade 5, Copenhagen K, Denmark.
*Tel.:* (01) AS 6130. *Cable:* Sukkerfabrikker, Copenhagen.
*Telex:* 27030 dansuk dk.

**The Davenport Engineering Co. Ltd.,**
Harris Street, Bradford, BD1 5JD England.
*Tel.:* 29361. *Cable:* Humidity, Bradford.
*Telex:* 517153.

**M. Dedini S.A. Metalúrgica,**
Ave. Mario Dedini 201, Piracicaba, Est. São Paulo, Brazil.
*Tel.:* 3-1122.

**The Deister Concentrator Co. Inc.,**
901/935 Glas ow Ave., Fort Wayne, Indiana, 46801 U.S.A.
*Tel.:* (219) 742–7213. *Cable:* Retsied, Fort Wayne.

**Deplechin,**
28 Avenue de Maire, 7500 Tournai, Belgium.
*Tel.:* 069 281.52. *Cable:* Deplechin, Tournai.

**Diamond Shamrock Chemical Company, Nopco Chemical Division,**
P.O. Box 829, 1901 Spring Street, Redwood City, Calif., 94064 U.S.A.
*Tel.:* (415) 369–0071. *Cable:* Diashamres, Redwood City.
*Telex:* 910 389-5412.

**Dicalite/GREFCO Inc., International Division,**
3450 Wilshire Boulevard, Los Angeles, Calif., 90010 U.S.A.
*Tel.:* (213) 381–5081. *Cable:* Dicalite, Losa.
*Telex:* 67-4224.

**John Dore & Co. Ltd.,**
51–55 Fowler Road, Hainault, Essex, England.
*Tel.:* 01-500 4144. *Cable:* Cuivre, Ilford.

**Dorr-Oliver Inc., Cane Sugar Division,**
Stamford, Conn., 06904 U.S.A.
*Tel.:* (203) 348-5871.
*Telex:* 965912.

**The Dow Chemical Company,**
Midland, Mich., 48640 U.S.A.

**Dreibholz & Floering Ltd.,**
Dereham, Norfolk, England.
*Tel.:* Dereham 3145. *Cable:* Slicing, Dereham.
*Telex:* 97357.

**Dust Control Equipment Ltd.,**
Thurmaston, Leicester, LE4 8HP England.
*Tel.:* 053723–3333. *Cable:* Dust, Leicester, Telex.
*Telex:* 34500.

**Maschinenfabrik H. Eberhardt,**
3340 Wolfenbüttel, Frankfurterstr. 14/17, Postfach 266, Germany.
*Tel.:* (0 53 31) 22002/3263. *Cable:* Eberhardt, Wolfenbüttel.
*Telex:* 09 52620 ebhdt d.

**Edwards Engineering Corporation,**
1170 Constance Street, New Orleans, La., 70130 U.S.A.
*Tel.:* (504) 524–0175. *Cable:* Joedco, New Orleans.
*Telex:* 058-342.

**Elba Machinefabrieken B.V.,**
P.O. Box 21, Ambachtsweg 3 (Industrieterrein), Huizen, N.H., Holland.
*Tel.:* (02152) 51956. *Cable:* Elbamachines, Huizen.

**Electromagnets Ltd.,**
Bond Street, Hockley, Birmingham, B19 3LA England.
*Tel.:* 021-236 9071. *Cable:* Boxmag, Birmingham, Telex.
*Telex:* 339192 Electromag Birmingham.

**Elliott Turbomachinery Ltd.,**
15 Portland Place, London, W1N 3AA England.
*Tel.:* 01–637 1591. *Cable:* Carell, London.
*Telex:* 25969.

**Enviro-Clear Company Inc.,**
1251 Avenue of the Americas, New York, N.Y., 10020 U.S.A.
*Tel.:* (212) 489-9060. *Cable:* Enclear, New York.

**Eriez Magnetics, International Division,]**
70724 Magnet Drive, Erie, Pa., U.S.A.
*Tel.:* (814) 833-9881. *Cable:* Eriez, Erie.
*Telex:* 91-4470.

**Escher Wyss Ltd.,**
Case Postale-Gare Centrale, 8023 Zurich, Switzerland.
*Tel.:* 444451. *Cable:* Escherwyss, Zurich.
*Telex:* 53906/7/8.

**Evans, Adlard & Co. Ltd.**
Postlip Mills, Winchcombe, Cheltenham, Glos., GL54 5BB England.
*Tel.:* 0242-602227. *Cable:* Adlard, Winchcombe.
*Telex:* 43316.

**Evenproducts Ltd.,**
Evesham, Worcs., WR11[4TS England.
*Tel.:* Evesham 41212.

**Ewart Chainbelt Co. Ltd.,**
Colombo Street, Derby, England.
*Tel.:* Derby 45451. *Cable:* Chainbelt, Derby.
*Telex:* 37575.

**Extraction De Smet S.A.,**
265 Ave. Prince Baudouin, B-2520 Edegem-Antwerp, Belgium.
*Tel.:* (03) 49.42.40. *Cable:* Extraxsmet, Antwerp.
*Telex:* 31824 Desmet B.

**Fabcon Inc.,**
1275 Columbus Avenue, San Francisco, Calif., 94133 U.S.A
*Tel.:* (415) 928-2400/1/2. *Cable:* Fabcon, San Francisco

**Farrel Company,**
Division of USM Corporation,
Ansonia, Conn., 06401 U.S.A.
*Tel.:* (203) 734-3331. *Cable:* Farrelmach, Ansonia.

**Farrow Irrigation Ltd.,**
Horseshoe Road, Spalding, Lincs., PE11 3JA England.
*Tel.:* Spalding 3764. *Cable:* Farrow, Spalding.
*Telex:* 22404 Sugrengine Bmly.

**Ferguson Perforating & Wire Co.,**
130-140 Ernest Street, Providence, R.I., 02905 U.S.A.
*Tel.:* (401) 941-8876. *Cable:* Ferguson, Providence.
*Telex:* 927539.

**Film Cooling Towers (1925) Ltd.,**
Chancery House, Parkshot, Richmond, Surrey, England.
*Tel.:* 01-940 6494. *Cable:* Aloof, Richmond, Surrey.
*Telex:* 27451.

**Fischer & Porter Ltd.,**
Salterbeck Trading Estate, Workington, Cumberland, England.
*Tel.:* 0946-830611. *Cable:* Saltfisch, Harrington.
*Telex:* 64114.

**Fives Lille-Cail,**
7 Rue Montalivet, 75 Paris 8e, France.
*Tel.:* 742.21.19. *Cable:* Fivcail, Paris.
*Telex:* Fivcail 65328.

**Fletcher and Stewart Ltd.,**
Masson Works, Litchurch Lane, Derby, England.
*Tel.:* Derby 40261. *Cable:* Amarilla, Derby, Telex.
*Telex:* 37514.

**Flexible Drives (Gilmans) Ltd.,**
Skatoskalo Works, Millers Road, Warwick, CV34 5AR England.
*Tel.:* Warwick 44331/5. *Cable:*Skatoskalo, Warwick.
*Telex:* 31451.

**Flexotube (Liverpool) Ltd.,**
25 Hope Street, Liverpool, L1 9BL England.
*Tel.:* 051-709 3345. *Cable:* Flexotube, Liverpool.

**Fontaine & Co. G.m.b.H.,**
51 Aachen, Grüner Weg 31, Germany.
*Tel.:* Aachen 21233. *Cable:* Fontaineco, Aachen.
*Telex:* 832558 fonte d.

**Foster Pump Works Inc.,**
07-73 Airport Road, Westerly, R.I., 02891 U.S.A.
*Tel.:* (401) 596-7711. *Cable:* Fostrpump, Westerly.
*Tel.:* 96-6451.

**Foster Wheeler John Brown Boilers Ltd.,**
P.O. Box 160, Greater London House, Hampstead Rd., London, NW1 7QN England.
*Tel.:* 01-388 1212. *Cable:* Rewopsteam, London.
*Telex:* 263984.

**Foxboro-Yoxall Ltd.,**
Redhill, Surrey, RH1 2HL England.
*Tel.:* Redhill 65000. *Cable:* Yoxbri, Redhill.
*Telex:* 25560.

**French Oil Mill Machinery Co.,**
1035 West Greene St., Piqua, Ohio, 45356 U.SA.
*Tel.:* (513) 773-3420. *Cable:* French, Piqua.
*Telex:* 228-009.

**Fulton Iron Works Company,**
Subsidiary of Katy Industries Inc.,
3844 Walsh Street, St. Louis, Mo., 63116 U.S.A.
*Tel.:* (314) 752-2400. *Cable:* Castiron, St. Louis.
*Telex:* 44-2381.

**General Tubing Pty. Ltd.,**
P.O. Box 124, Alexandria, N.S.W. 2015, Australia.
*Tel.:* Sydney 51-8645. *Cable:* Gentube, Sydney.
*Telex:* Sydney 21610.

**T. Giusti & Son Ltd.,**
202-228 York Way, Kings Cross, London N.7, England.
*Tel.:* 01-607 5021. *Cable:* Giustison, London N.7.
*Telex:* 22592.

**GR-Stein Refractories Ltd.,**
Castlecary Works, Bonnybridge, Stirlingshire, Scotland.
*Tel.:* 032484-255. *Cable:* Stein, Bonnybridge.
*Telex:* 77506.

**E. Green & Son Ltd.,**
Calder Vale Road, Wakefield, Yorkshire, England.
*Tel.:* Wakefield 71171. *Cable:* Economiser, Wakefield.
*Telex:* 55452.

**N. Greening (Warrington) Ltd.,**
Britannia Works, Warrington, Lancs., WA5 5JX England.
*Tel.:* Warrington 35991. *Cable:* Greenings, Warrington.
*Telex:* 62195.

**Greif-Werk Maschinenfabrik,**
24 Lübeck, Postfach 1183, Germany.
*Tel.:* 5303-1. *Cable:* Greifwerk, Lübeck.
*Telex:* 026895.

**Gruendler Crusher & Pulverizer Company,**
2915 North Market Street, St. Louis, Mo., 63106 U.S.A.
*Tel.:* (314) 531-1220. *Cable:* Grupulco, St. Louis.
*Telex:* 44-7415.

**Habasit A.G.,**
CH-4153 Reinach-Basel, Switzerland.
*Tel.:* 061 76 70 70. *Cable:* Habasit, Reinach-Basel.
*Telex:* 62 859.

**Hawaiian Agronomics Company (International),**
P.O. Box 3470, Honolulu, Hawaii, 96801 U.S.A.
*Tel.:* (808) 536-4461. *Cable:* Agronomics, Honolulu.
*Telex:* (RCA) 723326; (ITT) 430173.

**Hein, Lehmann A.G.,**
P.O. Box 4109, Fichtenstr. 75, 4000 Düsseldorf, Germany.
*Tel.:* 77011. *Cable:* Heinlehmann, Duesseldorf.
*Telex:* 8582740 hl d.

**John M. Henderson & Co. Ltd.,**
P.O. Box 26, King's Works, Aberdeen AB9 8BU, Scotland.
*Tel.:* 0224-24262. *Cable:* Cranes, Aberdeen.
*Telex:* 73109.

**Herbert & Sons Ltd.,**
18 Rookwood Way, Haverhill, Suffolk, England.
*Tel.:* 0440-3551.

**Hinz Electromaschinen und Apparatebau G.m.b.H.,**
3300 Braunschweig, P.O. Box 2749, Hansestrasse 30, Germany.
*Tel.:* (0531) 3 15 95. *Cable:* Hinzmotoren, Braunschweig.
*Telex:* 9 52 753 himot d.

**Hiro Zoki Co. Ltd.,**
Nihonbashi 2-3-10, Chuo-ku, Tokyo, Japan.
*Tel.:* 03-274-5821. *Cable:* Hirozoki Co., Tokyo.
*Telex:* 2223197.

**Hitachi Shipbuilding & Engineering Co. Ltd.,**
1-1 Hitotsubashi 1-chome, Chiyoda-ku, Tokyo, 100 Japan.
*Tel.:* 231-6611. *Cable:* Hitachizosen, Tokyo
*Telex:* J 24490/J 22363.

**Hodag Chemical Corporation,**
7247 North Central Park Avenue, Skokie, Ill., 60076 U.S.A
*Tel.:* (312) 675-3950. *Cable:* Hodag, Skokieill

**Houttuin-Pompen N.V.,**
Postbus 76, Utrecht, Holland.
*Tel.:* (030) 44 16 44.
*Telex:* 47280.

**Howard Pneumatic Engineering Co. Ltd.,**
Fort Road, Eastbourne, Sussex, England.
*Tel.:* 22804/5/6. *Cable:* Howmatic, Eastbourne
*Telex:* 87672.

**Industrial Magnets Ltd.,**
Enfield Industrial Estate, Redditch, Worcs.
*Tel.:* Redditch 66611. *Cable:* Unimag, Redditch

**Industrieprojekt A.G.,**
Badenerstrasse 281, CH-8003 Zurich, Swizterland.
*Tel.:* (01) 23.36.26. *Cable:* Indarchag, Zurich.
*Telex:* 54803.

**Ingeniörsfirman Nils Weibull A.B.,**
*see* Weibull.

**International Combustion Ltd.,**
Sinfin Lane, Derby, DE2 9GJ England.
*Tel.:* 0332–23223. *Cable:* Lopulco, Derby.
*Telex:* 37581/2.

**International Combustion Riley Ltd.,**
Sinfin Lane, Derby, DE2 9GJ England.
*Tel.:* 0332–21252. *Cable:* Rileypro, Derby.
*Telex:* 37581.

**Irrigation & Industrial Development Corp.,**
260 Madison Ave., New York, N.Y., 10016 U.S.A.
*Tel.:* (212) 679–4428. *Cable:* Irridelco, New York.
*Telex:* RCA NY 4182; ITT 420856.

**Jeffress Bros. Ltd.,**
351 Melton Rd., Northgate East, Brisbane, Queensland 4013, Australia.
*Tel.:* 67-1677. *Cable:* Telejeff, Brisbane.

**Jenkins of Retford Ltd.,**
Retford, Nottinghamshire, England.
*Tel.:* Retford 2231. *Cable:* Jenkins, Retford.
*Telex:* 56122.

**JK Industrial Fabrics,**
Division of James Kenyon & Son Ltd.,
P.O. Box 28, Pilsworth Rd., Bury, Lancs., BL9 8QE England.
*Tel.:* 061–766 7531-7. *Cable:* Kenyon, Bury.
*Telex:* 667440.

**Amandus Kahl Nachf.,**
2000 Hamburg 26, Eiffestrasse 432, Postfach 260 343, Germany.
*Tel.:* 722 2024. *Cable:* Kahladus, Hamburg.
*Telex:* 0217875.

**Kay Iron Works (Pvt.) Ltd.,**
P.O. Yamuna Nagar, East Punjab, India.
*Tel.:* Yamuna Nagar 4/4A. *Cable:* Mithal, Yamuna Nagar.

**Thomas C. Keay Ltd.,**
P.O. Box 30, Densfield Works, Dundee, DD1 9DY Scotland.
*Tel.:* 0382–89341. *Cable:* Keay, Dundee.
*Telex:* 76278.

**Kent Instruments Ltd.,**
Biscot Road, Luton, Beds., England.
*Tel.:* Luton 21151.
*Telex:* 825161.

**Dr. Wolfgang Kernchen Optik-Elektronik-Automation,**
D-3011 Letter/Hannover, Postf. 129, Germany.
*Tel.:* Hannover 40 19 61. *Cable:* Optronic, Hannover.

**Kettenfabrik Unna G.m.b.H. & Co. K.G.**
475 Unna, Postfach 186, Germany.
*Tel.:* (02303) 8411. *Cable:* Kettenfabrik, Unna.
*Telex:* 08 229250.

**KIW Construction Ltd.,**
595½ Spanish Town Road, P.O. Box 138, Kingston 11, Jamaica, West Indies.
*Tel.:* 923–7444/6841. *Cable:* Industrial, Kingston.

**Kleinwanzlebener Saatzucht AG.,**
vorm. Rabbethge & Giesecke,
3352 Einbeck, Grimsehlstr. 29, Postfach 146, Germany.
*Tel.:* 05561/3111. *Cable:* Original, Einbeck.
*Telex:* 0965612.

**Koppers-Wistra-Ofenbau G.m.b.H.**
4000 Düsseldorf-Heerdt, Wiesenstrasse 134, Germany.
*Tel.:* 50 11 97. *Cable:* Wistraofen, Duesseldorf.
*Telex:* 08 584518.

**A. H. Korthof N.V.,**
Hertshooiweg 18, Postbus 73, Bergen, N.H., Holland.
*Tel.:* 02208–5526. *Cable:* Sugarlab, Amsterdam.

**Krieg & Zivy Industries,**
10 Avenue Descartes, 92 Le Plessis-Robinson, France.
*Tel.:* 644-62-26. *Cable:* Zedka, Plessis-Robinson.
*Telex:* 27328 F.

**KSB Klein, Schanzlin & Becker AG.,**
6710 Frankenthal, Postfach 225, Johann-Klein-Strasse 9, Germany.
*Tel.:* (06233) 861. *Cable:* Kleinschanzlin, Frankenthal.
*Telex:* 0465211 KSB.

**A.G. Kühnle, Kopp & Kausch,**
D 6710 Frankenthal/Pfalz. Friedrich-Ebert-Str. 16, Germany.
*Tel.:* (06233) 85-1. *Cable:* Turbomaschinen, Frankenthalpfalz.
*Telex:* 0465221.

**Lainyl Filter Cloths,**
4200 Ougrée-Sclessin, Belgium.
*Tel.:* (04) 52.21.50. *Cable:* Lainière, Sclessin.
*Telex:* 41.496.

**Librawerk Pelz & Nagel K.G.,**
33 Braunschweig, P.O. Box 3712, Germany.
*Tel.:* (0531) 37 60 51. *Cable:* Librawerk, Braunschweig.
*Telex:* 0952 866.

**Lucks & Co. G.m.b.H.,**
D-33 Braunschweig, Celler Strasse 66–67, P.O. Box 382, Germany.
*Tel.:* 0531/5971. *Cable:* Baulucks, Braunschweig.
*Telex:* 09-52713 luco d.

**Lurgi Apparate-Technik G.m.b.H.—Bereich Chemotechnik,**
6 Frankfurt (Main), Lurgihaus, Gervinusstr. 17–19, Germany.
*Tel.:* (0611) 157. *Cable:* Lurgitechnik, Frankfurt.
*Telex:* 04 12 36.

**Martin-Markham (Stamford) Ltd.,**
Lincolnshire Works, Stamford, Lincs., England.
*Tel.:* Stamford 2621/4. *Cable:* Marktrac, Stamford.

**Massey-Ferguson (Export) Ltd.,**
P.O. Box 62, Banner Lane, Coventry, CV4 9GF England.
*Tel.:* Coventry 465211. *Cable:* Masferg, Coventry.
*Telex:* 31-655.

**Mawdsleys Ltd.,**
Dursley, Gloucestershire, GL11 5AE England.
*Tel.:* Dursley 4131. *Cable:* Zone, Dursley.
*Telex:* 43128.

**May & Baker Ltd.,**
Dagenham, Essex, England.
*Tel.:* 01–592 3060. *Cable:* Bismuth, Dagenham.
*Telex:* London 28691.

**Mazer Chemicals Inc.,**
3938 Porett Drive, Gurnee, Ill., 60031 U.S.A.
*Tel.:* (312) 244-3410. *Cable:* Mazchem, Gurnee.

**F. W. McConnel Ltd.,**
Temeside Works, Ludlow, Shropshire, England.
*Tel.:* Ludlow 3131.
*Cable:* McConnel 35313, Ludlow Shropshire Telex.
*Telex:* 35313.

**M.E. Boilers Ltd.,**
23 Bedford Row, London W.C.1., England.
*Tel.:* 01–242 2214.
*Telex:* 32138 Micontrac, Peterborough.

**Mennesson & Cie.,**
Route de Nimes, 30200 Bagnols-sur-Cèze, France.
*Tel.:* 16-66-89.50.75.
*Telex:* 48146 Telexer Nimes Code 25.

**Mikropul Ltd.,**
Towerfield Industrial Estate, Shoeburyness, Essex, SS3 9QU England.
*Tel.:* Shoeburyness 2373. *Cable:* Mikropul, Southend-on-Sea.
*Telex:* 99346.

**Mirrlees Pumps Ltd.,**
Hambridge Rd., Newbury, Berks., England.
*Tel.:* Newbury 2363. *Cable:* Plenty, Newbury.
*Telex:* 848110.

**The Mirrlees Watson Co. Ltd.,**
Cosmos House, 1 Bromley Common, Bromley, BR2 9NA England.
*Tel.:* 01–464 5346. *Cable:* Mirwat, Bromley, Kent.
*Telex:* 22404.

**Mono Pumps Ltd.,**
Mono House, Sekforde Street, Clerkenwell Green, London, EC1R 0HE England.
*Tel.:* 01-253 8911. *Cable:* Monopumps London EC1.
*Telex:* 24453.

**Nash Engineering Company,**
Norwalk, Conn., 06856 U.S.A.
*Tel.:* (212) 421-4200. *Cable:* Hytor, Norwalk, Conn.
*Telex:* 96-5971.

**Negretti & Zambra Ltd.,**
Stocklake, Aylesbury, Bucks., England.
*Tel.:* Aylesbury 5931. *Cable:* Negretti, Aylesbury, Telex.
*Telex:* 83285.

**Newell Dunford Engineering Ltd.,**
143 Maple Road, Surbiton, Surrey, England.
*Tel.:* 01–546 7799. *Cable:* Lindaresco, London, Telex.
*Telex:* 22413.

**Newman Fabrications Ltd.,**
Feeder Road, Bristol, BS2 0TU England.
*Tel.:* 0272–74201. *Cable:* Machplant, Bristol.
*Telex:* 44834/5.

**Neyrpic,**
Rue Général Mangin, 38 Grenoble, France.
*Tel.:* (76) 96.48.30. *Cable:* Neyrpic, Grenoble.
*Telex:* 32.750.

**Nordon & Cie.,**
9 Avenue du XXeme Corps, B.P. 441, 54001 Nancy Cedex, France.
*Tel.:* 28–52 2060. *Cable:* Frernordon, Nancy.
*Telex:* 85040.

**Chr. Ostenfeld & W. Jonson,**
3 rue d'Aguesseau, Paris 8, France.
*Tel.:* 2660840. *Cable:* Cowiconsult, Paris.
*Telex:* 28233.

**Parsons Chain Co. Ltd.,**
Worcester Road, Stourport-on-Severn, Worcs., DY13 9AT England.
*Tel.:* Stourport 2551. *Cable:* Chainwork, Stourport-on-Severn.
*Telex:* 339711 Chainwire Strpt.

**Paxman Process Plant Division, GEC Diesels Ltd.,**
P.O. Box 8, Colchester, Essex, CO1 2HW England.
*Tel.:* 0206–5151. *Cable:* Paxman, Colchester.
*Telex:* 98151.

**Perkin-Elmer Limited,**
Beaconsfield, Bucks., HP9 1QA England.
*Tel.:* Beaconsfield 6161. *Cable:* Peco, Beaconsfield.
*Telex:* 83257.

**The Permutit Co. Ltd.,**
632–652 London Rd., Isleworth, Middx., England.
*Tel.:* 01–560 5199. *Cable:* Permutit, Hounslow.
*Telex:* 24440.

**Pittsburgh Activated Carbon Division, Calgon Corporation,**
Calgon Center, Box 1346, Pittsburgh, Pa., 15230 U.S.A.
*Tel.:* (412) 923-2345. *Cable:* Pitcarb, Pittsburgh.
*Telex:* 086739.

**Plenty & Son Ltd.,**
Hambridge Road, Newbury, Berks., England.
*Tel.:* Newbury 2363. *Cable:* Plenty, Newbury
*Telex:* 848110.

**Plymouth Locomotives Division, Banner International Inc.,**
51 Bank Street (Suite 402), Stamford, Conn., 06901 U.S.A.
*Tel.:* (203) 327-5084. *Cable:* Plylocomot, New York.
*Telex:* 965887.

**J. & F. Pool Ltd.,**
Hayle, Cornwall, England.
*Tel.:* Hayle 3571. *Cable:* Perforator, Hayle.
*Telex:* 45286 A.B. Poolperf Hayle.

**P. & S. Textiles Ltd.,**
Broadway Mills, Haslingden, Lancs., BB4 4EJ England.
*Tel.:* Rossendale 3421. *Cable:* Neotex, Haslingden, Telex.
*Telex:* 63127 Neotex Hasden.

**H. Putsch & Comp.,**
Postfach 4221, Frankfurter Str. 5–25, 58 Hagen, Germany.
*Tel.:* (02331) 31031. *Cable:* Putsch, Hagen.
*Telex:* 823795.

**Ransomes Sims & Jefferies Ltd.,**
Nacton Works, Ipswich, Suffolk, IP3 9QG England.
*Tel.:* 0473–72222. *Cable:* Ransomes, Ipswich, Telex.
*Telex:* 98174.

**Rapid Magnetic Ltd.,**
Lombard St., Birmingham, B12 0QW England.
*Tel.:* 021–773 1361. *Cable:* Magnetism, Birmingham.
*Telex:* 338671 Magnetism Birmingham.

**Realm Engineering Works Ltd.,**
Milton Avenue, Croydon, CR9 2JP England.
*Tel.:* 01–684 8391. *Cable:* Realmard, Croydon.

**Redler Conveyors Ltd.,**
Dudbridge Works, Stroud, Gloucestershire, GL5 3EY England.
*Tel.:* (04536) 3611. *Cable:* Redler, Stroud.
*Telex:* 43228.

**Reed Darnley Taylor Ltd.,**
Larkfield, near Maidstone, Kent, England.
*Tel.:* 0622–77777. *Cable:* Satchelsac, Larkfield.
*Telex:* 965131.

**H. Reeve Angel & Co. Ltd.,**
70 Newington Causeway, London, SE1 6BD England.
*Tel.:* 01–407 6126. *Cable:* Reevangel, London SE1.
*Telex:* 885757.

**Reggiane O.M.I. S.p.A.,**
P.O. Box 331, 42100 Reggio Emilia, Italy.
*Tel.:* 41341. *Cable:* Reggiane, Reggio Emilia.
*Telex:* 51265 Reggiane.

**Robert Reichling & Co. K.G.,**
Kölner Strasse 397–403a, Postfach 2380, D4150 Krefeld, Germany.
*Tel.:* 3.32.17. *Cable:* Reichling, Krefeld.
*Telex:* 0853 757.

**The Reiss Engineering Co. Ltd.,**
Wey Valve Dept., 2 Dalston Gardens, Stanmore, Middx., HA7 1BQ England.
*Tel.:* 01–204 7155. *Cable:* Reisengine, Stanmore.
*Telex:* 935400.

**Renold Limited,**
Renold House, Wythenshawe, Manchester, England.
*Tel.:* 061–437 5221. *Cable:* Renold, Manchester.
*Telex:* 669052.

**Riley Stoker Corporation,**
P.O. Box 547, Worcester, Mass., 01613 U.S.A.
*Tel.:* (617) 852-7100. *Cable:* Riley, Worcester, Mass.
*Telex:* 920426.

**Robey of Lincoln Ltd.,**
P.O. Box 23, Lincoln, LN5 8HB England.
*Tel.:* 0522-21381. *Cable:* Robey, Lincoln.
*Telex:* 56109.

**Geo. Robson & Co. (Conveyors) Ltd.,**
Coleford Rd., Sheffield, S9 5PA England.
*Tel.:* Sheffield 49836.

**Rohm and Haas Company,**
Independence Mall West, Philadelphia, Pa., 19105 U.S.A.
*Tel.:* (215) 592-3000. *Cable:* Rohmhaas, Philadelphia.
*Telex:* 845-247.

**Rome Industries,**
P.O. Box 48, Cedartown, Ga., 30125 U.S.A.
*Tel.:* (404) 748-4450. *Cable:* Roman, Cedartown.
*Telex:* 542391.

**Rosin Engineering Co. Ltd.,**
15/17 St. Cross St., Hatton Garden, London, EC1N 8UR England.
*Tel.:* 01-242 9361/3.
*Telex:* 338078.

**Rotatools (U.K.) Ltd.,**
Brookfield Drive, Liverpool, L9 7EG England.
*Tel.:* 051-525 8611. *Cable:* Scalewell, Liverpool.

**Rudolph Research Inc.,**
International Sales, Ameresco Inc.,
101 Park St., Montclair, N.J., 07042 U.S.A.
*Tel.:* (201) 746-5300. *Cable:* Ameresque, Montclair.
*Telex:* 138614.

**Salzgitter Maschinen A.G.,**
D-332 Salzgitter 51, Postfach 51 1640, Federal Republic of Germany.
*Tel.:* (053 41) 302-1.
*Telex:* 954445 smg d.

**Sankey Green Wire Weaving Co. Ltd.,**
Thelwall, Warrington, Lancs., WA4 2LZ England.
*Tel.:* Warrington 61211. *Cable:* Sanco, Warrington.

**SAPAL Société Anonyme des Plieuses Automatiques,**
44 Avenue du Tir Fédéral, 1024 Ecublens près Lausanne, Switzerland.
*Tel.:* (021) 34 44 61. *Cable:* Autoplieuses, Lausanne.
*Telex:* 24 541.

**Saunders Valve Co. Ltd.,**
Grange Rd., Cwmbran, Monmouthshire, NP4 3XX England.
*Tel.:* 06333-2044. *Cable:* Saunval, Newportmon.
*Telex:* 49241.

**Schaefer Brush Mfg. Co. Inc.,**
117 West Walker St., Milwaukee, Wis., 53204 U.S.A.
*Tel.:* (414) 645-3664.

**F. C. Schaffer & Associates Inc.,**
1020 Florida Blvd., Baton Rouge, La., 70802 U.S.A.
*Tel.:* (504) 343-9262. *Cable:* Arkel, Baton Rouge.

**Schmidt + Haensch,**
1 Berlin 62, Naumannstrasse 33, Germany.
*Tel.:* 784 6031. *Cable:* Polarisation, Berlin.
*Telex:* 183 343 suhfo d.

**Schumacher'sche Fabrik,**
712 Bietigheim/Württemberg, Germany.
*Tel.:* (07142) 7721. *Cable:* Schumafilt, Bietigheim.
*Telex:* 724217.

**Serseg (Seguin-Sergot),**
4 Place Félix Eboué, 75 Paris 12e, France.
*Tel.:* (1)344.29.59. *Cable:* Sersegman, Paris.
*Telex:* 22.631 Serseg, Paris.

**N.V. Servo-Balans,**
Wegastraat 40, 2008 Den Haag-6, Holland.
*Tel.:* (070)-835503. *Cable:* Servbalaons, Den Haag.

**SEUM,**
62 Corbehem, France.
*Tel.:* (20) 85-70-40. *Cable:* Seum, Corbehem.
*Telex:* Seum 11.500 F.

**Siemens A.G., Industry Division, Chemical and Food Industries,**
D-8520 Erlangen, Postfach 325, Germany.
*Tel.:* (09131) 71.
*Telex:* 629871.

**Sigmund Pulsometer Pumps Ltd.,**
Oxford Road, Reading, RG3 1JD England.
*Tel.:* 0734-25555. *Cable:* Sigmeter, Reading.
*Telex:* 848189.

**Sil-Flo Incorporated,**
Sil-Flo Building, Port Jefferson, N.Y., 11777 U.S.A.
*Tel.:* (516) 928-0200. *Cable:* Silflo, Port Jefferson.

**Richard Simon & Sons Ltd.,**
Phoenix Works, Basford, Nottingham, England.
*Tel.:* 74211-9. *Cable:* Balance, Nottingham.
*Telex:* 37545.

**Simon-Heesen B.V.,**
P.O. Box 25, Boxtel, Holland.
*Tel.:* (04116) 2751.
*Telex:* 50243 simhe nl.

**A. & W. Smith & Co. Ltd.,**
Cosmos House, 1 Bromley Common, Bromley BR2 9NA, Kent, England.
*Tel.:* 01-464 5346. *Cable:* Sugrengine, Bromley, Kent.
*Telex:* 2-2404.

**Soc. Sucrière d'Etudes et de Conseils S.A.,**
1 Aandorenstraat, Tienen, Belgium.
*Tel.:* (016) 830-11. *Cable:* Rafsec, Tienen.
*Telex:* 22251.

**SPEICHIM,**
106 Rue d'Amsterdam, 75009 Paris, France.
*Tel.:* 744-73-79. *Cable:* Rectifpast, Paris.
*Telex:* 65688.

**SPP Systems Ltd.,**
Oxford Road, Reading, RG3 1JD England.
*Tel.:* 0734-25555. *Cable:* Sigmeter, Reading.
*Telex:* 848189.

**Stabilag Engineering Ltd.,**
34 Mark Road, Hemel Hempstead, Herts., England.
*Tel.:* Hemel Hempstead 4481.
*Cable:* Stabilag, Hemel Hempstead.

**Stansteel Corporation,**
Subsidiary of Allis-Chalmers Corporation,
5001 South Boyle Avenue, Los Angeles, Calif., 90058 U.S.A.
*Tel.:* (213) 585-1231. *Cable:* Stansteel, Los Angeles.
*Telex:* 674737.

**Stedman Foundry & Machine Co. Inc.,**
Box 209, Aurora, Ind., 47001 U.S.A.
*Tel.:* (812) 926-0038.

**Stella Meta Filters,**
Division of The Permutit Co. Ltd.,
Laverstoke Mill, Laverstoke, Whitchurch, Hants., RG28 7NR England.
*Tel.:* 025-682 2360. *Cable:* Stellameta, Whitchurch, Hants.
*Telex:* 85128.

**Stockdale Engineering Ltd.,**
Rock Bank, Bollington, Macclesfield, Cheshire, SK10 5LB England.
*Tel.:* 0625-72521. *Cable:* Mechanical, Bollington.
*Telex:* 668885.

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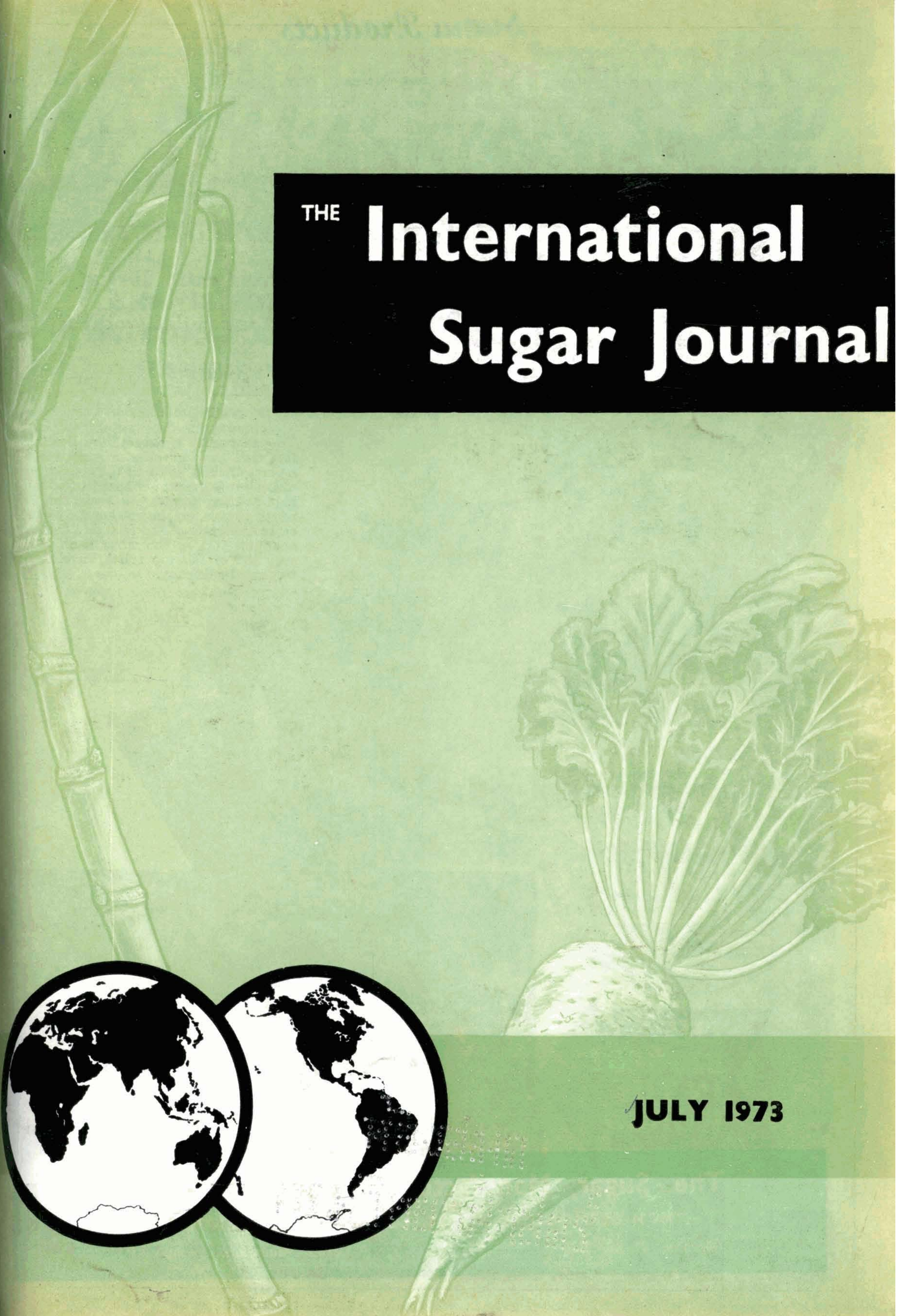

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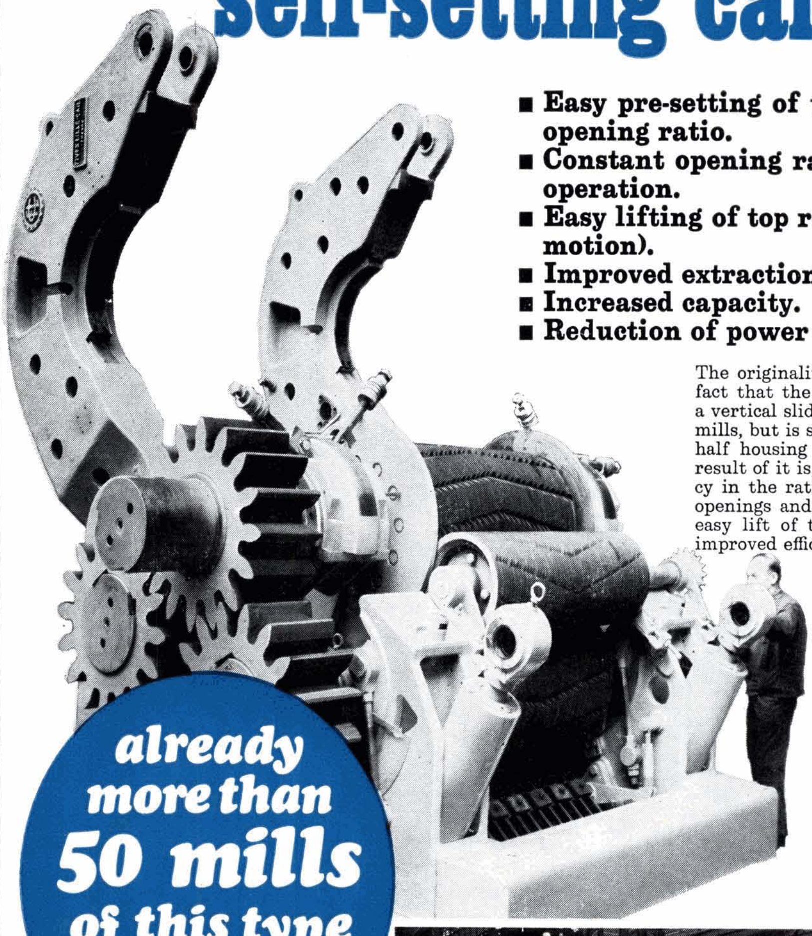

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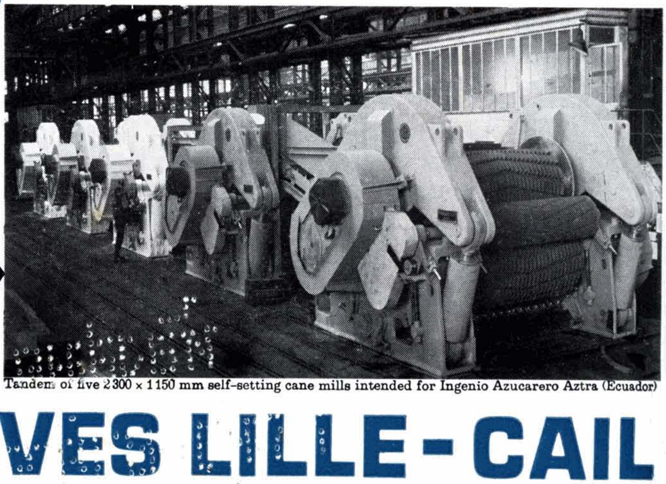

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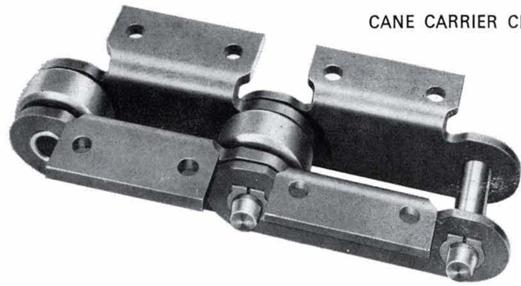

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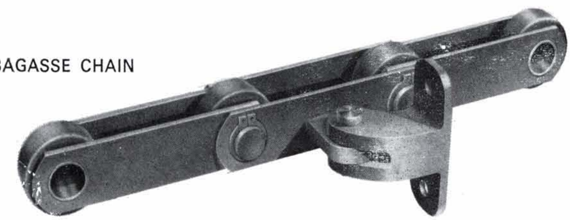

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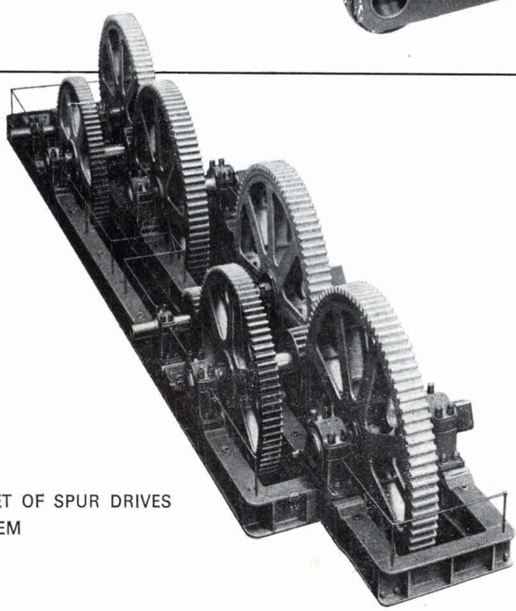

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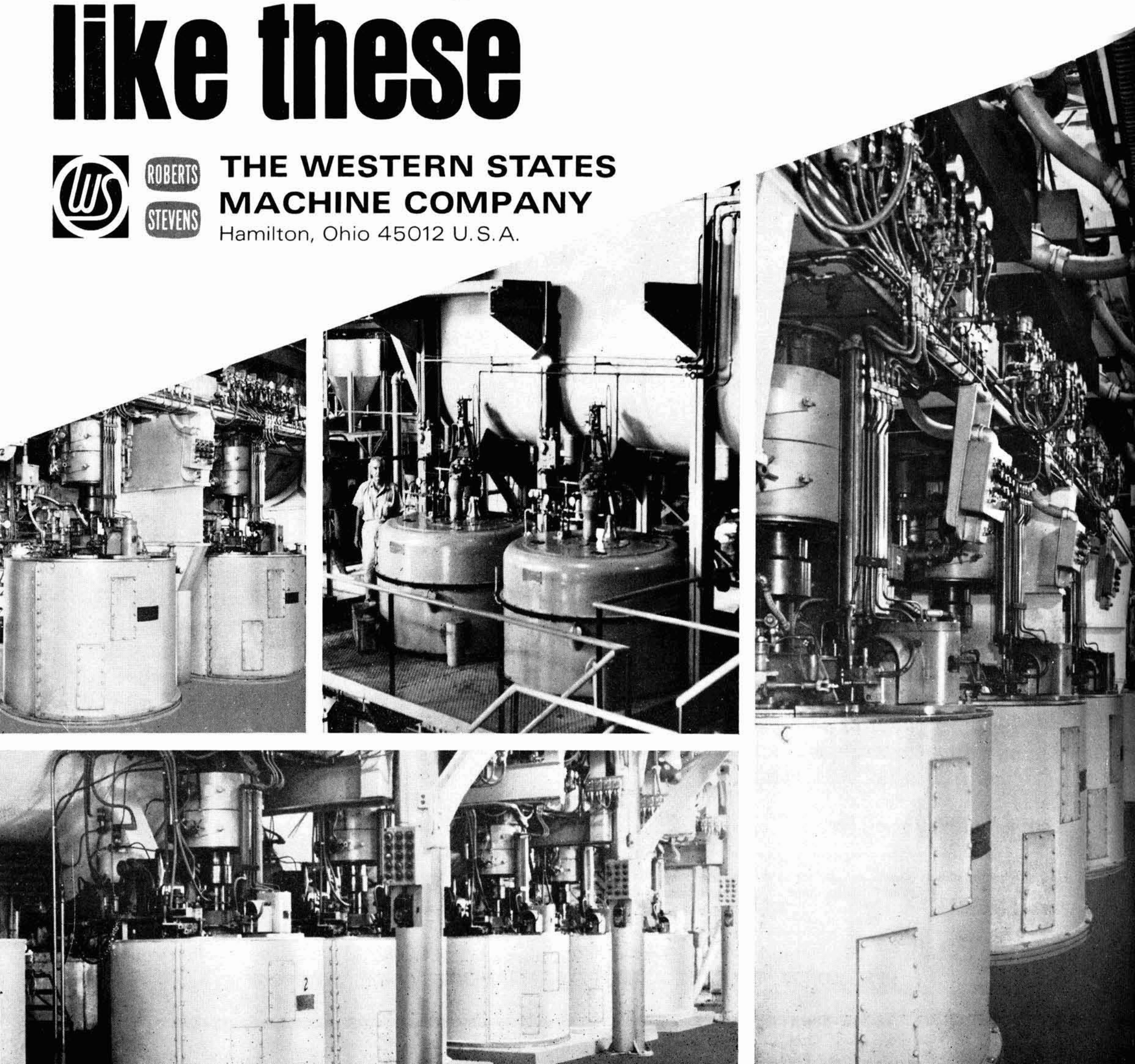

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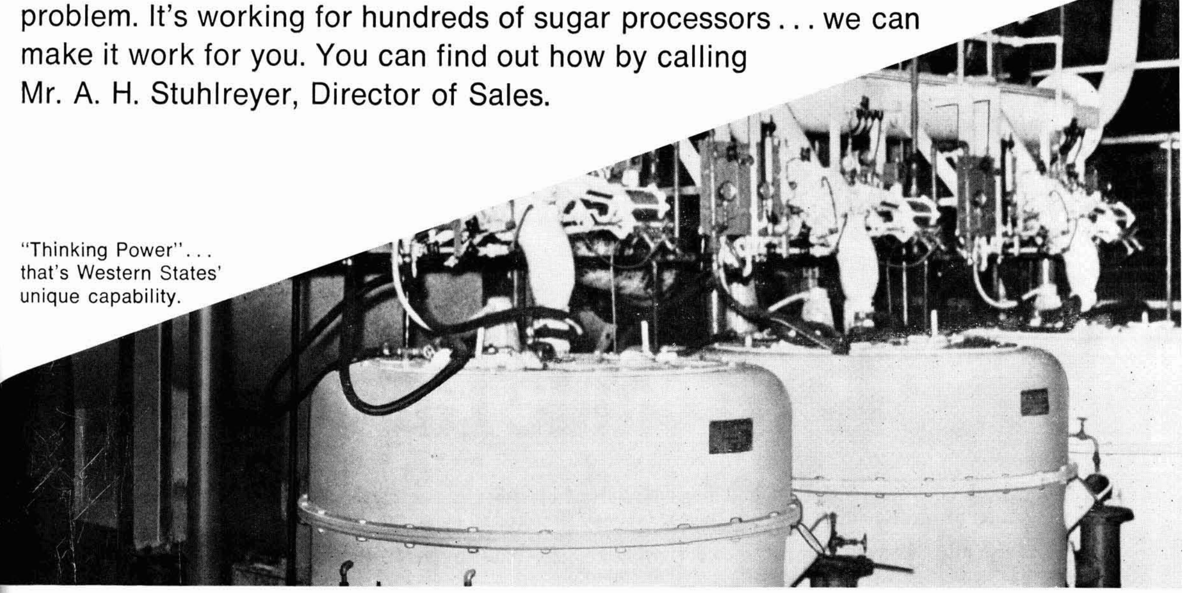

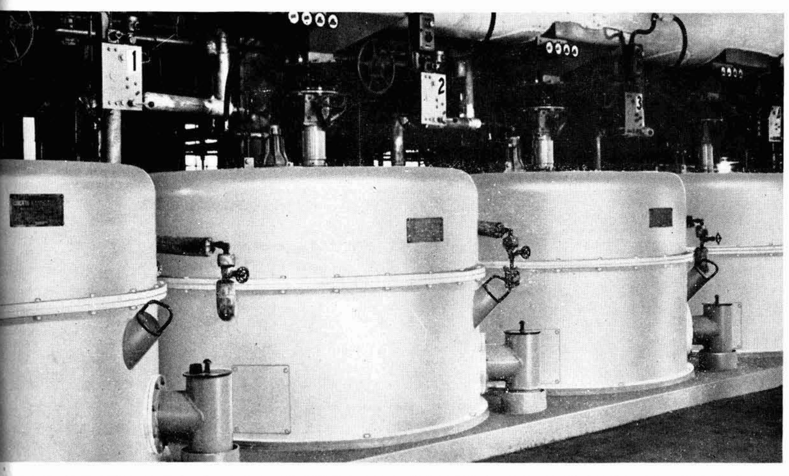


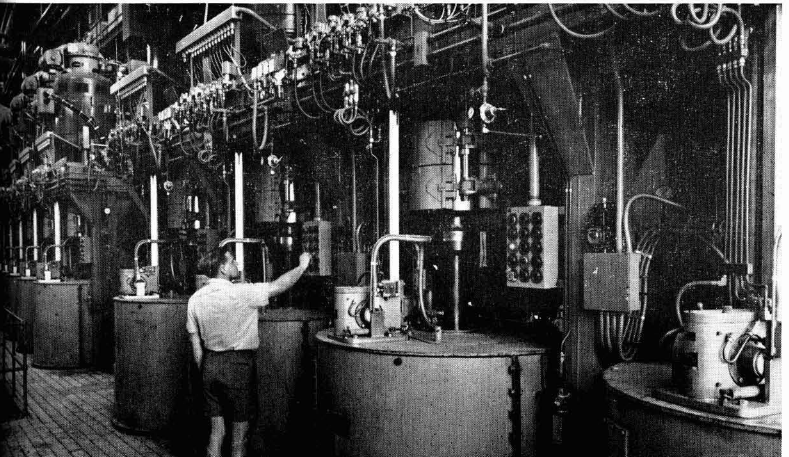

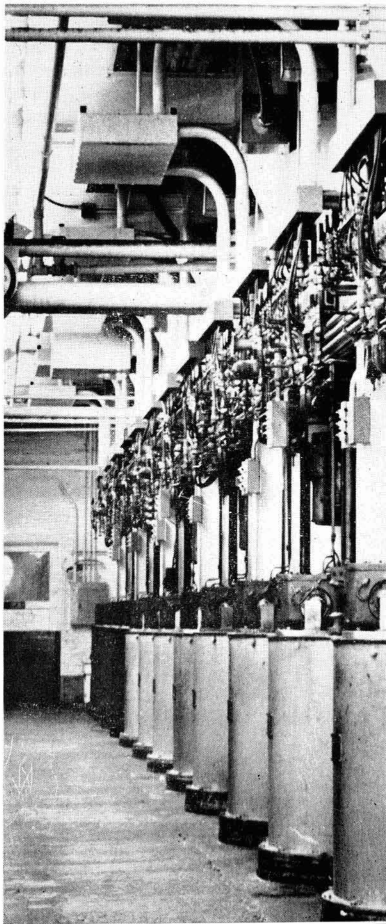

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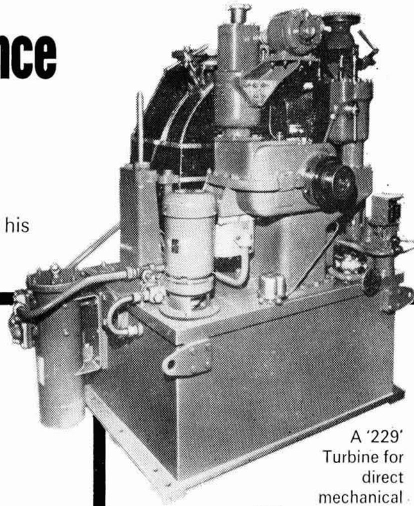

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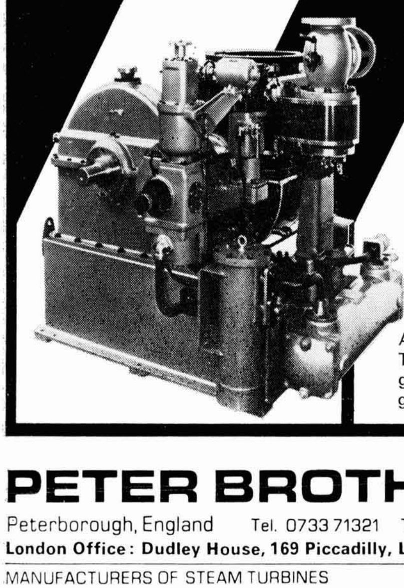

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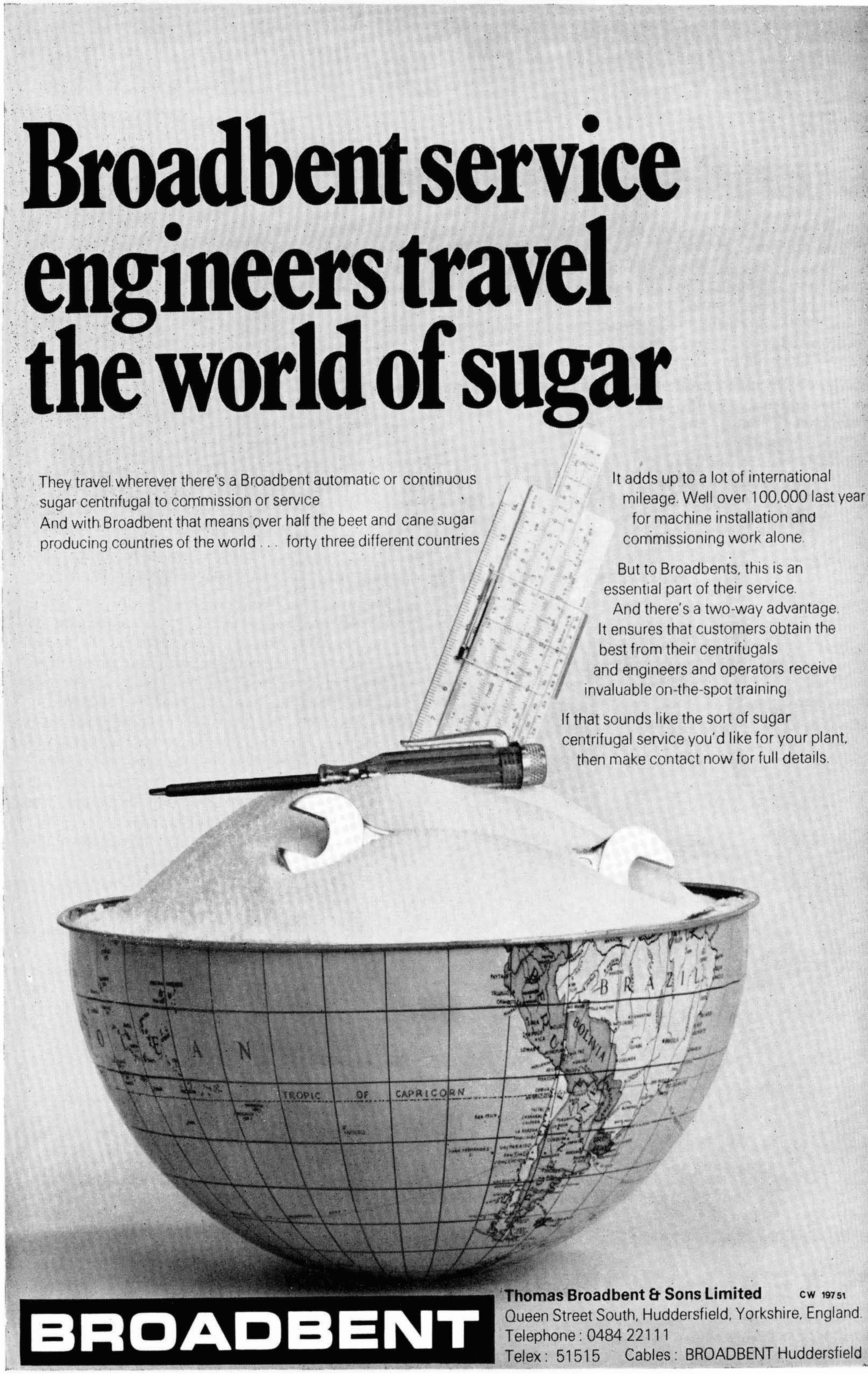
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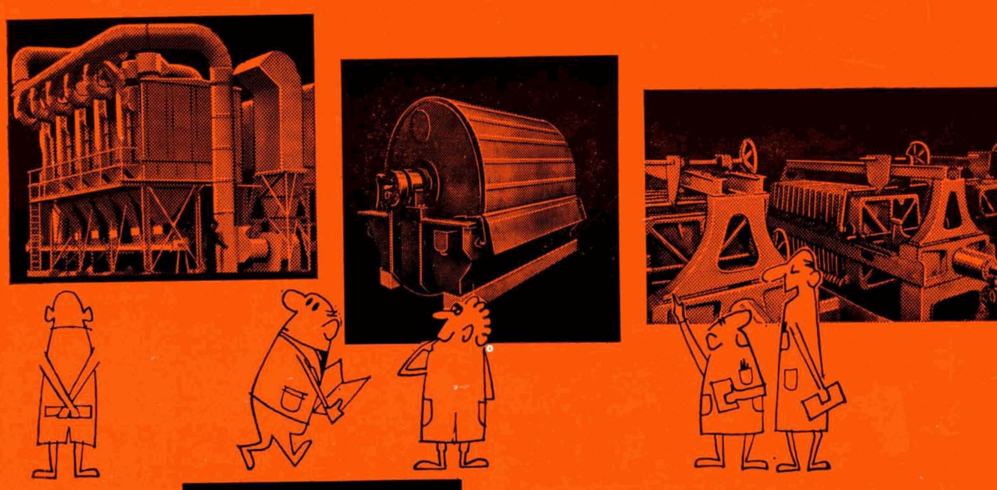

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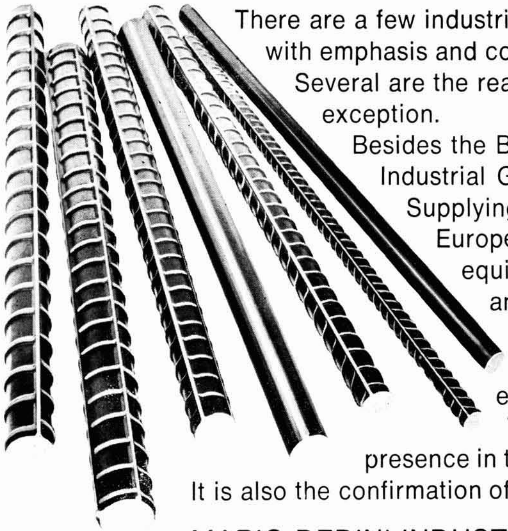

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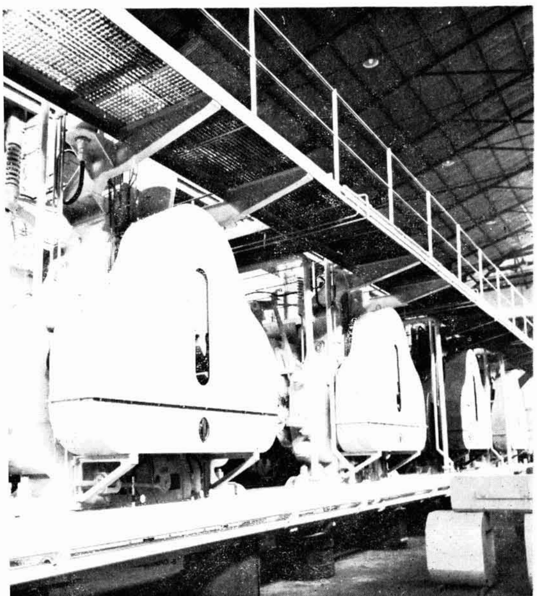

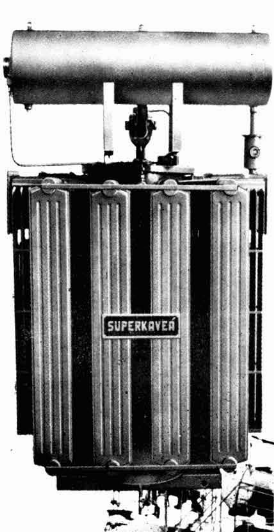


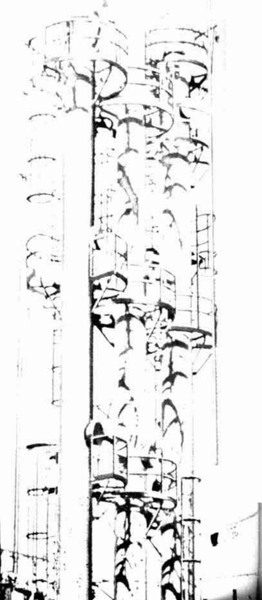

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# International Sugar Journal

*July 1973*

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# SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

**Phytotoxicité relative des esters herbicides 2,4-D/ioxynil.** B. M. SAVORY. *p.* 195–199

On rend compte d'essais entrepris en vue d'établir si une combinaison d'esters 2,4-D avec un ester ioxynil, utilisée pour le contrôle de mauvaises herbes dans les champs de canne, augmentait l'effet phytotoxique dû à la volatilisation ou au courant de vapeurs sur les cultures voisines. Les esters peu volatils testés ne causèrent qu'un dommage léger et passager à des plants de tomates cultivés en pots, tandis que l'ester éthylique hautement volatil causait un dommage plus important dont l'étendue augmentait avec les doses utilisées. Cependant, les calculs de la dose maximale utilisée et les références à la littérature concernant les quantités de vapeurs de 2,4-D présentes dans l'air ont montré que le risque de dommage causé par les vapeurs des combinaisons des esters à des cultures sensibles voisines de champs de canne était négligeable.

* * *

**Maladie de pousses herbeuses en Inde.** S. S. SANDHU, R. S. RAM et R. S. KANWAR. *p.* 200–201

On discute des recherches effectuées au Punjab sur le contrôle de la maladie de pousses herbeuses. Alors que le traitement à l'eau chaude de graines de canne ne donnait pas lieu à un contrôle complet, le traitement à l'air chaud s'est révélé être d'une efficacité totale sur les deux variétés testées et a augmenté les rendements de façon considérable. Un programme de contrôle est mis sur pied.

* * *

**L'activité du noir animal. Ière Partie. L'indice de performance.** J. C. ABRAM, R. M. MORTON et S. G. MULLER. *p.* 201–203

En se basant sur des analyses de noir animal s'étendant sur une période de 2 ans, on a développé une formule simple permettant d'évaluer l'efficacité du noir (élimination de la coloration et des cendres de liqueurs sucrées) en termes de trois propriétés physico-chimiques fondamentales: (i) l'étendue de la surface totale aisément accessible, (ii) la dispersion du carbone, c.-à-d. la surface de carbone présente par g de carbone et (iii) le DH, qui est la mesure de la quantité de calcium pouvant être éluée du noir dans l'eau et qui est directement reliée à la capacité de la surface d'hydroxyapatite pouvant adsorber les ions $Ca^{++}$.

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**Relative Phytotoxizität von Herbiziden auf 2,4-D-Ester/Ioxynilester-Basis.** B. M. SAVORY. *S.* 195–199

Es werden Versuche beschrieben, welche dazu dienen sollten festzustellen, ob die Kombination von 2,4-D-Estern mit einem Ioxynilester zur Bekämpfung von Unkraut auf Zuckerrohrfeldern den durch die Flüchtigkeit und die Abdrift der Dämpfe auf benachbarte Felder bedingten phytotoxischen Effekt steigert. Die untersuchten wenig flüchtigen Ester riefen nur geringe und vorübergehende Schädigungen bei im Topf gezogenen Tomatenpflanzen hervor, während der hochflüchtige Aethylester grössere Schädigungen verursachte, die mit steigender Dosierung zunahmen. Jedoch ergaben die Berechnung der maximal angewandten Dosis und Literaturrecherchen über die in der Luft enthaltenen Mengen an 2,4-D-Dämpfen, dass die Gefahr zu vernachlässigen ist, dass durch die Dämpfe der Esterkombinationen empfindliche, den Zuckerrohrfeldern benachbarte Bestände geschädigt werden.

* * *

**"Grassy shoot"-Krankheit in Indien.** S. S. SANDHU, R. S. RAM und R. S. KANWAR. *S.* 200–201

Es werden Untersuchungen über die Bekämpfung der "Grassy shoot"-Krankheit im Punjab diskutiert. Während eine Behandlung des Rohrsamens mit heissem Wasser eine vollständige Bekämpfung nicht ermöglichte, war die Behandlung mit heisser Luft bei beiden untersuchten Rohrvarietäten voll wirksam und erhöhte den Ertrag wesentlich. Ein Bekämpfungsprogramm wird beschrieben.

* * *

**Die Aktivität von Knochenkohle. Teil I. Der Leistungsindex.** J. C. ABRAM, R. M. MORTON und S. G. MULLER. *S.* 201–203

Aus Knochenkohleanalysen, die zwei Jahre lang durchgeführt wurden, konnte eine einfache Formel zur Ermittlung der Kohleleistung (Entfernung von Farbe und Asche aus Zuckerklären) abgeleitet werden, in der als Faktoren drei grundlegende physikalische Eigenschaften enthalten sind: (i) die sofort zur Verfügung stehende Oberfläche, (ii) der Kohlenstoff-Dispersitätsgrad, d.h. die im Gramm Kohlenstoff vorhandene Kohlenstofffläche, und (iii) DH, was ein Mass für die von der Kohle in Wasser eluierbare Calciummenge ist und direkt der Kapazität der Hydroxyapatitoberfläche für die Adsorption der Calciumionen proportional ist.

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**Fitotoxicidad relativa de hierbicidas que constan de ésteres de 2,4-D e ioxynil.** B. M. SAVORY. *Pág.* 195–199

Se recuerdan ensayos con el fin de establecer si la combinación de ésteres de 2,4-D con un éster de ioxynil para control químico de malas hierbas en campos cañeros crece el efecto fitotóxico en cosechas adyacentes, causado por volatilización o deriva de vapor. Los ésteres de baja volatilidad causaron daño solamente pequeño y transitorio a tomates plantado en tiestos, mientras el éster etílico, de gran volatilidad, causó daño más importante, la severidad creciendo con dosis. Sin embargo, calculaciones del dosis máximo usado y referencia a la literatura sobre cantidades del vapor de 2,4-D en el aire demuestran que es insignificante el peligro de daño por el vapor de las combinaciones de ésteres a cosechas sensibles en campos adyacentes a la caña.

* * *

**Mata zacatosa en la India.** S. S. SANDHU, R. S. RAM y R. S. KANWAR. *Pág.* 200–201

Investigaciones sobre control de mata zacatosa en el Punjab se discuten. Mientras tratamiento de estacas con agua caliente no ha dado control completo, tratamiento con aire caliente estuvó completamente eficaz con ambos variedades sujeto a los ensayos y rendimientos crecieron notablemente. Una programa de control se expone.

* * *

**El actividad de carbón animal. Parte I. El indice de cumplimiento.** J. C. ABRAM, R. M. MORTON y S. G. MULLER. *Pág.* 201–203

De análisises de carbones animales en un período de dos años, se ha derivado una fórmula sencilla para asesar la eficiencia del carbón (eliminación de color y cenizas de licores de azúcar) en términos de tres propiedades físico-químico básico: (i) el área superficial facilmente accesible, (ii) la dispersidad del carbón, es decir, el área de carbón elemental presente por gramo de carbón elemental, y (iii) DH, que es una medida de la cantidad de calcio que puede eluirse del carbón animal en agua y que es relatado directamente a la capacidad del superficie de la hidroxyapatita para adsorber iones de calcio.

THE

# INTERNATIONAL SUGAR JOURNAL

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# Notes & Comments

## International Sugar Conference

The first part of the United Nations Sugar Conference was opened on the 7th May in Geneva by Sr. MANUEL PÉREZ GUERRERO, Secretary-General of UNCTAD, and it continued to the 30th May. A second part is to take place in September for settling details of a new International Sugar Agreement.

The meetings were attended by representatives of 89 governments, of the EEC, of UN agencies and of the Afro-Malagasy Sugar Agreement. Mr. ERNEST JONES-PARRY, Executive Director of the International Sugar Organization, was elected Chairman of the Conference and Sr. RAÚL LÉON TORRAS, Chairman of the International Sugar Council, was elected Conference Vice-Chairman.

Much of the beginning of the Conference was taken up with statements made by the representatives before discussion could begin of the draft document prepared by the ISO Secretariat as a basis for a new Agreement. The latter omitted details of price levels and quotas which will have to be settled at the September meetings, although proposals were made by speakers concerning price changes necessary to take into account parity variations since the 1968 negotiations.

The FAO representative pointed out that to give the same purchasing power as the 3·25–5·25 cents/lb price range of the 1968 Agreement, that of a new Agreement would have to be some 4·40 to 7·00 cents/lb. At the time of the 1968 negotiations, however, sugar prices had been depressed for four years and it might be more appropriate to relate the new prices to those of the 1953 agreement which would establish a new price range of 5·75 to 7·70 cents/lb.

The Cuban delegate called for purchase commitments under which importing countries would be obliged to buy when the price fell below 5 cents/lb; he also called for a price range of 6 to 9 cents/lb with a Supply Commitment Price of 11 cents/lb, and other exporting countries have been quoted as regarding these levels as equitable and remunerative—characteristics necessary to provide the developing countries with stability of their markets and to provide adequate assurance for orderly development of production and avoidance of excessive increases.

The Japanese delegate, representing a major importing member of the Agreement, recommended care in adjusting the existing Agreement to avoid over-stimulating production in developed countries or curbing consumption in importing countries. The Canadian delegate, on the other hand, criticized the draft document for its favouring of exporting countries.

A press conference was held after the meetings by Mr. JONES-PARRY; he said that the Conference had first to consider whether a new Agreement was necessary. The EEC delegate had expressed the Commission's view that it was not timely to negotiate a new agreement since the EEC's own future sugar arrangements had not yet been worked out and neither was it possible to estimate developments under the US Sugar Act or to know what was the future sugar policy of the USSR.

Having regard to the plans for expansion of sugar industries, however, and the probability that weather conditions would not again cause such damage to the output of important producers as had been recently experienced, it was felt that sooner rather than later a balanced pattern of supply and demand would be restored. This in turn would lead to a fall in prices in the world market. Accordingly, to prevent a recurrence of disorderly market conditions there was now an overwhelming desire on the part of delegates to establish a new ISA. There was no question but that the great majority of members were confident that the simple extension of the present Agreement was not a practicable possibility. The Conference also expressed the hope that the EEC would participate actively in the September session with a view to becoming a member of the Agreement.

C. Czarnikow Ltd.[1] note that a new Agreement will have to differ from the present ISA in some important aspects. Basic export tonnages will need to be changed and the indicative price levels of the Agreement will have to be reconsidered. Meanwhile certain changes

[1] *Sugar Review*, 1973, (1129), 95.

are needed in the pattern of rights and obligations of importers and exporters. On the other hand there has been acceptance that the present regulations which allow for special arrangements must be continued in a new Agreement.

No decisions of a fundamental nature were made at the Conference but working groups have succeeded in identifying the main problems though for the time being they have done little more than explore them.

The session was noteworthy for its friendly atmosphere. Considerable goodwill exists which would be most valuable in the informal discussions to be held before the 10th September when the second session of the Conference is convened.

It would be possible to draw up an International Sugar Agreement without the participation of the EEC. Indeed, the 1968 Agreement has functioned satisfactorily without its adherence. But now that the Community has been extended to include three new members, one of which is a key member in another regional trading group, the problems of an Agreement to which it did not adhere would be very much more complex. It may be hoped, therefore, that before September, some method will be evolved which will enable the EEC to join with other countries in arrangements for the orderly marketing of sugar, even if its own internal arrangements have still not been finalized.

* * *

### World raw sugar price

The tightness of raw sugar supplies to the world market during the first half of 1973 has kept prices high, the lowest London Daily price having been £87 per ton and the level usually above £90. During May, however, there were rumours of large purchases by Mainland China of up to 800,000 tons and near the end of the month sales were confirmed of 240,000 tons by Brazil and 50,000 tons by Australia as well as other sales giving in total 400,000 tons. This affected what had been an effectively balanced situation and the price rose rapidly, to reach the level of £105 per ton (the peak level of January 1973 which was a nine-year high) on the 29th May. Subsequently the price slipped and at the time of writing is £94 per ton.

* * *

### US sugar supply quota, 1973

On the 27th April the US Department of Agriculture announced a shortfall of 50,000 tons against the quota for Puerto Rico and this was reallocated among Western Hemisphere producers. On the 25th May a further deficit of 20,000 tons was declared in the Puerto Rico quota and deficits of 100,232 tons for the West Indies, 15,889 tons for Panama and 12,259 tons for Honduras. The Department has also made adjustments to quotas following a recalculation of an increase awarded to Hawaii in February; the overall effect is to increase Western Hemisphere countries' quotas and reduce quotas of holders outside this grouping. The individual changes are tabulated eleswhere in this issue.

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### USSR sugar statistics

Calendar year statistics for the Soviet Union have been published by the International Sugar Organization[1] and appear elsewhere in this issue. Poor crops in two successive campaigns, coupled with reduced supplies from Cuba, have led to a dramatic change whereby, from being a re-exporter of sugar (with an ISA quota of over a million tons) the USSR has needed to call on the world market for over 600,000 tons, as well as imports of over 210,000 tons from East European countries.

C. Czarnikow Ltd.[2] write: "Looking ahead into the current year a similar pattern of trade in sugar can be expected. Final production figures for 1972/73 have not yet been released but our own estimate stands at eight million metric tons on a raw value basis. Accurate consumption figures are likewise difficult to come by but most observers place the total anticipated offtake for this year in excess of 10·5 million tons, raw value. Already, purchases from the world market for shipment in 1973 are thought to total between 800,000 and one million tons, which leave a balance of at least 1·5 million tons to be met by traditional suppliers. In effect this means Cuba and, given a crop of five million tons, this quantity should not prove impossible to deliver especially as for the past nine months Cuba has been a member of the Comecon group. Recent statements from the official news agency in Havana have not been optimistic, however, and much of the Soviet situation for the balance of this year will depend on final output in Cuba for 1972/73 and production prospects in the USSR for 1973/74".

* * *

**The late Dr. H. H. Dodds.**—Dr. H. H. Dodds, a pioneer of sugar research in South Africa, died in April at the age of 88. After graduation in 1906 he obtained his M.Sc. at Manchester University and joined the Kynoch explosives company in Co. Wicklow, Eire, as a supervisory chemist. After two years he went to South Africa for the same company as a supervisor. With the advent of war in 1914 came increased production for munitions and also the supply of fertilizers including those to cane farmers; it was from this time that his contact with the sugar industry stemmed. After the war, Kynoch reduced their activities and asked their permanent staff to try for alternative employment; Dodds went to Louisiana and took a degree in sugar technology at L.S.U., meanwhile studying the agricultural side of sugar production. After leaving the University he worked for a few years at different field and factory jobs in Cuba and US sugar factories. At this time, Uba canes, which had been the standby of Natal farmers for 40 years, were beginning to suffer from streak disease, with reduced yields. The South African Sugar Association decided to start an experiment station to find the remedy for streak and Dodds was asked to organize and start the Station which he did in 1924, choosing Mount Edgecombe as its site. He remained Director of the Station until 1950 when he retired, but subsequently acted as a consultant to sugar producers in Rhodesia and Portuguese East Africa, among other territories. In 1926 he helped to found the South African Sugar Technologists' Association of which he became Patron in 1965. In 1944 he was awarded an honorary D.Sc. of the University of South Africa in recognition of his services to the sugar industry.

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[1] *Stat. Bull*, 1973, **32**, (3), 107–109.
[2] *Sugar Review*, 1973, (1124), 73.

# Relative phytotoxicity of 2,4-D ester/ioxynil ester herbicides

By B. M. SAVORY, M.A., Ph.D.
(May & Baker Ltd.)

*Introduction*

ESTERS of 2,4-dichlorophenoxyacetic acid (2,4-D) have been included in formulations which have been used successfully for the control of numerous weed species in commercial crops including sugar cane. There has been a certain amount of resistance to use of such ester formulations in cane countries as the result of damage to adjacent crops by drifting of the herbicide vapour; this hazard has been recognized for more than 20 years[1]. It is generally accepted that *droplet* drift is largely a function of droplet size and wind speed and will be similar for all 2,4-D formulations under similar spraying conditions[2].

*Vapour* drift hazards, however, vary very significantly according to the formulation used; amine salts and acid emulsions are non-volatile and considered to be completely safe[1,3] although under hot dry conditions they have been found to cause delayed damage to adjacent cotton[4]. Several low-volatile esters (e.g. *iso*-octyl, butoxyethyl) have also been widely used and are quite safe under most spraying conditions, although these become more volatile at ambient temperatures of over 40°C.

Much greater hazard is presented by the high-volatile esters such that, for instance, their use is banned in many parts of the United States. Such esters include those with five or less carbon atoms in the ester chain and it has been suggested[5] that branched-chain esters with up to six carbon atoms should also be included.

The differences in safety arise from the volatility of the esters concerned, an indication of which is given by measurements made[5] of their vapour pressures, in mm Hg at 187°C: ethyl ester 18, *iso*-propyl ester 17, butyl 9·2, *iso*-octyl 3·1 and 2-ethylhexyl ester 2·9. The practical implications of these differences in volatility are shown by measurements made[6] of the amount of different esters in the air during a period of 106 days in Summer. *iso*-Propyl 2,4-D ester was detected on 72 days at an average concentration of 0·13 $\mu g\ m^{-3}$ at one location and for 89 days at an average concentration of 0·28 $\mu g\ m^{-3}$ at another. Corresponding figures for the butyl ester of 2,4-D were 60 days at an average of 0·07 $\mu g\ m^{-3}$ and 69 days at an average of 0·12 $\mu g\ m^{-3}$. The *iso*-octyl ester was detected on only 11 days at an average concentration of 0·001 $\mu g\ m^{-3}$ and on 5 days at an average of 0·007 $\mu g\ m^{-3}$ for the two locations and thus clearly presents a very much smaller danger to growing crops than the high-volatile esters.

The relative safety or hazard involved in the use of 2,4-D esters combined with other herbicides (apart from 2,4,5-T) does not appear to have been studied although a mixture of the *iso*-octyl ester with ioxynil octanoate is widely used in sugar cane in the Caribbean and other areas.

The present work was carried out to examine the effect of the combination of the two herbicides on the volatility of either component to test whether the effect of the combination was to produce a greater phytotoxicity hazard for crops adjacent to the cane fields.

*Material and methods*

*Test plants.*—Crops vary in their sensitivity to 2,4-D but HITCHCOCK *et al.*[1] have found the tomato to be suitable for bio-assay of plant damage. Tomato plants (*Lycopersicon esulentum* Mill. var. "Bonny Best") were grown in potting compost, one per 12·7 cm pot. Three replicate plants were used for each treatment. The plants were grown in a glasshouse with minimum temperatures of 21°C during the day and 15·5°C during the night. Supplementary lighting was used to give a 16-hour photoperiod, and the plants were treated when they were 5–6 cm in height, with three developed leaves.

*Chemicals.*—All concentrations quoted in this report refer to phenol equivalent for ioxynil octanoate and acid equivalent for 2,4-D esters. The chemicals were:

| | *Formulation code* | *Active ingredient* |
|---|---|---|
| A | FR 376/1/1 | 50% 2,4-D, as *iso*-octyl ester |
| B | NPH 1330, batch PAFD 824 | 25% ioxynil, as octanoyl ester |
| C | "Actril D", batch WN 241 (commercial product) | 30% 2,4-D as *iso*-octyl ester + 5% ioxynil as octanoyl ester |
| D | "Actril D", ARD 12/47 (experimental formulation) | 60% 2,4-D as iso-octyl ester + 10% ioxynil as octanoyl ester |
| E | FR 376/2/1 | 50% 2,4-D, as 2-ethylhexyl ester |
| F | FR 382/1/1 | 50% 2,4-D, as ethyl ester |

Emulsions were prepared from these formulations by diluting with demineralized water. The treatment concentrations used were 1·0, 0·1 and 0·01% a.i. In the case of the two "Actril D" mixtures, the "active ingredient" was taken to be 2-4,D, and the ioxynil content was ignored.

[1] HITCHCOCK *et al.*: *Contrib. Boyce Thompson Inst.*, 1953, **17**, 243–263.
[2] GROVER *et al.*: *Weed Sci.*, 1972, **20**, 320–324.
[3] BASKIN and WALKER: *Weeds*, 1953, **2**, 280–287.
[4] DAY *et al.*: *Hilgardia*, 1959, **28**, 255–267.
[5] JENSEN and SCHALL: *J. Agric. Food Chem.*, 1966, **14**, 123–126.
[6] ADAMS *et al.*: *Weeds*, 1964, **12**, 280–283.

**Table I. Mean responses of tomato plants to 24 hr exposure to 2,4-D and ioxynil ester vapours**

| Chemical | Dose* (µg a.i.) | Treatment code | Leaf modification (leaves 6 and 7, 11 days after treatment) Score: 0 = leaves normal 1 = slight modification 2 = marked modification 3 = moderately severe modification 4 = severe modification | Stem bending (24 hours after treatment) Score: 1 = straight 2 = slight bend 3 = moderate bend 4 = severe bend | Stem proliferation (11 days after treatment) Score: 0 = no proliferation 1 = 25% of stem length proliferated 2 = 50% ,, 3 = 75% ,, 4 = 100% ,, | Increase in height of stems (cm) during: First week after treatment | Second week after treatment† | Fresh weight per plant (g) (25 days after treatment) |
|---|---|---|---|---|---|---|---|---|
| 2,4-D | 10 | A1 | 0 | 1·2 | 0 | 4·4 | 5·83 abc | — |
| *iso*-octyl | 50 | A2 | 0·3 | 1·0 | 0 | 4·0 | 5·67 abc | — |
| ester | 100 | A3 | 0·3 | 1·0 | 0 | 4·5 | 5·17 abc | 63·3 |
| | 500 | A4 | 1·7 | 1·7 | 0 | 4·8 | 5·83 abc | — |
| | 1000 | A5 | 1·3 | 1·7 | 0 | 4·4 | 6·00 abc | — |
| | 5000 | A6 | 1·7 | 1·1 | 0 | 4·5 | 6·00 abc | 65·1 |
| Ioxynil | 10 | B1 | 0 | 1·3 | 0 | 4·4 | 5·83 abc | — |
| octanoate | 50 | B2 | 0 | 1·1 | 0 | 4·3 | 6·00 abc | — |
| | 100 | B3 | 0 | 1·4 | 0 | 4·6 | 5·50 abc | 67·1 |
| | 500 | B4 | 0 | 1·2 | 0 | 4·4 | 5·33 abc | — |
| | 1000 | B5 | 0 | 1·3 | 0 | 5·0 | 6·17 abc | — |
| | 5000 | B6 | 0 | 1·1 | 0 | 4·5 | 5·50 abc | 62·4 |
| "Actril D" | 10 | C1 | 0 | 1·2 | 0 | 5·3 | 5·33 abc | — |
| | 50 | C2 | 0 | 1·1 | 0 | 4·7 | 5·50 abc | — |
| | 100 | C3 | 0 | 1·3 | 0 | 4·9 | 5·83 abc | 71·5 |
| | 500 | C4 | 1·7 | 1·3 | 0 | 4·6 | 6·00 abc | — |
| | 1000 | C5 | 1·3 | 1·6 | 0 | 4·0 | 6·00 abc | — |
| | 5000 | C6 | 2·7 | 1·4 | 0 | 4·5 | 6·00 abc | 55·4 |
| "Actril D" | 10 | D1 | 0 | 1·0 | 0 | 4·9 | 5·50 abc | — |
| (double | 50 | D2 | 0·3 | 1·3 | 0 | 4·2 | 6·00 abc | — |
| strength) | 100 | D3 | 1·0 | 1·3 | 0 | 4·3 | 6·83 a | 73·2 |
| | 500 | D4 | 2·7 | 1·9 | 0 | 4·8 | 6·33 abc | — |
| | 1000 | D5 | 1·7 | 1·4 | 0 | 4·2 | 6·33 abc | — |
| | 5000 | D6 | 2·3 | 1·2 | 0 | 4·8 | 5·33 abc | 66·3 |
| 2,4-D | 10 | E1 | 0 | 1·2 | 0 | 5·2 | 5·00 bc | — |
| ethyl-hexyl | 50 | E2 | 0 | 1·3 | 0 | 4·8 | 6·00 abc | — |
| ester | 100 | E3 | 0·7 | 1·3 | 0 | 4·7 | 5·67 abc | 64·9 |
| | 500 | E4 | 1·0 | 1·6 | 0 | 5·0 | 6·50 abc | — |
| | 1000 | E5 | 1·0 | 1·4 | 0 | 4·6 | 5·67 abc | — |
| | 5000 | E6 | 2·7 | 1·4 | 0 | 4·8 | 5·83 abc | 61·4 |
| 2,4-D ethyl | 10 | F1 | 2·0 | 1·6 | 0 | 5·0 | 5·67 abc | 55·1 |
| ester | 50 | F2 | 3·7 | 2·3 | 0·3 | 4·8 | 5·00 bc | 57·8 |
| | 100 | F3 | 4·0 | 3·1 | 1·3 | 3·8 | 3·33 d | 48·2 |
| | 500 | F4 | leaves 6 and 7 | 3·8 | 4·0 | 0·8 | 0·33 e | 12·3 |
| | 1000 | F5 | failed to | 3·7 | 4·0 | 1·2 | 0·17 e | 10·2 |
| | 5000 | F6 | develop | 3·9 | 4·0 | 0·4 | 0 e | 6·1 |
| Untreated | — | U1 | 0 | 1·3 | 0 | 3·7 | 6·67 ab | — |
| (water | — | U2 | 0 | 1·3 | 0 | 4·9 | 5·83 abc | 66·2 |
| control) | — | U3 | 0 | 1·2 | 0 | 4·2 | 5·83 abc | 78·0 |
| | — | U4 | 0 | 1·4 | 0 | 5·0 | 4·83 c | — |

* See "*Material and methods*" for calculation of dose.
† Duncan's multiple range test: treatments with the same suffix letters are *not* significantly different at 5% probability level.
S.E. treatment means = 0·4986 cm.

Six doses were used:—

1. 0·1 ml of 0·01% emulsion containing 10 µg 2,4-D*
2. 0·5 ml of 0·01% emulsion containing 50 µg 2,4-D
3. 0·1 ml of 0·1% emulsion containing 100 µg 2,4-D
4. 0·5 ml of 0·1% emulsion containing 500 µg 2,4-D
5. 0·1 ml of 1·0% emulsion containing 1000 µg 2,4-D
6. 0·5 ml of 1·0% emulsion containing 5000 µg 2,4-D

* In the case of formulation B, these are amounts of ioxynil

*Application method.*—The required dose of emulsion was delivered by pipette on to a crumpled Whatman No. 1 (9 cm) filter paper placed in a 5 cm glass petri dish (lid or base only). The dish and filter paper were then placed in the bottom of a 5-litre plastic bucket, and a potted tomato plant was quickly placed next to the dish. The buckets had previously been placed inside a polythene bag, and the bag was now folded over twice and secured with paper clips. When sealed, the bags contained approximately 16 litres of air. Four sets of plants (= 12 in all) were similarly "dosed" with 0·5 ml water and acted as untreated controls.

The bagged plants were stood in the glasshouse for 24 hours; the temperature in the bags quickly rose to a maximum of 37°C, and fell during the night to a minimum of 23°C. After 24 hours, the plants were taken outside, the bags and buckets removed and the foliage thoroughly washed. The plants were then returned to the glasshouse until the end of the experiment (25 days).

### *Evaluation of Response*

The responses to exposure to 2,4-D vapour can be graded, in terms of increasing magnitude and severity as follows:

*Slight damage*—modification of developing leaves.

*Moderate damage*—leaf epinasty and stem bending.

*Severe damage*—proliferation of stem tissues, reduction in plant height, weight and leaf numbers.

These responses were evaluated as follows: leaf modification—on leaves 6 and 7, 11 days after treatment—on a score of 0 to 4 (see Table I for details). The modifications ranged from slight loss of colour and leaf area to severe deformation of leaflets and reduction in lamina area, and were most severe on the two leaves assessed. Stem bending was assessed on a score of 1 to 4, 24 hours after treatment. Height increase was measured 7 and 14 days after treatment. Stem proliferation was assessed on a score of 0 to 4, 11 days after treatment. Selected treatments were retained until the onset of flowering (25 days after treatment), and were then cut at ground level and weighed. Photographs of representative plants were taken 14 and 25 days after treatment.

## *Discussion*

The dose range used was selected after consideration of the results of HITCHCOCK *et al.*[1] and a preliminary experiment, which showed that increases in concentration of ester emulsion applied produced less dose response, particularly above 1% a.i., than increases in volume. It was therefore decided to use a combination of tenfold increases in concentration and fivefold increases in volume to achieve a reasonable dose response, which has been presented in terms of $\mu$g of 2,4-D acid applied (B treatments—ioxynil phenol), for the sake of simplicity.

The results (Table I and Figs. 1–4) quite clearly demonstrate three points:—

(1) Ioxynil octanoate had no vapour activity on tomato (the same result was obtained with bromoxynil octanoate.) The volatility of both chemicals is very low, which has hampered accurate determination of the vapour pressures, but present indications are that they are of the order of $10^{-6}$ mm Hg at 25°C[7]. Tomato plants at the three-leaf stage are susceptible to ioxynil and bromoxynil esters sprayed on the foliage (LD90's for ioxynil octanoate, bromoxynil octanate and 2,4-D *iso*-octyl ester were all 70 g/ha), so that the lack of response in this experiment must indicate an effective lack of volatility at the doses used.

(2) The mixtures of 2,4-D *iso*-octyl ester with ioxynil ("Actril" formulations) were not significantly more damaging to the test plants than 2,4-D *iso*-octyl or ethyl-hexyl esters alone at the same levels of 2,4-D a.e. The mixtures possibly caused slightly more leaf modification, but there was no sign of any epinasty,

[7] MUGGLETON: *Private Communication.*

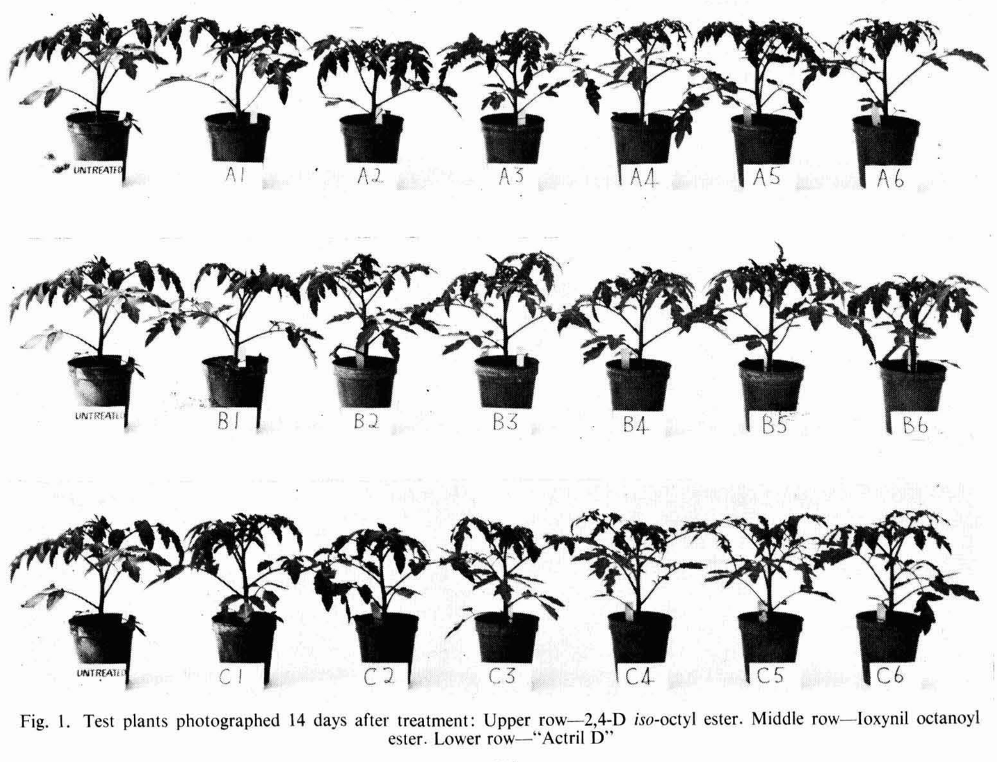


Fig. 1. Test plants photographed 14 days after treatment: Upper row—2,4-D *iso*-octyl ester. Middle row—Ioxynil octanoyl ester. Lower row—"Actril D"


Fig. 2. Test plants photographed 14 days after treatment: Upper row—"Actril D" (double-strength formulation). Middle row—2,4-D 2-ethyl-hexyl ester. Lower row—2,4-D ethyl ester

stem bending or any of the more serious forms of damage. The standard field dose of "Actril D" applied to sugar cane is equivalent to 0·84 kg/ha 2,4-D, compared with 1·5 kg/ha or more where 2,4-D is used alone, so that on balance the mixture is likely to be far less hazardous in the field.

(3) The maximum damage caused by 2,4-D *iso*-octyl ester (alone or with ioxynil octanoate) or 2-ethyl-hexyl ester at a dose of 5000 μg was a moderate degree of leaf modification restricted to leaves in an early stage of development at the time of treatment; subsequent development of leaves and flowers was normal (Fig. 4). By contrast, 2,4-D ethyl ester at 50–100 μg caused severe leaf modification and also stem bending, proliferation and slight stunting, while higher doses completely prevented further development of the plants. Under similar conditions, therefore, the low-volatile esters were about 100 times safer than the high-volatile ester.

The relative safety of low-volatile, compared with high-volatile, esters of 2,4-D has been recognised for many years, as noted in the introduction to this report. But how safe is "relatively safe" in the field? How does the top dose used in this experiment (5000 μg), which caused perceptible though transient damage, relate to field doses?

On an area basis, a standard dose of "Actril D" (2·8 litre/ha) is equivalent to 1,064 μg of 2,4-D a.e. on the surface area of the pots used (127 $cm^2$). On a volume basis, more relevant when vapour is under consideration, 5000 μg in a 16-litre bag is equivalent to a concentration of 312,500 μg $m^{-3}$ air, assuming complete volatilization. Under the conditions of this test, it is unlikely that more than 0·1% of the applied dose of 2,4-D *iso*-octyl or other low-volatile esters, equivalent to a concentration of 312·5 μg $m^{-3}$, was absorbed by the plant; this is nevertheless a very high concentration in relation to field usage. It must therefore be concluded that under most climatic conditions the risk of damage (due to volatilization or vapour drift) to nearby crops of sensitive species from application to sugar cane of the standard dose of "Actril D" or its separate components is infinitesimal.

*Summary*

The effect of adding ioxynil octanoyl ester to 2,4-D *iso*-octyl ester, as used for weed control in sugar cane, on the physiological volatility of the latter ester was examined by means of a tomato vapour bioassay. Ioxynil ester alone exhibited no vapour activity at doses up to 5000 μg (top dose used), and did not significantly increase the vapour activity of 2,4-D *iso*-octyl ester, in mixtures.

2,4-D *iso*-octyl and 2-ethyl-hexyl esters (low-volatile esters) at 5000 μg doses caused only minor and transient damage to the test plants. 2,4-D ethyl ester (high-volatile ester) caused slightly more severe damage at 50 μg dose, and at 500 μg and higher doses completely prevented further development of the test plants. The low-volatile esters were thus about 100 times less hazardous than the high-volatile ester, under the experimental conditions.

Calculations of the maximum dose used, in relation to field determinations in the literature of quantities of 2,4-D vapour in the air, showed that the risk of vapour damage to sensitive crop species resulting from cane field applications of 2,4-D *iso*-octyl ester/ioxynil octanoate mixtures is infinitesimal.

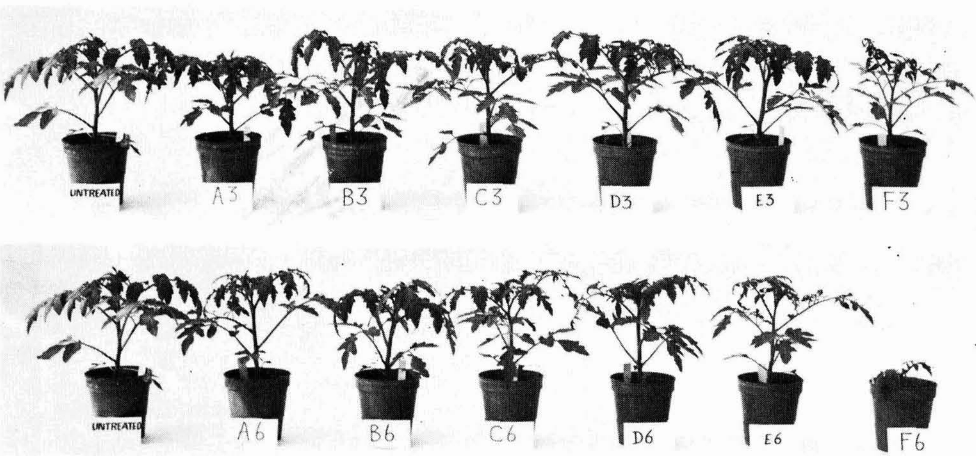


Fig. 3. Test plants photographed 14 days after treatment: Upper row—comparison of the six chemicals in Figs. 1 and 2, all 100 μg dose. Lower row—comparison of the six chemicals in Figs. 1 and 2, all at 5000 μg dose


Fig. 4. Test plants photographed 25 days after treatment, all plants in flower except treatments F4, F5 and F6: Upper row—2,4-D ethyl ester. Lower row—comparison of the other five chemicals at 5000 μg dose

# Grassy shoot disease in India

## Studies on the control of grassy shoot in the Punjab

By S. S. SANDHU, R. S. RAM and R. S. KANWAR
(Sugarcane Research Station, Punjab Agricultural University, Jullundur, Punjab, India)

### *Introduction*

THE first record of grassy shoot, a virus disease of sugar cane, in India was made in Maharashtra State in 1949[1], and it was recorded in the Punjab in 1961[2]. Since then the incidence and extent of the disease have continued to increase[3]. SINGH[4] also observed the disease in the Punjab and some other states in a number of important varieties. Apprehending the potentialities of the disease, a regular survey was undertaken in 1967–69 and revealed that the disease was fairly widespread in different districts of Punjab and that all the important varieties were affected.

### *Symptoms, time of appearance and mortality*

Only thin tillers are produced from the base of the diseased plants. Their number increases rapidly, resulting in a crowded bunch. The leaves, which are reduced in size, are also thin and narrow and develop different shades of chlorotic appearance. In some cases, however, chlorosis may not be indicated. As the buds go on throwing out only thin tillers no canes are formed in severely affected plants but where the attack of the disease is light one to two subnormal canes may be formed. When the season has advanced, infection is characterized by the premature sprouting of buds on standing canes, usually giving out slender, chlorotic shoots and/or by the production of abnormally large number of tillers at the base with pale green leaves.

Although the disease could be detected soon after germination, under field conditions at Jullundur the symptoms become pronounced in July with the onset of the monsoon rains resulting in the acceleration of growth. The percentage of diseased plants appearing during different months in the susceptible variety CoJ 46 is given in Table I.

Severely infected stools died in the course of time. Thus 14·6% of CoJ 46 stools showed complete drying, 68·5% did not show any cane formation till harvest and only 16·9% of the affected stools formed 1–3 subnormal canes. Out of the 14·6% stools showing complete drying, 10·5% dried during October, 75% during November and 14·5% in December.

**Table I**

| *Month* | *% diseased plants appearing* |
|---|---|
| July | 39 |
| August | 20 |
| September | 15 |
| October | 12 |
| November | 9 |
| December | 5 |

### *Control*

Studies carried out at the Jullundur Sugarcane Research Station have shown that the disease can be effectively controlled by hot air treatment of seed cane.

The relevant data concerning the trials conducted with CoJ 46, a late maturing approved variety, on the efficacy of treatment of seed cane with hot air[4] at 54°C for 8 hours and hot water[5] at 50°C for 2 hours are presented in Table II.

**Table II**

| *Treatment* | *Germination %* 1969/70 | 1971/72 | *Incidence of GSD (%)* 1969/70 | 1971/72 |
|---|---|---|---|---|
| Untreated | 29·9 | 49·5 | 56·2 | 10·0 |
| Hot air treated | 22·0 | 40·1 | 0·0 | 0·0 |
| Hot water treated | 23·3 | 37·5 | 12·5 | 3·6 |

The above data show that whereas the hot air treatment completely eliminated the disease the hot water treatment was not fully effective in as much as 3·6 to 12·5% escapes were noticed in the resultant crop. Both the treatments caused reduction in germination.

The data relating to the beneficial effect of hot air treatment in increasing the yield are set out in Table III.

1 CHONA: *Indian Phytopath.*, 1958, **11**, 1–9.
2 KAR and VERMA: *Indian Sugar*, 1961, **11**, 131–133.
3 SANDHU *et al.*: *J. Research Punjab Agric. Univ.*, 1967, **4**, 533–535.
4 *Indian Sugar*, 1967, **17**, 181–186.
5 SRINIVASAN and RAO: *Indian Farming*, 1968, **18**, 25–26.

**Table III**

| *Year* | *Crop* | *Variety* | Untreated: *Germination, %* | Untreated: *Incidence of GSD %* | Untreated: *Ave. wt. of millable canes (kg) per 10 ft row* | Hot air treated: *Germination, %* | Hot air treated: *Incidence of GSD, %* | Hot air treated: *Ave. wt. of millable canes (kg) per 10 ft row* |
|---|---|---|---|---|---|---|---|---|
| 1968/69 | Plant | CoJ 46 | 71·0 | 86·4 | 8·0 | 45·0 | 0 | 26·0 |
| | | Co 1148 | 50·3 | 65·3 | 13·0 | 45·2 | 0 | 33·0 |
| 1969/70 | Plant | CoJ 46 | 29·9 | 56·2 | 4·0 | 32·0 | 0 | 11·7 |
| | | Co 1148 | 19·2 | 19·2 | 8·3 | 18·5 | 0 | 15·9 |
| 1969/70 | Ratoon | CoJ 46 | — | 89·2 | 6·0 | — | 0 | 20·5 |
| | | Co 1148 | — | 71·4 | 7·0 | — | 0 | 19·5 |

As a result of the control of GSD by hot air treatment, variety CoJ 46 recorded cane yield improvements ranging from 192·5 to 225·0% in plant and 241·6% in ratoon crop. In Co 1148 the increase in yield varied from 91·5 to 153·8% in plant and 176·6% in ratoon cane.

*Seed treatment programme for controlling grassy shoot disease*

The success of cane cultivation is intimately connected with the supply of disease-free seed to the growers. This is now being taken up as a well-knit programme comprising the following steps.

1. The hot air treatment of the nucleus seed of the various improved varieties will be conducted at the main sugar cane research station at Jullundur under the technical supervision of the Pathologist. Such treated seed will be planted at the main research station at Jullundur and at the two sub-stations at Gurdaspur (submontane area) and Kheri (south-east Punjab).

2. The multiplication of the foundation seed will then be taken to the six sugar factory farms in the state.

3. At the third stage the seed grown at the factory farms will be passed on to 20–25 progressive growers for multiplication and distribution amongst the growers for planting in each factory zone.

The above programme of seed cane production will be kept constantly under supervision at all the stages and necessary measures such as roguing and spraying with suitable insecticides adopted to give effective control of the vectors of this disease.

# The activity of bone charcoal

## Part I. The index of performance

By J. C. ABRAM, R. M. MORTON and E. G. MULLER
(Tate & Lyle Refineries Ltd., Plaistow Wharf, London E16 2AG)

### *Introduction*

A CONSIDERABLE effort has been directed by the sugar industry to the problems of assessing regeneration efficiency and the activity of char stocks.

Certain tests[1] such as the Lye test, and the *DH* and pH of revivified char have proved to be useful indicators of kilning efficiency, but there remains no simple absolute test for char activity.

It is possible to determine the quality of stocks by comparing their decolorization performance in column tests. These tests, however, are tedious, and the results depend as much on the nature of the liquor used as on the quality of the char. The value of such tests is severely limited.

More recently a series of tests have been established[2] which allow the adsorptive properties of bone char to be examined in depth. These tests, which are outlined in Table I, provide fundamental information about the two basic component surfaces of char, hydroxyapatite and carbon, the availability of these surfaces for adsorption and the nature of the surfaces.

**Table I. Bone char activity tests***

1. Total surface area: measured by the equilibrium adsorption of sodium di-2-ethylhexylsulphosuccinate (OT) from water.
2. Readily accessible surface area: an indication of the amount of surface readily available to colorant molecules is given by the amount of OT adsorbed by 0·5 g char from 10 ml of 10 mM OT at 30°C during ½ hr contact time.
3. Carbon surface area: the amount of carbon surface present, as distinct from the hydroxyapatite surface, can be determined by measuring the equilibrium adsorption of cetyltrimethylammonium bromide (CTAB) from water.
4. Readily accessible carbon surface: the availability of the carbon surface for adsorption is indicated by the amount of CTAB adsorbed by 0·5 g char from 10 ml of 10 mM CTAB at 30°C during 3 hr contact time.
5. Carbon content: expressed as the % carbon present on sample. Normal chars should have carbon contents between 5 and 12%.
6. Carbon dispersity: this is expressed as the area of carbon present in char per gram of carbon, and is calculated from Test 3 ÷ Test 5. Basically this test describes the way in which the carbon has been deposited within the hydroxyapatite lattice[2,3]. The carbon in new char has been deposited as a thin layer and is of high activity. In service, the pores within the bone char structure become blocked with inactive carbon, resulting from the carbonization of adsorbed organic impurities and the dispersity falls.
7. *DH*: this is a measure of the amount of calcium which can be eluted from bone char in water, and is directly related to the capacity of the hydroxyapatite surface to adsorb calcium ions[4]. For a constant hydroxyapatite surface area, the lower the *DH*, the higher the capacity of the char for calcium (ash) and colour. The *DH* is affected by the effectiveness of washing and kilning, and the previous history of the char.
8. pH: the chemical factors which influence the pH of revivified char are complex. Additional information as provided by the other tests is required to enable a meaningful interpretation of the test to be made.
9. Lye test: this test is used to indicate under-burning of char, and as such is useful for controlling the kilning reaction. For maximum effect it should be interpreted in conjunction with a *DH* test.
10. % sulphate.
11. % carbonate.

These last two tests are necessary for accurate interpretation of the previous tests.

[1] (a) *Tech. Rpt. Bone Char Research Project*, 1961, (62); *Rpt. Nat. Bureau Standards* (Washington, D.C.), (7321).
(b) DE WHALLEY: "ICUMSA Methods of Sugar Analysis" (Elsevier, Amsterdam). 1964.

[2] BENNETT and ABRAM: *Sugar Industry Tech. Inc.*, 1970, **29**, 88–101.

12. Liquor decolorization, bottle shaking test. This test gives a reasonable indication of char activity and a check on information provided by Tests 1–9. The results are usually expressed as % colour removed and % ash removed by 10–30 g char from 100 ml of 65°Bx carbonatated or phosphated liquor at 75°C during 4 hr contact time.

* Tests 7–11 are recommended by ICUMSA.

A more detailed explanation of these tests is given elsewhere[1].

Although these tests have been shown to of be significant value for determining the quality of stocks on a three- or six-monthly basis, they are too time-consuming and comprehensive for routine control of revivification, where a rapid assessment of performance is required. The results of several of the tests are interrelated. Others provide information of a confirmatory rather than basic nature, essential only when a complete picture of the char is required.

When the object is to obtain either a more accurate picture of revivification performance than is given solely by the Lye test, or to provide a means whereby the relative activity of a stock may be assessed, then it may be possible to reduce the number of tests employed.

### *Experimental*

In order to test this hypothesis and to determine the relative importance of each of the tests, the results obtained over a two-year period of fourteen stock and new chars from six different countries were analysed. Each of these chars had at one time been compared for ash and colour removal capacity (Test 12) with a single sample of Tate & Lyle Refineries Ltd. stock char. Thus the ratios of % colour removal ($C$) and % ash removal ($A$) between the stock char and the test chars provide a relative measure of char performance.

The relevant results are given in Table II.

### *Analysis of Results*

The results for each of the activity tests were compared with the colour and ash removal ratios, $C$ and $A$ respectively. A correlation matrix was then calculated using standard statistical techniques.

No correlation was found between either colour or ash removal and the Lye test, the bulk analyses fo carbon, calcium sulphate and calcium carbonate, and the pH test.

Significant correlations were obtained between $C$ and

(*a*) accessible total area, $AT$ and

(*b*) carbon dispersity, $CD$.

Other lesser correlations were shown to be due to the dependence on the two main factors.

A multiple regression analysis provided the following equation:

$$C = 0{\cdot}000232\,(CD) + 0{\cdot}00448\,(AT) + 0{\cdot}247 \quad \ldots\ldots(1)$$

Only one of the tests showed any correlation with ash removal, $A$, that being $DH$. The correlation was improved when $1/DH$ was considered. This is to be expected for, under normal kilning conditions with a maximum working temperature of 550°C, as the $DH$ falls so the capacity of char to adsorb calcium increases. Above 600°C the trend reverses, but this condition can be neglected[4].

An equation of the form

$$A = \frac{k_1}{DH} + k_2 \quad \ldots\ldots(2)$$

would tend to infinity as the DH decreases. New chars with $DH$ values of 0 are not unknown and the problem was overcome by reformulating equation 2 as follows:

$$A = \frac{K_1}{(DH + 0{\cdot}5)} + K_2 \quad \ldots\ldots(3)$$

It was found by multiple regression analysis that the equation

$$A = \frac{1{\cdot}23}{(DH + 0{\cdot}5)} + 0{\cdot}29 \quad \ldots\ldots(4)$$

gave a good fit to the data shown in Table II.

In a recent paper, CHOU and HANSON[5] have shown that the rate-determining step in column decolorization by bone char is one of intraparticle diffusion. This is regulated by the size and porosity of the particle and by the chemical nature of its surface with respect to the colorant molecule.

The rate of adsorption of $OT$, test 2, was designed to give a relative measure of the size and porosity of

[3] BENNETT & ABRAM: *J. Colloid Interface Sci.*, 1967, **23**, 513.

[4] ABRAM: Unpublished work.

[5] *Sugar Industry Tech. Inc.*, 1971, **30**, 27–40.

**Table II. Analyses of char stocks**

| Char | Comparison test with T & L Stock Char Relative removal of Colour $C$ | Ash $A$ | 1 Total area $T$ (μ moles/g) | 2 Accessible total area $AT$ (μ moles/g) | 3 Carbon area $B$ (μ moles/g) | 4 Accessible Carbon area $AB$ (μ moles/g) | 5 % Carbon $PC$ | 6 Carbon Dispersity $CD$ (μ moles/g) | 7 $DH$ ($Ca^{++}$mN) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0·99 | 1·05 | 166 | 73 | 110 | 65 | 9·2 | 1196 | 3·4 |
| 2 | 0·90 | 0·69 | 171 | 95 | 88 | 53 | 4·8 | 1833 | 2·2 |
| 3 | 0·63 | 0·56 | 107 | 51 | 44 | 20 | 3·1 | 1419 | 1·8 |
| 4 | 0·80 | 2·12 | 175 | 83 | 106 | 57 | 12·4 | 855 | 0·4 |
| 5 | 0·63 | 0·85 | 103 | 49 | 49 | 19 | 9·6 | 510 | 7·6 |
| 6 | 0·63 | 0·60 | 106 | 23 | 61 | 24 | 5·6 | 1090 | 3·6 |
| 7 | 0·60 | 0·63 | 102 | 23 | 61 | 24 | 5·3 | 1150 | 3·1 |
| 8 | 0·79 | 0·63 | 150 | 62 | 98 | 46 | 14·0 | 700 | 4·6 |
| 9 | 0·87 | 0·75 | 210 | 80 | 110 | 49 | 8·9 | 1236 | 2·9 |
| 10 | 0·63 | 0·53 | 165 | 94 | 115 | 60 | 15·5 | 742 | 1·0 |
| 11 | 0·59 | 0·56 | 123 | 53 | 99 | 62 | 17·0 | 582 | 2·4 |
| 12 | 1·20 | 1·00 | 196 | 74 | 128 | 61 | 5·6 | 2286 | 0·9 |
| 13 | 1·14 | 0·36 | 140 | 100 | 54 | 26 | 4·9 | 1102 | 5·0 |
| 14 | 1·18 | 0·36 | 153 | 99 | 66 | 34 | 3·7 | 1784 | 4·2 |

bone char, for both carbon and hydroxyapatite surfaces. The *DH*, test 7, gives a measure of the available hydroxyapatite surface for ash and anionic colour. The carbon dispersity, test 6, provides the best available assessment of the nature of the carbon surface. Thus the three terms chosen to describe colour and ash capacities by a statistical analysis of data describing basic physico-chemical properties of char, together provide the sort of information which is required to define the limiting rate-determining step in the kinetic theory of adsorption.

These three terms are not sufficiently comprehensive to give an absolute measure of char activity. It should be possible, however, to combine them into an equation giving a relative measure of char performance, which can be used to assess the effectiveness of regeneration or to provide a good indication of char stock activity. Hitherto, this has been possible only by undertaking column decolorization or bottle shaking tests using reference chars which have been stored under carefully controlled conditions. Even then the results have been dependent on the liquor used in the tests.

It must be pointed out at this stage that the analysis of the results failed to show a significant correlation between colour removal in the bottle test and *DH*. It can be shown, however, under certain conditions of constant carbon surface that the decolorizing ability is influenced by *DH*[4]. It can also be shown that the hydroxyapatite surface is of secondary importance when compared with the carbon surface in decolorization. It is possible, therefore, that any correlation between decolorization and *DH* for the fourteen very diverse chars investigated has been masked by the overriding influence of the carbon surface.

While the most important function of bone char in the refining process is the removal of colour, the removal of ash is also of value and must be considered in any performance index.

We assess the relative importance of these two factors to be in the ratio of approximately 85:15.

It is proposed, therefore, that the performance index, (*pi*), for bone char be represented by the equation:

$$pi = 0{\cdot}85 \text{ (equation 1)} + 0{\cdot}15 \text{ (equation 4)}$$

$$\text{i.e. } pi = 0{\cdot}000197\,(CD) + 0{\cdot}0038\,(AT) + \frac{0{\cdot}184}{(DH + 0{\cdot}5)} + 0{\cdot}253 \quad \ldots\ldots\ldots\ldots\ldots(5)$$

This is not in a convenient form and it would be desirable if char performance could be rated on the scale 0–100, with new char standing at 100. This can be achieved by substituting results for the three significant tests on new char in equation (5),

$$\text{then } PI = 100pi/pi \text{ (new char)}$$

The analyses of some fifteen samples of high activity new chars provided the following average results:

| | |
|---|---|
| Total readily accessible surface (*AT*) | 160 μ moles/g |
| Carbon dispersity (*CD*) | 2200 μ moles/g |
| *DH* | 1·0 |

Substituting in equation (5) gives *pi* (new char) = 1·418.

$$\therefore \text{ Performance Index} = \frac{100}{1{\cdot}418}\,[0{\cdot}000197(CD) + 0{\cdot}0038(AT) + \frac{0{\cdot}184}{(DH + 0{\cdot}5)} + 0{\cdot}253]$$

$$\text{i.e. } PI = 0{\cdot}014\,(CD) + 0{\cdot}27\,(AT) + \frac{13}{(DH + 0{\cdot}5)} + 18 \quad \ldots\ldots\ldots(6)$$

On this scale new char has a *PI* of 100, and an average stock char 75.

This index has been calculated for a number of chars used in comparative bottle shaking and column decolorization tests. In every case the actual performance measured in decolorization terms was in agreement with the index of performance.

It is not claimed that this gives an absolute measure of char activity. It is thought, however, that it provides a simple and fairly accurate measure of relative char performance.

### *Conclusions*

The ability of a char to remove colour and ash from impure sugar liquors has been related to three basic physico-chemical properties of char:

(a) readily accessible total surface area (*AT*)

(b) the carbon dispersity (*CD*), that is the carbon area present per gram of carbon.

(c) the *DH*.

These terms, which can be measured very readily, have been combined to give a Performance Index, which provides a useful working guide to the decolorizing and ash removal efficiency of char.

$$PI = 0{\cdot}014\,(CD) + 0{\cdot}27\,(AT) + \frac{13}{(DH + 0{\cdot}5)} + 18$$

On this scale a good new char would rate at 100, and an average stock char at 75.


### *Summary*

In a recent paper[2] BENNETT and ABRAM have described methods by which the activity of bone charcoal can be assessed. A series of twelve tests were listed which together yielded a comprehensive picture of the state of the char.

These tests have proved useful for the overall control of refinery stocks, and for ascertaining the reasons why a char has deteriorated in any particular respect, with resulting loss of activity.

They are, however, too time-consuming to use in full for the routine control of revivification, where a rapid evaluation of char performance is required. It would be desirable if the decolorizing performance of a char could be assessed rapidly and expressed as a number or performance index.

This article describes the development of a simple formula which relates decolorizing performance to three readily measurable basic physico-chemical properties of char.

# Sugar cane agriculture

**Sprinkler irrigation.** C. BAYMA. *Brasil Açuc.*, 1971, **78,** 550–557; 1972, **79,** 38–47.—Details, including mathematical formulae applicable to sprinkler irrigation of cane, are discussed and the need for economical control stressed. Government regulations on irrigation and drainage are reproduced and some comparative data tabulated showing the effects of natural, sprinkler and mixed irrigation on cane yields.

* * *

**Mud and more mud.** L. L. LAUDEN. *Sugar Bull.*, 1972, **50,** (Jan. 1), 3.—The difficulties caused by an excessively wet season at harvesting time in Louisiana connected with lodged and twisted cane, are outlined. The behaviour of different cane varieties is described.

* * *

**New type cane planter demonstrated.** ANON. *Producers' Rev.*, 1972, **62,** (1), 13–14.—A new type of cane planter, the "Etwell", designed to be used on large areas, is described and illustrated with photographs. It can plant 1½ acres per hour under reasonable conditions. A three-man team is needed to operate it. It is capable of single or double-row planting but the former works out at nearly double the cost of the latter, as three men are still needed. Setts or billets from a chopper harvester are used. Bin capacity is two tons. Large fertilizer and spray storage bins are fitted.

* * *

**Pollution control—how far and at what cost.** ANON. *Producers' Rev.*, 1972, **62,** (1), 16.—Atmospheric pollution associated with the burning of sugar cane trash is discussed, particularly its implications in Hawaii where trash burning is likely to become illegal. Radical changes in cane harvesting may be called for and this could apply to Australia in time.

* * *

**Novel cane harvester—grower designed.** ANON. *Producers' Rev.*, 1972, **62,** (1), 55–56.—An unusual cane harvester, designed and built by an Australian cane grower (Mr. CLIVE MORTON of Hambledon), is described. The machine was designed to deal with the high percentage of lodged cane on Mr. MORETON's farm.

* * *

**Louisiana sugar industry continues research on cane cleaner.** ANON. *Sugar Bull.*, 1972, **50,** (Jan. 15), 8–9. Work with an experimental cane cleaner is described with the aid of photographs, the work being a joint effort of the American Sugar Cane League, the US Department of Agriculture and Louisiana State University.

* * *

**The Cyclone and Drought Insurance Board (Mauritius) 1946–1971.** ANON. 44 pp.—The history of this insurance fund, established in 1946 to compensate cane growers for losses incurred as a result of cyclones and drought, is outlined and its operation explained.

* * *

**Smut disease now in Hawaii.** L. L. LAUDEN. *Sugar Bull.*, 1972, **50,** (Jan. 15), 14.—Reference is made to the recent discovery of this dreaded sugar cane disease in Hawaii. At present the disease is isolated on one plantation near Honolulu. How the disease was introduced is still uncertain. There is a good chance that a cutting may have been brought in by some well-meaning but uninformed individual. For many years the Louisiana, Florida and Hawaiian sugar industries have attempted to prevent this and other sugar cane diseases from entering their states.

* * *

**A comparison of the sugar industry of Peru with that of Venezuela.** P. E. SEQUERA. *Azúcar y Productividad* (Venezuela), 1971, **1,** (2), 7–9.—Comparisons are made of various aspects of the sugar cane industries of the two countries. Various recommendations are given for improving sugar production in Venezuela, the main needs being improved harvesting and transport to the factory.

* * *

**The dry savannahs of the Ureña and their employment for sugar production.** ANON. *Azúcar y Productividad* (Venezuela), 1971, **1,** (2), 47.—This is a continuation of an earlier article[1] and describes the commencement of irrigation in the area.

* * *

**A proven new system of sugar cane cultivation in central Venezuela.** ANON. *Azúcar y Productividad* (Venezuela), 1971, **1,** (2), 57–59.—The great success that has been achieved in central Venezuela with mechanization is described with the aid of illustrations showing Howard rotary cultivators and Massey-Ferguson harvesters in action.

* * *

**Recommendations for the control of Johnson grass and other weeds in Louisiana sugar cane, Spring 1972.** ANON. *Sugar Bull.*, 1972, **50,** (Feb. 1), 5–11.—Both chemical and mechanical control methods are dis-

[1] *I.S.J.*, 1972, **74,** 276.

cussed. Discussion relates to (i) removal of winter weeds with both methods and (ii) application of pre-emergence herbicides, the latter involving programmes using TCA, "Fenac", "Terbacil" ("Sinbar"), "Trifluralin" ("Treflan"), etc. Raoul grass and Bermuda grass are the other main grass weeds discussed.

* * *

**An evaluation of poultry manure as a sugar cane fertilizer.** P. K. MOBERLY and D. W. A. STEVENSON. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 136–141.—The material used was from broiler houses in which sawdust was used for litter. The findings of a number of experiments designed to test the response of sugar cane to poultry litter are reported. The experiments were conducted with both plant and ratoon crops. In general, yield responses to poultry litter are no greater than can be obtained from the equivalent N-P-K content of mineral fertilizers. It was concluded that organic manures of this type may be satisfactorily used if available on the farm, but to purchase at ruling prices would be economically unsound.

* * *

**The effects of filter cake on soil fertility and yield of sugar cane.** G. ROTH. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 142–148.—The varying responses of cane to filter cake application are well known. A study in the different stages of its decomposition are here recorded. In the later stages of decomposition an invasion of spore-forming bacilli and actinomycetes was found. These micro-organisms were shown to have a positive influence on soil aggregate stability. It may be of considerable practical significance that some micro-organisms which thrive in filter cake are antagonistic to *Pythium arrhenomanes*, the cause of root rot in sugar cane.

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**The growth and productivity of sugar cane.** H. ROSTRON. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 152–157.—Largely because of improved cane varieties and improved agronomy (notably use of fertilizers and weed control), the average sugar yields in South Africa have increased from 3·08 tons ha in 1949/50 to 5·05 tons/ha in 1969/70. Data are here presented to show that there should be considerable scope for increasing yields beyond the limits of existing varieties. It is confirmed that radiation, temperature and plant age or size are important factors affecting growth when water and nutrients are freely available. It is concluded that detailed investigations are necessary to determine what morphological and physiological characteristics should be incorporated into new varieties in order to maximize sucrose production.

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**Changes in sucrose % cane and yield of sucrose per unit area associated with cold, drought and ripening.** J. GLOVER. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 158–164.—It is shown that under South African conditions, increasing dryness (drop in monthly rainfall) produces a more rapid increase in sucrose % cane than does increasing cold. The ripening of cane (defined as sucrose storage in the stem) is discussed and the construction of a simple model of the process explained. It is pointed out that since cane weight increase does not follow the same pattern as increase in sucrose content, there is a limit to cane ripening beyond which the gain in sucrose is offset by the penalty incurred as a result of the greater fresh weight of cane to be transported to the factory. However, under "non-ripening" conditions any gain in sucrose is accompanied by considerable increases in fresh weight and hence still greater penalties.

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**Asphalt barriers to improve productivity of sandy soils—preliminary assessment.** M. E. SUMNER and E. C. GILFILLAN. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 165–168.—Much of the South Aftican sugar cane area consists of light, sandy soils, easily leached and subject to rapid moisture loss through deep percolation. The value of the asphalt layer[1] was tested and gave outstanding results with sugar cane and some other crops. The barrier is placed 60 cm below the surface by excavating and then sprayed with 60% asphalt emulsion and the soil replaced. It was felt that further experimentation was needed before the practice could be recommended on a large scale. The high cost of laying asphalt barriers commercially is a serious obstacle.

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**Comparisons of measured evapotranspiration of sugar cane from large and small lysimeters.** G. D. THOMPSON and J. P. BOYCE. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 169–177.—Evapotranspiration, estimated for plant, 1st and 2nd ratoon crops in a large 405 $m^2$ plastic-lined lysimeter and three small 3·71 $m^2$ lysimeters, was found to be little affected by size of lysimeter during the first 230 days of the plant crop, but during the final 80 days of the experiment differed considerably between the two sizes as a result of lodging in the large lysimeter which caused a 30% reduction in evapotranspiration. This drop in water use is shown to last for at least 2½–3 months after lodging occurs. It is concluded that productivity per unit time is reduced by about 30% after lodging, since the yield of cane per 100 mm evapotranspiration was the same for both lodged and erect cane.

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**Reclamation of some sodic soils by the high salt water dilution method.** R. W. FITZPATRICK, D. P. TURNER, A. CASS and M. E. SUMNER. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 178–188.—In some South African cane areas a long history of injudicious irrigation has produced saline soils with consequent deterioration of physical structure causing cane yields to decline drastically. The aim of this work was to investigate the high salt water dilution method of reclamation on a laboratory scale so that the

[1] WANG *et al.*: *I.S.J.*, 1971, **73**, 143.

information could be used for the design of a suitable drainage system. The exchangeable sodium percentage (ESP) of all soils was decreased by leaching with solutions of decreasing Na but constant Ca concentration. Although a final leaching with water of low electrolyte concentration did not produce a rapid decrease in hydraulic conductivity, most soils showed an overall decrease of up to 34%.

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**The soils of the Eastern Transvaal sugar industry.** C. N. MACVICAR and G. A. PERFECT. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 189–195. The physiography, geology and soils of the area are described. Because irrigation is essential for sugar cane growing there, the physical properties of the soils are emphasized.

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**A nutrient survey of sugar cane in the South African industry with special reference to trace elements.** J. H. MEYER, R. A. WOOD, and P. DU PREEZ. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 196–204. This survey was undertaken to ascertain whether large-scale deficiencies of major nutrients or trace elements exist. Results indicated that the only extensive major nutrient deficiency is in potassium, although sulphur levels in Swaziland and Eastern Transvaal are low without actually appearing to limit sugar cane growth. There are no widespread trace element deficiencies, but zinc is undoubtedly a problem in certain areas of the midlands and coastal lowlands. The survey also showed that the midlands mistbelt region has considerable areas where the toxic levels of soil aluminium may be a hazard to sugar cane production, and there is possibly cause for concern regarding certain of the sandy soils of the coastal lowlands.

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**The nitrogen requirements of ratoon crops of sugar cane in relation to age and time of harvest.** P. K. MOBERLY. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 205–211.—With regard to the effects of excessive nitrogen on recoverable sugar it was found that, when the ratoon cane is 18 months of age (or more) the time of cutting is relatively unimportant in contrast to 12-month cane, on which the adverse effect of excessive nitrogen is greater at an unfavourable than at a favourable time of the year, e.g. May *vs.* November. The uptake of nitrogen is more efficient in crops grown during a favourable climatic cycle compared with a less favourable cycle, e.g. in winter months. Lower levels of nitrogen could be used therefore for crops grown during a favourable climatic cycle. High levels of nitrogen would, in general, be more profitable when applied to long (18-month) rather than to short ratoons. The merits of a 12-month cutting cycle on the coastal midlands are questioned.

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**Incidence of toxic aluminium in sandy soils.** M. E. SUMNER and J. H. MEYER. *Proc. 45th Congr. S. African Sugar Cane Tech. Assoc.*, 1971, 212–216.—This is a summary of available information on the subject in relation to sugar cane soils in South Africa. The occurrence of toxic quantities of aluminium in these soils is a widespread phenomenon and the potential benefits of limestone under these conditions should be more widely known. It is considered that some 18,500 hectares of cane land would benefit from liming.

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**Some factors affecting foliar analysis in sugar cane.** J. M. GOSNELL and A. C. LONG. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 217–232.—The advantages and disadvantages of foliar analysis in connexion with fertilizer recommendations are well known. Foliar analysis introduces a whole set of variables which are not present in the case of soil analysis. These are discussed and include effects of: time of sampling, delay in midrib removal, age, season, variety, moisture stress, nitrogen, potash and other elements. There were large differences between different cane varieties suggesting that the critical level must be found for each variety.

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**A system of routine foliar analysis of sugar cane major and trace elements.** A. C. LONG. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 233–239.—A system of routine foliar analysis, as practised in Rhodesia, is discussed. Together with subsequent field soil analysis it is used for fertilizer recommendations on sugar estates and privately-owned sugar farms in Rhodesia. This paper gives a brief account of the procedure adopted, from sampling to analytical methods. When planning the foliar analysis it was resolved that methods should be rapid and economical, a turnover of 500 samples a month being envisaged.

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**Some effects of hot water treatment.** G. L. JAMES. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 240–248.—The rôle of ratoon stunting disease in causing yield losses under fully irrigated conditions in the lowveld is as yet undefined. Hot water treatment at 50·5°C for 2 hr was shown to affect germination adversely and reduce stalk populations in certain varieties. The optimum age for hot water treatment of N:Co 310 and N:Co 376 seed cane was found to be 11–12 months. Leaving hot water-treated cane stacked in the field had no detrimental effect if the period did not exceed two days. No unsatisfactory stands resulted from planting hot water-treated cane during a mild winter. Later infections of culmicolous smut were controlled by thermotherapy.

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**Recent investigations on nematodes in sugar cane fields.** J. DICK and R. H. G. HARRIS. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 249–254.—Three experiments on nematode control under prevailing conditions are discussed. *Meloidogyne* practically disappeared when the grass *Eragrostis curvula* was grown for three seasons, but increased when tomatoes and beans were grown. Yield responses to nematicides in the absence of *Meloidogyne* show that this is not the only nematode concerned. The sugar cane variety N 50/211 responded considerably more to treatment with nematicide than did N 55/805, suggesting a degree of tolerance in the latter variety. As control, chicken litter proved ineffective. The nematicides EDB and DBCP were more effective than "Temik" or "Lannate" but this might have been due to the high pH of the soil in the experimental site. There now seems to be some evidence that "Temik" is inactivated in alkaline soils.

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**A comparison of herbicide treatments for the control of grass and *Cyperus* species.** F. E. RICHARDSON. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 255–260.—The experiments were carried out on two Natal soils, one heavy with high organic matter, the other sandy with low organic matter. The trials were designed to evaluate pre- and post-emergence herbicide treatment on the specific weeds *Panicum maximum* (a grass), *Cyperus rotundus*, *C. esculentus* and annual grasses, the more important of which were: *Digitaria adscendens*, *D. ternata* (the two commonest), *Panicum laevifolium*, *Setaria pallidefusca*, *Paspalum urvillei*, *Phalaris angusta* and *Eragrostis curvula*. "Alachlor"/2,4-D was the most successful herbicide mixture for pre-emergence grass control. No pre-emergence treatment effectively controlled *Cyperus* (nut grass and water grass). Post-emergence grass control was dependent upon the stage of growth when treatments were applied. Mixtures of "Ametryne" or "Diuron" with 2,4-D were highly satisfactory for the post-emergence control of grass and *Cyperus* species. The addition of a non-ionic surfactant was always beneficial.

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**Soil compaction studies at Pongola.** M. A. JOHNSTON and R. A. WOOD. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 261–269.—In South Africa, past studies on the effects of soil compaction on cane yield appear to have been somewhat contradictory or variable, partly because of the onset of drought. Consequently it was decided to conduct a well-replicated trial under irrigation conditions on a uniform sandy clay at Pongola, previously shown to be highly compactable. Ratoon cane was used. In spite of significant compactive efforts on soil bulk density and macroporosity, no reductions in yield due to compaction were recorded. Restorative treatments following compaction sometimes improved the soil's physical condition without increasing yield. Utilization of moisture from considerable depths and regular irrigation are thought to be the main factors responsible for preventing a decline in yield.

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**A study on the response of sugar cane to "Diquat" for tassel control.** S. S. GARRUCHO. *Sugar News* (Philippines), 1971, **47**, 592–598.—Earlier work on the subject in the Philippines and elsewhere is reviewed. Experiments showed that different varieties of cane varied in their reaction to "Diquat" ("Reglone") and that by judicious enzyme control it is possible to wilt the leaves, to maintain some photosynthesis and to retard metabolism, thereby effecting tassel control. The application of "Diquat" for tassel control gave a marked additional net income.

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**New harvesters purchased during the 1971 season.** L. G. VALLANCE. *Australian Sugar J.*, 1972, **63**, 473–477.—Information is given on chopper harvesters purchased by Queensland cane growers in 1971. Of the 250 bought, most were of the larger type such as the Don "Mizzi", the Massey-Ferguson "201" and the Toft "Robot".

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**Diversification of crops on sugar cane soils.** R. ANTOINE. *Rev. Agric. Sucr. Maurice*, 1971, **50**, 214–218.—For various reasons, such as excessive stoniness of the soil or irrigation difficulties, a large proportion of the land devoted to sugar cane is unsuitable for most other crops. However, crops such as maize, potatoes, sunflower and groundnuts can be grown in many areas, their climatic requirements being roughly similar to those of cane. These crops are discussed.

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**Regional selection of sugar cane in Réunion: varietal tests and their applications.** F. LÉOVILLE. *Rev. Agric. Sucr. Maurice*, 1971, **50**, 248–255.—The different sugar cane growing areas of the island are well illustrated in a map, there being four main zones: the super-humid zone (Saint André, Saint Philippe), the humid zone (Bel Air, Bois Rouge), the dry, irrigated zone and the dry zone. Several varieties have had to be eliminated because of susceptibility to disease such as leaf scald, gummosis, and yellow spot.

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**Reflections on mechanical loading of cane (in Réunion).** M. HOARAU. *Rev. Agric. Sucr. Maurice*, 1971, **50**, 353–363.—The difficult labour conditions now prevailing in Réunion in regard to sugar cane are stressed. It is pointed out that the production of a ton of sugar in Réunion requires the equivalent of 12 days work for one man, whereas in France, with the present high degree of mechanization of the beet sugar industry, the production of a ton of sugar needs only 12 hours. The performance of an Australian cane loader (the Toft WTL 250) is described and illustrated.

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**Sugar cane varieties.** F. GUILLERMO L. *Memoria Campaña* 1970–71 (Chacra Expt. Sta., Argentina), 1972, (March), 10 pp.—An account is given of the Chacra Experiment Station, founded in 1951, and its work, especially on sugar cane breeding. In 1969 a glasshouse was erected for raising seedlings and the first 400 seedlings bred at the Station were germinated in it. The prefix "NA" to seedlings or new varieties stands for Northern Argentina.

**Economics of fertilizer use (India).** P. D. JHAMB. *Sugar News* (India), 1971, **3,** (8), 15–17.—In India irrigation and fertilizers are often complementary in obtaining maximum or optimum yields. A table is given showing the response (in Northern India) in cane yield and sugar to different amounts of nitrogen, i.e. from 50 to 200 kg/ha, where 150 kg/ha proved to be the optimum or most profitable rate.

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**Problems and prospects of the sugar industry in Maharashtra.** D. M. POPAT. *Indian Sugar*, 1971, **21,** 597–599.—The fall in Indian sugar production in 1970–71 compared with the previous season is discussed. The fall was steeper in some states than in others. Contributing factors were reduced areas of cane cultivation and damage to crops by floods, drought and pests, and greater cane utilization for gur production because of higher gur prices.

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**Review of the work done on subterranean pests of sugar cane in India.** S. KUMAR. *Indian Sugar*, 1971, **21,** 605–608.—Subterranean pests of sugar cane in India are restricted to termites and beetle grubs. The 5 species of termite known to be capable of damaging cane in India are listed. Control measures are discussed. BHC or gamma-BHC application lasts up to 3 or 4 months only, i.e. during the germination and tillering stage. "Aldrin", "Dieldrin" and "Heptachlor" dusts can be effective for two crop seasons. Eight different beetle grubs are listed and recognised methods of control or reducing damage considered. Suggested future lines of work on chemical and possibly biological control are discussed.

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**Prospect of adsali (monsoon) planting of cane in North Bihar.** R. B. PRASAD. *Indian Sugar*, 1971, **21,** 609–611. The high reputation of North Bihar as a sugar cane-growing area is discussed. It is considered that some of the newer cane varieties that proved unsuitable under normal planting conditions might well prove profitable if used for adsali (monsoon) planting. This would involve an 18-month instead of a 12-month period and greater attention to the problems of pests, diseases and cane lodging.

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**Performance of foreign varieties under wetland conditions of Tiruchirappalli district.** T. R. SRINIVASAN, P. S. SANJEEVI, P. PARAMESWARAN and K. N. GOVINDASWAMY. *Indian Sugar*, 1971, **21,** 613–616.—The special climatic conditions that prevail in this area of Tamil Nadu State mean that a cane crop planted in the main season has to face the adverse effects of acute drought during early growth and continuous water logging caused by the monsoon later. With the special season crop (planted in August or September) the reverse applies. This considerably restricts choice of varieties. The answer may well lie in the future use of locally-bred varieties.

**Some observations on a sugar cane disease complex in Nizamabad district of Andhra Pradesh.** N. N. SARMA. *Indian Sugar*, 1971, **21,** 619–627.—An account is given of studies undertaken to ascertain the cause of large-scale death of cane stalks which occurred in the area in 1958. It was concluded that the pathogen mainly responsible was the fungus *Cephalosporium sacchari*, the rôle of bacteria being secondary. The presence of scale insects may have created favourable conditions for invasion by bacteria.

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**Plant cane nurseries.** ANON. *Sugar Bull.*, 1972, **50,** (Feb. 15), 8.—All the commercially cultivated cane in Louisiana is susceptible to either mosaic or ratoon stunting disease. Control measures must be exercised by the grower. The value of plant cane nurseries in this connexion is discussed. Varieties are grown on the grower's best land and treated for ratoon stunting disease if need be. They are rogued and double checked for borers and usually fertilized more than at recommended rates. Plots are kept free of weeds. The beneficial experiences of several farmers, who have run their own plant nurseries for some time, are given.

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**Fertilizer and soil fertility practices for sugar cane production.** L. E. GOLDEN, R. RICAUD, D. T. LOUPE and O. D. CURTIS. *Sugar Bull.*, 1972, **50,** (Feb. 15), 10–11.—Solid and liquid fertilizers from any of the common materials are approximately equal in their effectiveness on cane. Except in cases where a late application of nitrogen is anticipated, all fertilizers should be applied in the Spring and should be placed 6 to 10 inches deep in the soil on both sides of the row. Fertilizer recommendations for plant cane and ratoon cane are given. Other materials considered are rock phosphate and filter press mud. Any decision by a grower to use sulphur, rock phosphate or cement kiln dust should be made only after advice from a competent authority.

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**Mechanical application of nematicides.** ANON. *S. African Sugar J.*, 1972, **56,** 115–117.—Damage to sugar cane by nematodes is very prevalent in Natal, especially on some of the light sandy soils. It may result in stunting, leaf roll and general debility. Subject to the conditions for their registration, four nematicides have been selected for soil treatment before planting sugar cane. They are: "Aldicarp" ("Temik"), D-D, EDB and DBCP. Information is given on timing and placement, soil conditions, methods of mechanical application, etc. A table gives specifications of four different makes of nematicide mechanical applicators that are available. It is pointed out that nematicides are expensive and that they should always be applied at the recommended optimum rate. The use of quantities in excess of the recommended dosage does not increase the response in proportion to the additional expenditure.

**Recommendations for the control of mosaic disease in sugar cane in Louisiana, 1972.** ANON. *Sugar Bull.*, 1972, **50,** (March 1), 6–7.—Mosaic disease of sugar cane occurs universally throughout the sugar cane growing areas of Louisiana, although only traces of infection occur in the northern area of the cane belt. Plant cane and ratoon cane are discussed separately. Recommendations advised for control include: getting to know the symptoms of the disease thoroughly; surveying in spring all fields which are to be used for seed cane; roguing diseased cane; and planting mosaic-resistant varieties.

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**Mechanical cane cleaning.** G. J. DURBIN. *Sugar Bull.*, 1972, **50,** (March 1), 8.—Reasons why mechanical cleaning of cane is desirable are discussed. It is pointed out that in the future it may not be possible to burn trash on account of air pollution. A new approach towards mechanically cleaning of cane is being tried and is described. The aim is to develop a new piece of field equipment which will clean the cane and leave the trash in the field. The cleaner would not be a part of the harvester but could be combined with the loader or operated separately from the loader.

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**Ultrastructure of cells in toxin-treated and** *Helminthosporium sacchari***-infected sugar cane leaves.** G. A. STROBEL, W. M. HESS and G. W. STEINER. *Phytopathology*, 1972, **62,** (3), 339–345.—*Helminthosporium sacchari* is the causal agent of eye spot disease of sugar cane and produces a host-specific toxin, helminthosporoside. In this study, resistant and susceptible clones of sugar cane were treated for varying periods, with normal helminthosporoside and with the same chemical with radio-carbon in its molecule, and then examined by electron microscopy and radioautography. Cells from fungus-infected leaves and from leaves of a susceptible clone treated with the toxin varied from showing virtually no alteration of the cytoplasm to its complete disruption. Furthermore the cytological alterations seen in fungus-infected tissues greatly resembled those observed in susceptible tissues treated with helminthosporoside.

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**Effect of soil types on response of sugar cane to N-P-K in Uttar Pradesh.** C. L. MEHROTRA, K. N. TIWARI and P. S. PANWAR. *Fertilizer News*, 1972, **17,** (2), 43–48.—The response to N was universal, irrespective of soil type, whereas the response to P and K showed more variation. In general, yield response was in direct proportion to the maturity of the soil, the youngest soil showing least response and fully matured soils the maximum.

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**Study of press mud as medium for raising seedlings from sugar cane fluffs.** M. A. ELAHI and N. N. SARKAR. *Pakistan J. Sci.*, 1970, **22,** (3/4), 148–150; through *Hort. Abs.*, 1972, **42,** 314.—Press mud mixed with soil and sand (2:2:1) was an excellent medium for raising sugar cane seedlings.

**The mass selection reservoir and sugar cane selection.** A. H. D. BROWN, J. DANIELS and N. D. STEVENSON. *Theoret. Appl. Genetics*, 1971, **41,** (4), 174–180; through *Hort. Abs.*, 1972, **42,** 314.—A method is proposed which extends the use of this selection technique to a clonally propagated crop. The populations selected in an MRS programme in Fiji produced yields greater than those of the commercial clone or variety Ragnar. Two possible artificial selection methods are compared.

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**Efficacy of hydrochloric acid on the germination of shy germinator cane variety Col. 9.** O. SINGH. *Indian J. Sci. Ind.*, 1970, **4,** (3/4), 179–180; through *Hort. Abs.*, 1972, **42,** 316.—The treatment of cane setts by soaking in 0·01% HCl for 1 hour more than doubled the subsequent germinating percentage. Some improvement in germination also resulted from soaking in 0·05% HCl, but treatment with 0·1% and 0·5% solutions inhibited growth.

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**Sex-attractant in sugar cane stalk borer,** *Chilo auricilius*. A. N. KALRA and H. DAVID. *Ind. J. Agric. Sci.*, 1971, **41,** (1), 21–24; through *Hort. Abs.*, 1972, **42,** 319.—The techniques tested in these experiments are described. The addition of 1 ml of sandalwood oil to 100 ml of an extract of crushed abdominal tips of 250 females enhanced attraction. Anhydrous ether was the best extractant used.

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**Big future tipped for Joe Mizzi cane harvester.** ANON. *Producers' Rev.*, 1972, **62,** (2), 17–21.—Details are given of a chopper harvester, designed by Mr. JOE MIZZI and tested in the Ingham area of Queensland. Intended by the designer, a local cane grower, to handle green and burnt cane, the harvester has a number of noteworthy features which are described.

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**A new approach in cultivation of sugar cane for TSC farms.** ANON. *Taiwan Sugar*, 1972, **19,** 3–4.—The changes in agriculture and field practice brought about by increasing mechanization, especially harvesting, are discussed.

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**The improvement of cultivation conditions for successful growing of ratoon cane.** T. P. PAO. *Taiwan Sugar*, 1972, **19,** 5–11.—The purpose of the experiments described was to find a method or methods of improving ratooning under Taiwan conditions, long known to leave much to be desired. Soil water content proved to be specially important. Irrigation was more important than fertilizers which ranked second in importance.

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**Review and progress of chemical weed control for sugar cane in Taiwan.** S. Y. PENG. *Taiwan Sugar*, 1972, **19,** 12–17.—The combating of labour shortage in the Taiwan sugar industry has become all-important in recent years and herbicides are an effective weapon. Matters discussed include: herbicides for pre-emergence control; danger of indiscriminate use of 2,4-D; selection of pre-emergence herbicides for autumn- and spring-planted crops; herbicides for post-emergence control; herbicides for intercropped sugar cane; eradication of perennial weeds during fallow; sensitivity of growing cane to weed composition; effect of time of herbicide uptake by roots on cane tolerance of herbicides; use of a soil conservation agent ("Curasol AH") to protect cane intercrops against herbicides washed into furrows from field ridges by heavy rain; suspicion that herbicidal residues cause reduction in cane yield (unconfirmed); and improvement in ratoon yield by combined application of plant growth regulators and herbicides.

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**Report of a cane planter operated on Nanchow sugar mill farm.** S. T. KING. *Taiwan Sugar*, 1972, **19**, 18–20. Because of the inability to obtain enough seasonal labourers for cane planting, increased attention has been given to mechanization, especially of planting operations. Experiments with 5 different types of mechanical planter, one made by Nanchow sugar mill staff, are discussed. Suggestions are made for improvements of some of the machines and costs between manual and mechanical planting compared. These are shown in a table which presents a detailed analysis. Mechanical planting was cheaper than hand planting.

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**Studies on the chemical control of sugar cane flowering in Taiwan.** P. C. YANG, T. P. PAO and F. W. HO. *Taiwan Sugar*, 1972, **19**, 21–27.—The effects of "Reglone" and CMU applied by means of an automatic hand sprayer and aerial spraying on the cane varieties N:Co 310 and F 146 were evaluated. The application of "Reglone" at the rate of 0·75 litres/ha and CMU at 5·6 kg/ha, sprayed at the end of August and early September, produced the best results in flower control with the variety F 146. The variety N:Co 310 flowered little because of lodging caused by typhoons. It was concluded that chemicals can be used effectively to control cane flowering but that no substantial increase in sugar yield can be expected if the cane is harvested before February under the environmental conditions of Taiwan.

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**"No-plough" sugar cane farming being tested by TSC.** ANON. *Taiwan Sugar*, 1972, **19**, 33–34.—The phenomenal growth of industrial development in Taiwan during the last decade has resulted in greatly decreased labour supplies for the sugar cane industry. "No-plough" sugar cane farming is described as Taiwan's most revolutionary innovation in cane cultivation. It is currently being tested and successfully implemented at Peikang sugar mill plantation. After the harvesting of rice, the land was not ploughed or harrowed but was immediately mechanically planted to cane. Germination and growth compared favourably with other crops. Advantages of the method are listed under 8 headings. Two disadvantages are that root development in the subsoil is restricted (but could be overcome by subsoiling) and weeds are likely to grow more rapidly.

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**Sugar cane in the Vidarbha—Marathwada regions of Maharashtra.** J. R. KAKDE. *Sugar News* (India), 1972, **3**, (10), 6–12.—The prevailing climatic and soil conditions in relation to sugar cane cultivation are described. A map is supplied showing location of irrigated areas and of existing and proposed future mills.

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**Studies on the effect of lodging on sugar cane.** M. LAKSHMIKANTHAM, B. GOPALAM, K. L. RAO and N. N. V. V. P. RAO. *Sugar News* (India), 1972, **3**, (10), 15–17, 21.—The weight and sucrose content of lodged and of erect cane was studied at monthly intervals at the Anakapalle Sugar Research Station. Lodged cane showed, irrespective of variety, a steady decline in the mean cane weight from December to April. Erect cane was always richer in sugar than lodged cane. There was some varietal difference in the effect of lodging on juice quality.

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**Response of mid-season and late varieties of sugar cane to nitrogen.** O. SINGH and B. P. SINGH. *Indian Sugar*, 1972, **21**, 679–682.—The response of 4 sugar cane varieties to 4 levels of nitrogen was studied with a view to ascertaining the most profitable method for growers to adopt, having regard to costs. The two mid-season varieties were CoL 9 and Co 975 and the two late varieties Co 1148 and Co 1328. One cane variety, Co 975, gave greater increases in yield at all levels of nitrogen than did the other varieties, while CoL 9 gave the lowest yields. In all cases, yields and net profits were higher with the experimentally-found optimum than with the officially recommended lower level.

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**Incidence of stalk borer (*Chilotraea auricilius* Dudg.) in relation to the condition of the sugar cane crop.** Y. P. MADAN. *Indian Sugar*, 1972, **21**, 683–684.—This pest is a serious one in some places, as in the terai (wet belt) areas under cane in the U.P. Recently it has spread to some parts of Haryana and Punjab. It was found that cane showing poor growth was less likely to be attacked than cane of good growth. The cane variety Co 1148 was preferred by the pest to other varieties.

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**Studies on the utility of distillery effluent (spent wash) for its manurial value and its effect on soil properties.** P. D. BAJPAI and S. P. DUA. *Indian Sugar*, 1972, **21**, 687–689.—In view of the great need for additional nitrogen for cane growing in India, an intensive study was made of the value of distillery effluent (containing 0·1% N, 0·9% K and 0·2% P on dry basis) as a fertilizer when applied to cane. A table is given showing the chemical composition of distillery effluent or spent wash. It was concluded from trials that the diluted spent wash applied up to 200 kg N/ha increased sugar cane yields but higher doses had an adverse effect on yields and on available nitrogen in the soil. It needs to be judiciously applied to avoid damage to the cane crop.

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**Co 1053—a promising variety for Orissa.** K. C. MISHRA and K. C. PANDA. *Indian Sugar*, 1972, **21,** 691–693.—An account is given of this variety and its successful cultivation in Orissa where it is replacing existing varieties. It is a hard cane with profuse tillering ability, is high-yielding and resistant to red rot and smut. The canes are greenish yellow in colour with occasional green stripes.

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**Attack of scale insect, *Melanaspis glomerata* Green, on sugar cane in Delhi.** S. KUMAR, S. S. MISRA and S. K. PRASAD. *Indian Sugar*, 1972, **21,** 695.—Areas where this sugar cane pest is known to occur in India are listed. Punjab, Haryana, Rajasthan and Uttar Pradesh are areas so far considered free from attack. This note records the insect as a sugar cane pest in the Delhi region.

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**What happens when a sugar company takes up pig farming?** C. C. CATANAOAN. *World Farming*, 1972, **14,** (3), 6–8, 24.—The Taiwan Sugar Corporation's pig breeding project, involving about 310,000 pigs in 1971, is described and illustrated.

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**Better sugar cane burns with "Gramoxone".** ANON. *World Farming*, 1972, **14,** (3), 17.—For burning-off sugar cane trash before harvesting, "Gramoxone" has proved to be the best desiccant at present available according to experience in such countries as Hawaii, Mexico, Puerto Rico, Taiwan and elsewhere. As more and more cane is cut by machine it becomes even more important to get good burns prior to harvest. This means less trash to cut, load, transport and mill. It is early in the season that the value of "Gramoxone" is particularly noticeable.

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**Spring and fall planting.** I. S. RALSTON. *J.A.S.T.J.*, 1969, **30,** 18–21.—Planting practices on a 2900-acre estate, all of which is irrigated (400 acres by sprinkler), are discussed. Spring planting takes place during January–June while autumn (fall) planting is carried out in July–December, although there is no marked difference between seasons as in temperate-climate countries. Previously, two-thirds of the planting had been carried out in spring; this was increased to 85% with adverse results, and finally a planting ratio between the two seasons of 1:1 was adopted. Advantages of the latest scheme include the possibility of improving: land preparation, equipment utilization, supervision, deployment of labour and ratoon maintenance as well as seed material availability.

**Tractor maintenance and costing.** N. C. HYLTON. *J.A.S.T.J.*, 1969, **30,** 53–57.—It is felt that greater attention should be paid by cane estates to tractor economics. The seven basic factors affecting the economic life of a tractor which are considered are: initial cost, depreciation, operating costs, repair costs, down-time, increased cost of replacement and proper matching of implements to the tractor.

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**Transportation of sugar cane.** J. C. VAN GROENIGEN. *J.A.S.T.J.*, 1969, **30,** 104–108.—Cane transport on an estate is discussed and a number of factors involved in efficient transport organization considered. Four systems of cane handling in the factory yard are described, viz. the use of slings, side-dumping (chain-net system), side-tipping, and discharge from containers (which can also be left unemptied in the yard until required). The last two systems are regarded as ideal for chopped cane handling.

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**Hot-water treatment for mosaic and RSD control.** G. T. A. BENDA. *Sugar J.*, 1972, **34,** (10), 32–39.—The writer considers that the full potential of heat treatment for sugar cane diseases has not been fully realized. This paper describes a method for heat-curing virus diseases that uses a series of treatments. A treatment at lower temperature precedes one or more treatments at higher temperature, and each treatment is separated from the one that follows by an interval of a day. With certain combinations of treatments, it is possible to free the majority of setts from symptoms of sugar cane mosaic and ratoon stunting disease. It has not been possible, so far, to free all the treated setts from both. Results of experiments with different varieties are tabulated. (See also BENDA: *I.S.J.*, 1973, **75,** 48.)

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**An insecticide test to control the sugar cane beetle borer (Coleoptera: Curculionidae).** A. K. OTA and W. C. MITCHELL. *Hawaiian Planters' Record*, 1971, **58,** 147–158.—Owing to a combination of circumstances, the beetle borer or New Guinea sugar cane weevil (*Rhabdoscelus obscurus*) was causing excessive damage on the island of Kauai. An account is given of an attempt to control the pest with insecticides in an experiment using "Aldrin", "Dieldrin" and "Carbaryl" ("Sevin") applied as both granules and apple pomice bait. Both "Aldrin" and "Dieldrin" applied at a rate of 3 and 2 lb a.i. per acre, respectively, reduced borer damage for at least 9 months. However, beetle borer damage increased in the treated plots until it was equal to untreated plots at harvest. The insecticides did not adversely affect parasitism of the weevil larvae by the tachinid parasite, *Lixophaga sphenophori*, but "Aldrin" and "Dieldrin" reduced the population of the ant, *Pheidole megacephala*, which is known to feed on larvae and pupae of the weevil.

# Sugar beet agriculture

**The effect of N-P-K applied singly and in combination on the quality of sugar beet juice at different stages of growth in the Hyderabad region.** M. Slaeem and T. M. Choudhry. *West Pakistan J. Agric. Res.*, 1970, **8**, 141–151.—The study here reported was undertaken to investigate the possibilities of getting higher recovery and better quality juice under Hyderabad conditions. The experiments were carried out at the Agricultural College and Research Institute, Tandojam. It was concluded that the sugar beet with good quality juice may be grown successfully up to the end of April in the Hyderabad region, especially when adequately fertilized with N-P-K. With regard to optimum doses of N-K, P-K and N-P-K it is suggested that further research work should be carried out to ascertain the exact applications of nutrients required for getting the most economical return from standard varieties.

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**Studies on the effect of different rates and combinations of nitrogen, phosphorus and potassium on the yield and quality of sugar beet.** A. A. Khan, M. Athar, G. A. Shah and H. Rehman. *West Pakistan J. Agric. Res.*, 1970, **8**, 210–215.—It is stated that in recent years sugar beet has become the most important cash crop in the Peshawar Valley. In 1958/59 only some 700 acres were planted to beet, but by 1969/70 this had increased to 25,000 acres. Experiments at the Agricultural Research Institute, Tarnab, indicated that a combination of 90 lb N, 60 lb P (as $P_2O_5$) and 60 lb K (as $K_2O$) per acre gave the highest yield of various combinations tested, i.e. 743·29 maunds (approximately 37 tons) of beet/acre.

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**Developmental physiology of sugar beet. III. Effects of decapitation, defoliation and removing part of the root and shoot on subsequent growth of sugar beet.** D. K. D. Gupta. *J. Exp. Bot.*, 1972, **23**, 93–102.—Decapitation and subsequent removal of unfolding leaves of sugar beet plants at 2-, 4-, 14- and 31-leaf stages resulted in much greater growth of the remaining leaves, the effect being more pronounced the less advanced the leaves at the time of treatment. A two- or three-fold increase in area was accompanied by a five to six-fold increase in weight. Both treatments caused a transient increase in the rate of growth of the root. Removal of part of the shoot resulted in proportionately greater growth of that remaining, whereas removal of part of the root had no effect on the shoot unless it was reduced to one quarter. The change in the amount of shoot had no significant effect on the growth of the root, nor was there a compensating effect on the growth of the remaining root after more than one half of it had been removed.

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**Developmental physiology of sugar beet. IV. Effects of growth substances and differential root and shoot temperature on subsequent growth.** D. K. D. Gupta. *J. Exp. Bot.*, 1972, **23**, 103–113.—Results are discussed of the effects of three growth substances (indolyl acetic acid, gibberellic acid and kinetin) and of differential shoot and root temperatures on growth of sugar beet plants. The growth substances were applied in aqueous lanolin at different concentrations (50 ppm to 5000 ppm) to decapitated sugar beet plants at the 8-leaf stage, one group also having alternate leaves removed. The growth substances significantly increased the dry weight of the plants when all the leaves were present, which was mainly explained by the large increase in roots. Combinations of root and shoot temperatures were imposed on plants decapitated at the 8-leaf stage. When all the leaves were present, growth rate was maximal at shoot temperatures of 17°C and root temperature of 25°C. With alternate leaves removed maximum root growth occurred at shoot and root temperatures of 25°C.

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**Herbicidal activity of chloroacetamides and pyridazinones on sugar beets and weeds.** E. E. Schweizer. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 359–368. Herbicides currently used for sugar beet in the western United States include "Cycloate", "Diallate", "Pyrazon" and "Endothal". Complete control has been difficult because of the diversity of weed species that may infect beet fields, belonging to several different families and two of them (*Chenopodium album* and *Kochia saponaria*) belonging to the same family as sugar beet. There is need for herbicides that will control a broader spectrum of annual weeds when herbicides are incorporated with the soil or applied to the soil surface. In investigations which are described, the chloroacetamides controlled foxtail millet the best, whereas the pyridazinones were more effective against common lambs-quarters and wild buckwheat. Both groups of compounds controlled pigweed effectively, but not *Kochia*. The herbicides BAS 2430 and "Delachlor" surpassed the standard herbicide "Cycloate" in reducing the average stand of all five weeds.

**Effect of agronomic and storage practices on raffinose, reducing sugar, and amino-acid content of sugar beet varieties.** R. E. Wyse and S. T. Dexter. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 369–383.—Results of this work stressed the importance of temperature in affecting the development or accumulation of non-sucrose products. Less than ideal storage practices were found to have a much greater effect on the chemical composition of beets with the exception of the amino-acid content than did agronomic practices. In beets stored at various temperatures, varieties differed considerably with respect to the level of raffinose, reducing sugars, and amino-acids in the clarified juice. Since these compounds make up the major proportion of the non-sucrose constituents of the clear juice, it would appear that the level of these impurities could be controlled through variety improvement and proper agronomic and storage practices.

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**Techniques for evaluating sugar beet for resistance to** *Cercospora beticola* **in the field.** E. G. Ruppel and J. O. Gaskill. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 384–389.—A successful method for uniformly infecting sugar beet fields with leaf spot (*Cercospora beticola*) in order to test resistance of new varieties is explained. This has been done because so many requests have been received about the method, which is notable for its simplicity, reliability and low cost. Viability tests indicated only 2% spore germination in the stock suspension, whereas 49% of the spores germinated in a more dilute inoculum.

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**Source of recoverable sugar losses in several sugar beet varieties during storage.** R. E. Wyse and S. T. Dexter. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 390–398.—The recoverable sugar per ton (RSPT) of beet was determined at harvest and after 130 days' storage for five varieties treated with 24 and 150 kg nitrogen/acre during growth. The effect of N on storage losses differed widely between varieties, but in general RSPT loss was greater with the smaller N application. On average, 65% of the RSPT reduction was due to direct loss of sucrose (through respiration and conversion to compounds not found in clear juice), while the remainder was due to impurity accumulation in factory juice. The impurity content was the same quantitatively at 3° and 10° storage temperature, but qualitatively there was marked difference: raffinose accounted for 34% of the total impurities after 100 days at 3°C, whereas at 10°C reducing sugars, amino-acids and other unknown impurities predominated.

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**Impurity index selections on individual sugar beets.** G. K. Ryser and J. C. Theurer. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 399–407.—In work carried out at two centres in Utah (Logan and Farmington) the merit of utilizing an economical and easy method of individual sugar beet selection for high and low sugar content and high and low impurity index was evaluated. Recurring selections, made by use of Mendelian male sterility as a crossing tool, resulted in positive selection pressure for all factors studied. Self-sterile progenies, selected on an individual beet basis, gave varied results, probably as a result of inbreeding and fixing of the genes. Progress in the direction of low quality selection was easier to accomplish than was selection toward high quality. The impurity index was an effective breeding tool for improving the beet quality of a line, while maintaining high sugar content.

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**The influence of root zone temperature on phosphorus nutrition of sugar beet seedlings.** K. M. Sipitanos and A. Ulrich. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 408–421.—It has been previously established that the period of phosphorus deficiency normally occurs very early in the life of sugar beet plants. Low soil temperatures prevail at the seedling stage. Pot experiments are here reported where soil temperatures were maintained at 5, 10, 15, 20, 25 and 30°C by means of thermostatically-controlled water baths. Four phosphorus treatments were replicated six times. Temperature greatly influenced seedling emergence, the optimum temperature being about 25°C. Phosphorus fertilization had no effect on emergence except at 5°C. There appeared to be a plant age factor in considering sugar beet seedling response to phosphorus fertilization.

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**A plot seeder for sugar beet field experiments.** I. O. Skoyen and J. S. McFarlane. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 422–427.—A seed drill adapted to sowing sugar beet seed nurseries and variety trials is described and illustrated with photographs. It was developed at the US Agricultural Research Station, Salinas, California. Cone-fed units were attached to commercial seeders and equipped with sprocket combinations to permit the sowing of various size plots up to 86 feet long. Seeder frame construction provided seating for operators and permitted simple adjustment for different bed or row spacings.

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**Boron nutrition in the growth and sugar content of sugar beets.** J. Vlamis and A. Ulrich. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 428–439.—This study was made to determine the growth, boron content of the tissues and sugar production of sugar beet plants grown in nutrient solutions covering a wide range of boron supply. The first signs of boron deficiency appeared within a week in the treatments where no boron was added. The growing point of the shoot and root failed to grow and the plant remained stunted. Other boron deficiency symptoms are described. The mature blades were found to be the most suitable tissues for assessing the boron status of sugar beet plants. The blades had a higher boron content than the petioles where the boron supply was adequate but this relation was reversed in the deficient plants.

**Prevention and control of fungal root diseases of young sugar beet plants.** W. R. SCHÄUFELE and C. WINNER. *Zucker*, 1972, **25**, 153–156.—Modern methods of cultivation and sowing to an extremely thin stand have greatly increased the risk of loss through young plants being attacked by root diseases. The environmental conditions which influence the level of infection are described. The early protection of young plants from root or soil fungi may be obtained by dressing the seed, but this is normally only effective locally and for a limited period.

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**Important aspects of sugar beet cultivation in Sriganganagar, Rajasthan.** N. MUKERJI. *Indian Sugar*, 1971, **21**, 565–568.—A general account is given of the extended sugar beet cultivation now taking place in the area. It is pointed out that as difficulties or problems arise, such as those from pests and diseases, it is important that they be dealt with or remedied promptly, otherwise the peasant cultivators who raise the beet are likely to be discouraged or lose interest in the new crop.

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**Observations on seed beds for sugar beet.** E. DALLEINNE. *Hautes Etudes Betterav. Agric.*, 1972, **4**, (14), 7–13.—The various soil factors concerned with the successful germination of sugar beet seed are discussed. Special emphasis is given to the deleterious effects, on germination, of compaction of the soil as caused by the wheels of heavy vehicles.

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**Regarding irrigation.** M. ROBELIN. *Hautes Etudes Betterav. Agric.*, 1972, **4**, (14), 24–29.—Crop irrigation has, of course, been practised from the earliest times. Since sugar beet is primarily a temperate climate crop, it is only in exceptional dry seasons that irrigation is likely to prove really beneficial. But in other warmer regions, where rainfall is minimal, irrigation may be essential for good sugar beet crops. Various aspects of sugar beet irrigation are here discussed, especially spray irrigation.

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**The cultivation of sugar beet in Spain.** R. J. ALVAREZ. *Hautes Etudes Betterav. Agric.*, 1972, **4**, (14), 34–39. A summary is given of the history of sugar beet cultivation in Spain, which commenced in 1878 in the provinces of Granada and Córdoba. Present day cultivation and production in the various beet producing areas of the country are then discussed. During the last decade the area devoted to sugar beet has greatly increased (by over 30%). There has been a similar increase in the per caput consumption of sugar in Spain during this period. The varieties of sugar beet at present cultivated are listed and some of the modern machinery used in harvesting in Spain illustrated.

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**Combating weeds by chemical means.** ANON. *Supplement to Betterav. Franç.*, 1971, (230), 20 pp.—The main weeds of sugar beet in France are listed under their French names (without scientific names) along with notes on their importance in beet cultivation and their sensitivity to various herbicides. The herbicides described and discussed include: "Pyramine", "Venzar", "Avadex", "Ro-neet", CL85, "Betanal" and mineral oil. The grass or monocotyledonous weeds are considered separately from the broad-leaved or dicotyledonous weeds.

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**Influence of inoculation date on expression of beet western yellows tolerance in twelve sugar beet varieties.** G. I. MINK. *Plant Disease Reporter*, 1972, **56**, 93–96. This disease is the major form of yellowing in Washington and other parts of the USA. Inoculation experiments with 12 varieties of sugar beet are described. It was found that the varieties could be separated into two groups based on level of total sugar loss resulting from the inoculations. Group 1 showed little or no disease tolerance when infected early but appeared tolerant when infected late. Group 2 showed little or no measurable tolerance regardless of the date inoculated. There was no apparent correlation between rate of symptom development and effects on sugar yield.

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**Production of sugar beet in Poland.** H. W. BYSZEWSKI. *Sucr. Belge*, 1972, **91**, 139–145.—Poland has about 400,000 hectares devoted to sugar beet, mainly in the form of small farmer's holdings (under 0·6 ha). Various technical, economic and social aspects of sugar beet production in the country are presented. Cultural methods at present practised are discussed and a broad outline given of selection and the production of Polish sugar beet varieties. There are 1120 regional reception centres for the crop. There are many complex problems of handling, transport and storage.

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**The fight against *Cercospora* disease of sugar beet in Turkey in 1970 with new systemic fungicides.** M. GÖBELEZ. *Sucr. Belge*, 1972, **91**, 151–153.—The fight against *Cercospora* disease of sugar beet in Turkey in 1970 with new systemic fungicides is discussed. The efficiency of tin-based fungicides was compared with the newer systemic fungicides "Benlate" and "Enovit". A double treatment with them was more profitable than a triple treatment with the tin-based fungicide. There was no notable difference in beet yield, but polarization was affected.

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**Changes in sugar beet caused by γ-irradiation of seed.** M. P. FASULO, G. MANTOVANI, G. DALL'OLIO, M. BERTI and G. PANCALDI. *Zucker*, 1972, **25**, 247–256. Experiments were carried out to determine the effects of varying doses of irradiation in the range 250–50,000 rads on the seed of two diploid beet varieties, one a high-yielding and the other a high-sugar variety. Investigations of the morphology of pot- and field-grown plants, of root histological structure and of the caused marked damage, while the effects of smaller doses varied and could not be clearly described.

**Variation among Washington isolates of beet western yellows virus.** A. AAPOLA and G. I. MINK. *Plant Disease Reporter*, 1972, **56**, 198–202.—Thirty-two field isolates of beet western yellows virus (BWYV) were tested for their ability to infect 9 plant species. Sugar beets and shepherds' purse (*Calsella bursa-pastoris*) were infected by all 32 isolates. The other plants, mainly weeds, were affected by some of the isolates, varying from 3 to 28. Differences were found in the behaviour of some isolates from different geographical areas. In further tests, 9 isolates failed to infect one or both sugar beet varieties. Most produced slight stunting and reductions of top weight. Greatest variation occurred in root weights. Only one isolate significantly reduced root growth. There was no apparent correlation between origin of the isolates and effect on plant growth.

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**The incidence of sugar beet seedling diseases and effects of seed treatment in England.** W. J. BYFORD. *Plant Pathology*, 1972, **21**, (1), 16–19.—On average, 180 samples of sugar beet seed grown in England between 1958 and 1970, and examined before being steeped in ethyl mercuric phosphate (EMP), had 39% of clusters infected with *Phoma betae*. However, the fungus damaged few seedlings in commercial crops because this treatment controlled it. In 1969 *Aphanomyces* sp. was unusually prevalent in sugar beet crops. Treating EMP-steeped seed with a protectant fungicide did not, on average, significantly increase seedling emergence or final plant stand. It was concluded that the general use of protectant fungicides on sugar beet seed in England could not be justified. A method of soil treatment at drilling should be sought for use in fields where there is a special risk of soil-borne seedling disease, especially with late drilling in soil containing *Aphanomyces*.

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**Interpreting the rate of change in nitrate-nitrogen in sugar beet petioles.** J. N. CARTER, M. E. JENSEN and S. E. BOSMA. *Agronomy J.*, 1971, **63**, 669–674; through *Soils and Fertilizers*, 1972, **35**, 218.—Sugar beet was grown at 4 fertilizer rates and 2 irrigation levels to determine root yields, sucrose percentage, sucrose yield and N uptake in relation to $NO_3$-N concentration. The $NO_3$-N in the petioles increased to a peak concentration and then decreased during the growing season. The "rate of change approach" could be used to predict N needs of sugar beet and to characterize the N status of the soil crop system.

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**Effect of soil cultivation on development and yield of sugar beet (Experimental results 1968-70).** A. VEZ and P. VULLIOUD. *Mitt. Schweiz. Landwirt.*, 1971, **19**, (9), 161–170; through *Soils and Fertilizers*, 1972, **35**, 218. Three-year trials showed that sugar beet on medium to heavy soils benefited most (high emergence and yield) from autumn ploughing. Ploughing in the spring, especially on heavy soils, resulted in heterogeneous soil structure (owing to compression by tractor wheels), unfavourably affecting the emergence and quality of the beet; subsequent disc harrowing minimized the harmful effects of late ploughing on soil structure without improving emergence very much. Ploughless cultivation of sugar beet was not promising, as it generally resulted in lower yields and poorer quality of beets.

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**Effect of nitrogen fertilization on the nitrate nitrogen of petiole and its relation to root yield of sugar beet.** M. C. SAXENA, K. V. PARMESWARAN and A. JOSEPH. *Indian J. Agric. Sci.*, 1971, **41**, 206–209; through *Soils and Fertilizers*, 1972, **35**, 219.—Sugar beet, which was growing in a silty loam, was fertilized with N at various levels, either all at planting or part applied subsequently. Petiole $NO_3$-N contents generally decreased with age. N fertilizing significantly increased petiole $NO_3$-N content at all stages and the differences between N rates were greatest 120 days after planting. Petiole $NO_3$-N at 120 days was greatest in treatments receiving part of the N application as a top dressing. The best correlation of petiole $NO_3$-N content with root yield was obtained at 120 days.

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**Effect of lithium on growth, salt absorption and chemical composition of sugar beet plants.** A. M. EL-SHEIKH, A. ULRICH and T. C. BROYER. *Agronomy J.*, 1971, **63**, 755–758; through *Soils and Fertilizers*, 1972, **35**, 219.—Sugar beet plants were grown in a greenhouse with two K concentrations and lithium at 0·25 and 8·0 meq/litre. Li was detrimental to sugar beet growth at very low concentrations, especially to fibrous roots under low K conditions. Li toxicity induced yellow colouring of the leaf margins. The concentration in plant tissues was low, partly owing to low Li uptake, and increased with leaf age. Li induced an increase in K concentration and a decrease in Ca concentration in the plant, especially in mature and old leaves. Li was readily absorbed until the K in the nutrient solution was depleted.

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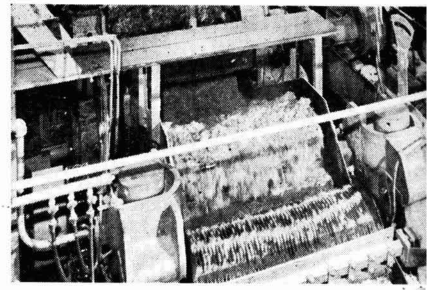
**Experiences in the application of herbicides and insecticides in a reduced amount of water to sugar beet.** F. LÖCHER. *Zucker*, 1972, **25**, 292–295.—In the experiments described, various soil-acting herbicides ("Pyrazon", "Diallate", "Triallate") and one insecticide ("Dimethoate") were tested with different amounts of liquid (50–400 litres/ha). The efficiency of "Pyramin" was not influenced by the reduction in the amount of liquid per ha, but with "Diallate" a clear reduction in efficiency was observed with 50 litres/ha. The insecticidal effect was not altered by the amount of spray mixture. With the reduced amounts of spray mixture, drift increased markedly, especially with 50 and 100 litres/ha. It is considered that in practice not less than 100–150 litres/ha of spray mixture should be used. Trials also showed that with different active ingredients the amount of spray mixture may not be reduced to the same extent.

# Cane sugar manufacture



**The Louisiana sugar industry.** G. J. DURBIN. *Sugar y Azúcar*, 1972, **67**, (6), 33–34.—A brief survey is presented on cane agriculture and sugar production in Louisiana.

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**The Florida sugar industry's outlook for the 1970's: continued growth with stability.** J. N. FAIRBANKS. *Sugar y Azúcar*, 1972, **67**, (6), 35–37.—Prospects and problems facing cane growing and sugar production in Florida are discussed.

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**Milling.** M. ANAND. *Sugar News* (India), 1972, **3**, (12), 4–9, 22–26.—The subject of cane milling is examined, including advantages of the inclined mill, mill drives, roller speeds, hydraulics, roller groovings, imbibition and sanitation.

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**Further work on fondant seeding and boiling of final massecuite.** T. C. JHINGAN and S. C. ARORA. *Sugar News* (India), 1972, **3**, (12), 27–30.—The use of a ball mill for seed slurry preparation has led to improvements in *C*-massecuite boiling and curing at the authors' factory. The practices used and results obtained are discussed.

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**Reclamation of continuous centrifugal screens.** J. P. MUKHERJEE and K. CHETTY. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.11–E.12.—See *I.S.J.*, 1973, **75**, 115.

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**Observations on the use of steel tubes in juice heaters.** K. P. MITTAL and A. PRAKASH. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.13–E.16. Tabulated data indicate no adverse effects on raw and sulphitation juice of steel tubes used in juice heaters instead of brass tubes.

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**Some aspects of steam turbine operations.** R. K. SIRDESHMUKH. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.17–E.22.—Advice, based on the author's experience, is given on factors to be considered regarding steam conditions and layout of steam piping for the satisfactory operation of a steam turbine in a generator plant.

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**Studies on cane diffusion.** D. P. KULKARNI and J. R. UNDE. *Proc. 4th Joint. Conv. Indian Sugar Tech. Assocs.*, 1971, E.23–E.38.—Laboratory data showed that diffusion extracted more soluble impurities from bagasse than did milling. Factory data for a mill plus DDS diffuser showed that the increases in CaO and ash contents from primary to mixed juice were greater than with milling alone but the latter extracted more gums and colloidal matter. Optimum diffusion temperature at which soluble impurity extraction was minimum was 65–70°C. Reducing sugars and ash contents were minimum and juice purity maximum at pH 6, although colour was minimum at pH 4–5, after which it increased with pH rise.

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**Facts about continuous centrifugals.** J. P. MUKHERJI, A. C. CHATTERJEE and S. S. GANGAVATI. *Proc. 4th Joint Conv. Indian Sugar Tech. Assoc.*, 1971, E.43–E.50.—See *I.S.J.*, 1973, **75**, 54.

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**An improvement in juice heaters and the process of heating juice therewith.** J. P. MUKHERJI, A. C. CHATTERJEE, C. SHYAMSUNDER and B. A. BHAGWAT. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.51–E.60, E.93–E.99.—Details are given of a "dynamic" juice heater in which the steam/vapour flow arrangement is such that there is positive flow and minimum condensation, heat transfer is better than in a conventional heater and steam consumption is lower for the same effective heat exchange area.

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**The continuous cane diffusion system "Nandi".** B. L. MITTAL. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.61–E.65.—A description is given of a patented cane diffuser design (the "Nandi") which consists of a horizontal rotary drum containing a scroll fitted with perforated screens and vanes fixed to the interior drum wall. The bagasse flows against the extraction liquid (water and thin juice from dewatering mills), heating being effected by low-pressure steam. Pilot-scale trials are to be carried out.

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**Observation on the working of a De Smet diffuser.** B. NARAYANARAO, K. BRAHMANANDAM and K. PATCHAPPALAM. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.67–E.76.—Performance data are presented for the De Smet diffuser at the Tanuku sugar factory of Andhra Sugars Ltd. Covering the second season of the diffuser's operation, they indicate greater extraction of sugar but not non-sugars. The problem of uneven bagasse discharge was overcome by modifications to the discharge scraper. Considerable reductions in the crushing rate had no adverse effect on diffusion. Other advantages are mentioned.

**Chemical cleaning and water conditioning for boilers in sugar industries.** A. K. BASU. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.77–E.79 —Boiler feedwater treatment is discussed and chemical cleaning and off-season protection of boilers using products of A1 Industries, of Bombay, are described.

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**Free floating of mill top rollers.** N. S. BHAT. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.81–E.83.—To reduce friction causing wear of upper brasses and mill housing when mill top rollers were free floating, the author introduced needle-type roller bearings between the feed side faces of the brasses and the mill housing, thereby replacing sliding friction with rolling friction.

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**Chemical cleaning of industrial equipment.** P. K. CHHEDA. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.85–E.92.—The pros and cons of chemical *vs.* mechanical cleaning of various types of vessels in the sugar factory are discussed and chemical descaling using products of Ashok Industries is described.

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**Bagasse saving.** K. R. PUNDIR. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.101–E.111.—See *I.S.J.*, 1970, **72**, 338.

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**The concept of manufacture of bold grains in sugar factories.** D. R. PARASHAR. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.1–M.6.—See *I.S.J.*, 1972, **74**, 247.

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**Influence of imbibition on recovery as observed in New Horizon Sugar Mills Private Ltd. during the season 1970-71.** L. C. BANERJI. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.7–M.9—It was found that sugar recovery % cane tended to fall (by 0·4–0·6% absolute) when imbibition was reduced from 20–25% to 15–18% on cane, best results being obtained generally about the 25% level.

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**Total purity loss—true index of boiling house efficiency.** B. S. GURUMURTHY. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.11–M.19.—Data and sample calculations of boiling house efficiency in terms of total purity loss (virtual molasses purity)[1] are presented to demonstrate the validity of the concept.

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**Virtual purity of molasses—the concept and its utility.** T. T. OOMMEN and B. S. GURUMURTHY. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.21–M.28.—See *I.S.J.*, 1971, **73**, 92.

**A case of entrainment.** K. K. RAO. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.29–M.32. Causes of entrainment in the last vessel of a quadruple-effect evaporator and how the problem was solved are discussed.

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**Different systems for cleaning of evaporators and their merits and demerits.** S. SRINIVASAN. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.33–M.41. See *I.S.J.*, 1971, **73**, 180.

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**Use of surface-active additive chemicals in low-grade massecuite boilings.** S. SRINIVASAN and T. S. THIYAGARAJAN. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.43–M.47.—Despite a lower purity drop in low-grade boiling and massecuite cooling, lower molasses Brix and purity and higher purity *C*-sugar when "Cutol" surfactant was used compared with "Instol" and with the absence of a surfactant, "Instol" is considered preferable for a number of reasons, including shorter boiling and purging times and better handling of massecuite. Addition of triple superphosphate to clarified juice was found to contribute to better molasses exhaustion.

* * *

**Continuous filtration in a carbonatation sugar factory.** U. P. SINGH and R. K. GUPTA. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.49–M.57.—The performances of a Dorr-Oliver 3-tray clarifier and Oliver belt filter used for 1st carbonatation juice treatment at Mawana factory are reported, and comparison made with the results of filter-press operation. The rotary filter cake had a pol content of 0·4–1·6% compared with 3–35% in the filter-press cake. Clarifier overflow had a suspended solids content of 0·2–0·4%.

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**Studies on the working of Grand Pont filters in carbonatation sugar factories.** N. K. SAWHNEY. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.59–M.65.—Grand Pont filters, manufactured under licence by Triveni Engineering Works Ltd., have been installed at Ramkola sugar factory for continuous 2nd carbonatation juice treatment. Their operation and performances are discussed and their advantage over plate-and-frame filters listed. Filtrate from the Grand Pont filters is clear and free of haze. Use of the filters for 1st carbonatation juice treatment, with rotary filters to handle the muds, is considered practical.

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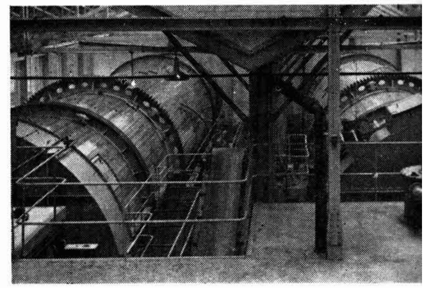
**A method for calculation of net gain in recovery on installation of a diffuser in cane sugar factories.** S. K. GOEL. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, M.193–M.199.—The method described has been applied to results at a particular factory and shows that sugar and non-sugar extraction was greater in diffusion than in milling, although there was a net gain in sugar recovery of 0·356% on cane.

[1] *I.S.J.*, 1971, **73**, 92.

# Beet sugar manufacture



**Automatic control of 1st carbonatation juice clarifier operation based on juice quality parameters.** A. M. Bunyak, V. P. Koval'chuk and I. I. Gritsenko. *Sakhar. Prom.*, 1972, (5), 26–30.—A system, which has proved satisfactory in factory trials, is described which is based on measurement of juice turbidity in the vertical zone between clarified juice above and mud suspension below. With a fall in turbidity caused by downward mixing, the mud discharge port is closed until re-establishment of required conditions.

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**Sharpening beet slicer knives in tempered form with discs of very hard materials.** A. D. Baglyuk. *Sakhar. Prom.*, 1972, (5), 31–33.—A unit constructed by the author for beet slicer knife sharpening with diamond or cubanite discs is described and the resultant high cossette quality discussed.

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**Evaporator boiling-out without clarifier liquidation.** A. P. Lapin. *Sakhar. Prom.*, 1972, (5), 33–34.—At the author's factory the evaporator is boiled out during 6·5–7 hr but the clarifiers are not liquidated, formalin being added to the juice every 2 hr; filtrate from the mud filters and muddy suspension are recirculated to the clarifiers.

* * *

**Improving the control of low-grade massecuite crystallization.** I. N. Akindinov. *Sakhar. Prom.*, 1972, (5), 35–37.—Expressions are given for calculation of permissible massecuite purity and Brix at the end of cooling. Sample calculations are presented and some calculated results tabulated.

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**Mixtures of liquid sugars and starch hydrolysates and their use.** C. Krüger and W. Steinmetzer. *Zucker*, 1972, **25**, 356–360, 396–401.—The applications of liquid sugar mixtures and their advantages and disadvantages are discussed, and references made to the literature and experiments regarding discoloration in storage, solubilities of various types of sugar in syrup mixtures, mixture viscosities, equilibrium relative humidity of mixed syrups and their microbiological stability as well as their effects in sugar-containing foodstuffs.

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**Calculation of uniflow drum dryers by means of transfer units.** W. Poersch and P. Thelen. *Zeitsch. Zuckerind.*, 1972, **97**, 311–319.—It is shown how the dimensions of a drum dryer can be calculated with the aid of a computer from the number and length of the transfer units as in distillation and absorption calculations. The theoretical considerations are discussed and the effects of changes in operating conditions examined, with a beet pulp dryer as example, using processed data to simulate the course of each drying stage 1.

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**The dependence of technological criteria—alkalinity, molasses sugar and juice purity—of sugar beet on location-related and modifiable production factors.** A. Graf. *Zeitsch. Zuckerind.*, 1972, **97**, 320–324. Beet yield, Na, K, amino-N and sugar contents, juice alkalinity and purity, molasses sugar and beet sugar yield are tabulated to show the effect of year, growth area, climatic conditions, soil factors (type, heaviness and $P_2O_5$ and $K_2O$ contents), N fertilizing and variety. The aim is to demonstrate the number of beet quality factors which can be controlled by modifications in beet growing and physiology.

* * *

**Decomposition of predefecation mud during raw juice liming.** K. D. Zhura, S. S. Miroshnichenko and S. P. Olyanskaya. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 85–88.—Laboratory tests showed that at 50°C the albumin in predefecation mud starts to decompose and the amino-N content rises, the effect increasing with temperature and time, although the process is most pronounced in the first 60 min.

* * *

**Effect of boiling point on colour change in sugar solutions.** M. A. Geishtovt, L. P. Maiorova and V. V. Maiorov. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 89–91.—Experiments with a test plant showed that under otherwise identical heating conditions, the colour rise in thick juice with time of evaporation was smaller with forced circulation than with natural circulation. Empirical equations are presented which relate the colour rise to time at constant Brix and thus permit approximate calculation of the permissible juice residence time.

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**Effect of number of recirculation cycles on massecuite density in continuous boiling.** I. S. Gulyi and N. M. Fedotkin. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 138–143.—A series of equations based on the recirculation theory is presented for use in analysing the continuous boiling process and calculating massecuite Brix as a function of the number of times the massecuite is circulated through the downtake and risers.

**Sugar crystallization rate during low-grade massecuite boiling with cutting.** M. I. DAISHEV and N. A. LYUSYI. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 185–186.—An equation is presented for calculation of crystallization rate between cuts as a function of massecuite purity in low-grade boiling. Using massecuite cutting has been found to give crystals having the same sizes as crystals in 2nd massecuite in a 3-boiling scheme. At an initial purity of about 84 no false graining was observed in tests.

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**NVI-L-1000-03 centrifugal for sugar.** M. I. IL'IN *et al.* *Sakhar. Prom.*, 1972, (6), 11–15.—Details and some performance data are given of the Soviet NVI-L-1000-03 continuous centrifugal which has a 2nd massecuite throughput of 15 tons/hr in a basket of 1000 mm diameter. The machine can also be used for affination.

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**Efficient types of batch vacuum pans.** L. G. BELOSTOTSKII and YU. D. KOT. *Sakhar. Prom.*, 1972, (6), 19–22.—The VAMTs-600 Soviet-designed vacuum pan is described and its advantages discussed. This so-called "multi-sectioned" pan has a series of annular elements, made of rectangular-section tubing, above a conventional calandria, the upper heating elements coming into operation only when the massecuite level rises above the calandria.

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**Experience in the use of beet slicers.** M. I. RYBALKIN. *Sakhar. Prom.*, 1972, (6), 22–23.—The author calls for greater attention to cossette length and quality than is being paid in many Soviet sugar factories and gives advice on slicer operation and knife maintenance.

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**Nomogram for establishing optimum conditions of regenerating strongly acidic cation exchange resins with sulphuric acid.** V. N. BELOUS and K. P. ZAKHAROV. *Sakhar. Prom.*, 1972, (6), 24–27.—A nomogram, based on demineralization experiments with green syrup, is presented and its use to find optimum regeneration conditions explained. A graph is also given showing the number of regeneration stages from 1 to 5 which is recommended according to acid concentration and consumption.

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**Determination of the cross-section area of evaporator circulation tubes.** B. A. MATVIENKO. *Sakhar. Prom.*, 1972, (6), 28–33.—Empirical equations and graphs are given for calculation of the minimum area of cross-section of evaporator circulation tubes at which optimum technological conditions are maintained. Satisfactory agreement was found between results calculated with the formula and experimental values of the ratio between the areas of cross-sections of circulation and boiling tube sections under optimum conditions.

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**Examination of entrainment characteristics of evaporators.** D. A. STOLYAR and N. YU. TOBILEVICH. *Sakhar. Prom.*, 1972, (6), 34–36.—Factors leading to entrainment in evaporators are examined on the basis of data obtained from an experimental unit, and graphs relating entrainment to juice level and steam rate are presented. A formula is derived which permits evaporator throughput to be calculated at a given permissible entrainment level.

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**Coagulation of organic matter by lime in beet juices in the presence of calcium carbonate.** J. VAŠÁTKO, A. DANDÁR and L. ZÁVODSKÝ. *Sucr. Belge*, 1972, **91**, 235–242.—Laboratory tests with a sucrose solution containing added albumin to which calcium carbonate and milk-of-lime were fed in controlled quantities showed that the improvement in coagulation was brought about by two distinct reactions: fixing of the colloids on the carbonate crystals in conformity with the law of adsorption, and the formation of insoluble $(CaO)_n$-$(CaCO_3)_m$ compounds having a stability governed by the quantity of $CaCO_3$ and reducing the reaction between sucrose and lime.

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**Experiments on oil firing of a lime kiln.** D. E. ASH. *Paper presented to the 21st Tech. Conf., British Sugar Corp.*, 1972.—Because of threatened supplies of coke for limestone burning, tests were made with oil firing of a standard "Belgian" kiln at Peterborough factory during the 1971 off-season. The installation is described and an account given of the three tests. The main difficulty in the first two was fusion of limestone in the burner quarls which badly affected combustion. Modifications were made to the quarls for the third test, gas recirculation was introduced and the fuel water content increased to 50%, while additional thermocouples were fitted for recording more information during the test. Loading and firing were to be carried out at 600°C, afterwards rising slowly to 650–700°C. Adjustment of the firing rate and water content, temperature, etc., followed during the test and the % calcination data are recorded. Burning was even and controlled, and the kiln lining undamaged. Although calcination was not as great as with coke, this was compensated by the lower cost of the oil fuel.

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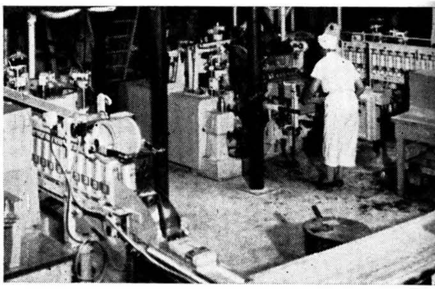
**Applications of powder technology in sugar handling.** J. MATHER. *Paper presented to the 21st Tech. Conf., British Sugar Corp.*, 1972.—The literature contains much information on the properties of solids in powder form—including sugar—but this has not previously been assembled. The author reviews the properties of sugar in respect of factors which may be used for theoretical design of bulk handling equipment and bulk storage plant; these include the primary properties (temperature, moisture content, particle size analysis, crystal density, concentration and previous history) and the secondary properties dependent on these (angular properties, pneumatic conveying properties, bulk density, packing characteristics, permeability, explosive properties and Jenikes flow function and cohesion).

# Sugar refining



**Some aspects of the pore structure of carbonaceous adsorbents.** C. C. Chou. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 16–27.—Measurements of N sorption isotherms at —195°C, adsorption of cetyl trimethyl ammonium bromide from aqueous solution, oxidation of the carbon in adsorbents and retention of sucrose on adsorbent contacted with 60°Bx pure solution were used to examine the pore structure of carbonaceous adsorbents. It was found that an activated condition is necessary for the entry of an adsorbate molecule into the so-called "ink bottle" type of pore, the "activated entry" effect being used to explain the mechanism of sucrose retention which is mainly a pore-filling process. Pore blockage is responsible for adsorbent deterioration in service.

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**Use of chloride electrodes in refinery control.** P. Pommez and S. Stachenko. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 82–102.—Since chloride was found to be the constituent most removed (about 90%) in raw sugar affination and there was little variation in the quantity removed from raws of different origins, measurement of $Cl^-$ was chosen as a means of determining affination efficiency. Tests with a solid-state ion-selective chloride electrode paired with a silver-silver chloride reference electrode are described. Response of the electrode to changes in chloride concentration depended on temperature, Brix and liquor flow conditions around the electrode. Measured values were always higher than and not as accurate as values obtained by potentiometric titration with silver nitrate, but the latter is too time-consuming for on-line determination. Further studies are to be made using differential techniques. Measurement of potassium or sodium instead of chloride entails the use of flame photometry and possible interference, although the possibility of using selective electrodes, if available, is mentioned.

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**The rate of reaction of synthetic colorants and resinous adsorbents.** J. E. Rader and R. E. Anderson. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 114–124.—Studies are reported in which model colorants (caramelized sucrose, melanoidins and alkaline degraded fructose) were treated with each of four resinous adsorbents. It is shown that the percentage decolorization with time was governed by the nature of the colorant and the adsorbent structure, so that no one adsorbent would be capable of removing all the colorants in a sugar solution.

**Chemical losses of sugar in cane raw sugar processing.** Kh. Kh. Fai and S. Z. Ivanov. *Sakhar. Prom.*, 1972, **46**, (2), 14–16.—Investigations at a refinery have shown that in calculating the losses in boiling as a proportion of the total factory undetermined losses, the value obtained will be exaggerated if no allowance is made for the fact that the quantity of sugar in the pan increases gradually, i.e. the total amount in each strike is not subjected to heating throughout the entire boiling period. Reducing sugars adversely affect the thermal stability of sugar by reducing the product pH. No relationship was found between product purity and buffering capacity which is affected by non-sugar quality as well as quantity.

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**Raw sugar treatment in beet sugar factories with recycling of some of the green syrup to purification.** M. I. Daishev and I. F. Golubov. *Sakhar. Prom.*, 1972, **46**, (2), 17–20.—A major problem in inter-campaign processing of raw sugar at Soviet beet sugar factories is the inadequate number of boiling stages, which should be at least five where each strike is boiled on the preceding massecuite run-off, in contrast to three with normal campaign operation. One solution is use of a liquor composed of 1st massecuite raw syrup and 2nd and 3rd sugar remelt together with 1st massecuite raw washings for 1st massecuite boiling to yield white sugar, a 2nd massecuite boiled on 40% of the total 1st massecuite raw syrup, and 3rd massecuite boiled exclusively from 2nd massecuite run-off. Results at a factory using this scheme indicated a greater output of white sugar of lower colour content (0·75°St) and a lower molasses purity (50·9) and sugar loss (0·93%) than with previous schemes at the same factory.

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**The use of new types of bags for sugar storage.** M. B. Yarmolinskii. *Sakhar. Prom.*, 1972, **46**, (2), 29–30. Snags in the use of plastic bags for sugar which are discussed include the possibility of caking under adverse storage conditions and the creation of pockets of infection. Hence, the author advocates the evacuation of air from the bags before heat sealing or, better still, bulk storage and transport.

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**Decolorization and filtration of sugars.** W. B. Hill. *Paper presented to meeting of Filtration Society*, 1972, 4 pp.—Colour removal in refining is briefly discussed and details given of the "Talofloc" system[1], with its advantages and disadvantages listed and representative efficiency compared with that of a conventional system.

[1] *I.S.J.*, 1972, **74**, 313.

**Establishment of theoretical and experimental bases for continuous decolorization. I. Derivation of fundamental relationships from the viewpoint of kinetics of sorption processes.** M. Friml, B. Tichá and K. Toninger. *Listy Cukr.*, 1972, **88**, 65–69.—A method of calculating the parameters involved in continuous counter-current remelt colour adsorption in a column is proposed. The formulae are valid under conditions of constant temperature and constant adsorbent and adsorptive properties. Constants in the formulae are independent of column size and shape. The principle of drawing-up a colour balance on the basis of extinction measurement is explained.

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**Examination of the causes of crushed crystals in refined sugar.** S. A. Brenman and N. K. Kudryavtseva. *Sakhar. Prom.*, 1972, **46**, (3), 20–23.—Causes of crystal crushing during packaging, conveying, storage and transporting of refined sugar (granulated and cube) are investigated and recommendations made for its avoidance.

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**Possible means of controlling refined sugar drying in multi-zone units.** V. A. Demchenko. *Sakhar. Prom.*, 1972, **46**, (4), 21–23.—The principles of a control scheme for refined sugar drying in a Chambon unit based on variations in the initial moisture content of the input sugar are described[1].

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**Mathematical statistics applied to maintenance in the refinery.** E. Vergara. *ATAC*, 1972, (1), 11–15. Maintenance presents special problems for a developing country because of the economic difficulties arising from the need to import spare parts, lack of resources, etc., and it is necessary to extend the useful life of machinery to the maximum. A planned preventive maintenance programme is necessary and it is shown how statistical methods can be applied to identify the areas and equipment in a refinery where priority should be given to reduce breakages and downtime.

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**Activated carbon in the refining of sugar.** A. Vera Z. *ATAC*, 1972, (1), 42–45.—The nature, preparation, analysis and use of activated carbon as a decolorizing agent are reviewed.

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**Strong base anion resins in the chloride form as a supplement to bone char in a refinery employing phosphatation.** W. R. Tuson, R. N. Pollet and E. J. Guidry. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 14–26. The liquor decolorizing plant at Gramercy refinery which is described consists of four columns charged with macroreticular strongly basic resin in $Cl^-$ form and is used as a supplement to the bone char station. Performance ranges from 52% to 62% and costs are calculated as 0·89 cents per cwt of solids filtered, or 0·61 cents per cwt of refined sugar.

**The kinetics of colorants adsorption on carbons.** C. C. Chou and K. R. Hanson. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 27–40.—Batch and column tests on decolorization of raw sugar liquor with bone char were carried out to determine the effect of system variables on performance with the aim of establishing the relative importance of film and intra-particle diffusion and separating the controlling mechanisms in order to demonstrate the effect of each type of diffusion on colour removal and evaluate the rate coefficients of each diffusion. The results are discussed in terms of the effects of particle size and flow rate. Experimental data correlated satisfactorily with a theoretical diffusion model.

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**Thoughts on desweetening of char.** F. M. Chapman. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 41–43. The costs of decolorizing with bone char will be strongly affected by its capacity as expressed by the volume of liquor decolorized and this varies widely within world-wide extremes of 30:1. This capacity will be related to the physical nature of the char which should be protected by care in its handling. Conditions in four sweetening-off installations are tabulated and compared, and conclusions drawn as to the optimum.

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**"Vibro" process for C & H cube sugars.** J. Shpak and D. M. Humm. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 44–51.—A description is given of the "Vibro" cube sugar installation[2] at Crockett refinery which replaced a Hersey unit. Reasons for selection of the new system are listed and a number of teething problems encountered with it are discussed. Solutions to the problems are described and the benefits derived during 3½ years' operation are enumerated.

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**Preliminary results on the use of "Talofloc" in sugar refining.** M. C. Bennett. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 52–59.—See *I.S.J.*, 1972, **74**, 313; 1973, **75**, 183.

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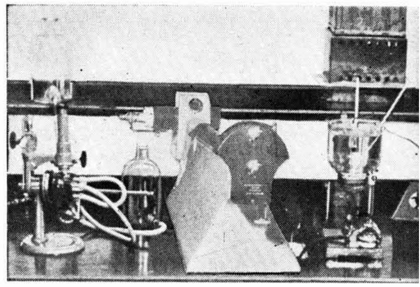
**Modernization of affination and carbonatation stations at Redpath Sugars Ltd., Montreal.** R. Valkers, K. E. Baker and S. Stachenko. *Proc. 30th Meeting Sugar Ind. Tech.*, 1971, 60–77.—Details are given of the modernized station, which is equipped with a Stevens coil heater and four 48 × 36-inch Western States automatic centrifugals, and modifications to the Sweetland filter station are described. Advantages of the changes include steady maintenance of melt rate and savings in manpower (only 2 operators run the entire affination-carbonatation station) as well as reduced maintenance and power costs.

[1] *I.S.J.*, 1972, **74**, 313.
[2] Birch-Iensen: *I.S.J.*, 1965, **67**, 148.

# Laboratory methods & Chemical reports



**Determination of mineral oils in waste waters.** M. MAROUNEK. *Listy Cukr.*, 1972, **88**, 88–91.—Adsorption chromatography on a silica gel column was found to be suitable for examination of the composition of effluent extract. In experiments which are described, beet sugar factory waste water yielded three fractions, of which two were non-polar and contained mineral oils, while the third, clearly polar, contained oxidized mineral oils. The results indicate that the gravimetric method used to determine mineral oils in waste waters is imprecise and gives inaccurate values.

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**The standard criteria of raw sugar and the premium and penalty involved.** A. H. HIÑOLA. *Philssuccap Crystal*, 1972, **1**, (1), 18–21.—The standard set by US refiners for imported raw sugar pol, moisture, ash, osmophilic yeasts, grain size, filtrability and colour are set out and the possible monetary losses and gains to be made from above- and below-standard sugar are calculated. The standard set by the Philippines Sugar Quota Administration for raw sugar quality to meet the US requirements is a sugar pol of 97·2 and a safety factor of 0·25 ex-warehouse.

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**Statistical evaluation of polarization results as analysed by three sugar laboratories.** E. G. QUE and A. P. GUERRERO. *Sugar News* (Philippines), 1972, **48**, 49–53. Statistical analysis of polarization values obtained in 1969/70 at three Philippine sugar laboratories indicated significant differences in other than the first quarter of the fiscal year. It is suggested that these are the result of differences in the times taken to transport the samples from the bulk terminal to the laboratories, since the laboratory and sugar factory effects were eliminated as possible causes.

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**Determination of sodium, potassium and calcium in final molasses by means of the flame photometer.** S. H. FLEITES, M. MURO and J. MONTERDE. *Bol. Azuc. Mex.*, 1971, (264), 20–23.—The method described earlier[1] has been applied to molasses ashed in the presence of HCl, and its precision determined.

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**Effect of double curing on the quality of white sugar obtained.** P. DEVILLERS, M. LOILIER and J. ROGER. *Sucr. Franç.*, 1972, **113**, 257–260.—Double curing was simulated under laboratory conditions by mixing 1 kg of sugar with 1 kg of syrup (obtained by dissolving sugar in water) for 1 hr at 20°C followed by centrifuging for 5 min at 3000 rpm. Comparison between the resultant sugar and the initial sugar was made on the basis of visual appearance, ICUMSA colour value and ash, and indicated that double curing improves white sugar quality.

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**Prepared cane sampling at Mossman.** S. C. GRIMLEY. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 231–243.—Details are given of the cane sampling system at Mossman which incorporates a Rietz P.B.12 "Prebreaker" and a rotary sub-sampling table. A series of tests was conducted in 1971 and the results are analysed statistically.

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**The density of primary mud.** K. J. NIX. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 281–287.—An empirical formula $\frac{P_m}{P_j} = 1 + 0{\cdot}40\ X_1$, where $P_m$ and $P_j$ are, respectively, primary mud density and mud juice density at the temperature of the mud, and $X_1$ = mass fraction of the insoluble solids, has been found to give accurate values of primary mud density to within $\pm$ 2% for temperatures in the range 0–100°C. Details are given of the experimental procedure used, and the theoretical analysis of mud is explained.

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**Nucleation studies.** R. BROADFOOT and P. G. WRIGHT. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 353–362.—Empirical relationships have been developed under simulated factory conditions for the threshold supersaturation limit and for the rate of nucleation once the limit has been exceeded. However, it is stressed that the expressions, obtained only for high-purity solutions, should be used only with reservation, since many aspects are still to be investigated, particularly the effect of temperature on the threshold limit and the effects of supersaturation, temperature, crystal surface area, time and syrup purity on nucleation rates.

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**Conversion of a sieve analysis to a number size distribution.** E. T. WHITE and P. G. WRIGHT. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 369–377. An approximate method of interconverting sieve analysis values (crystal mass distribution with size interpreted as a sieve size, $L_s$) and crystal size distribution expressed as a number with size measured as the volume equivalent size $L_v$ is described, which is based on the counting of the number of crystals in a

[1] *I.S.J.*, 1973, **75**, 185.

given weight of a narrowly-sieved fraction, calculation of $L_r$ from the crystal mass by means of an expression which is given and plotting $L_v$ *vs.* $L_s$ for that fraction. The expression derived from the plot is only approximate, since the $L_r$:$L_s$ ratio is shape-dependent and will thus vary from crystal to crystal. Because of this, the same ratio can be used as a measure of crystal shape, as is briefly demonstrated.

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**The technological quality of sugar beet.** S. G. Enikeev and L. Z. Meshkova. *Sakhar. Prom.*, 1972, (5), 10–11. The adverse effects of cavity formation in the central parenchyma of beet crowns, here considered one of the major causes of poor processing quality because of the reduced sugar and increased noxious nitrogen contents, are discussed and free amino-acid and asparagine/aspartic acid contents in the central and outside parenchymata tabulated, showing the considerable increase in these with the formation of a hidden cavity.

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**Laboratory and manufacturing notes. I. Sugar losses in the factory.** C. Bayma. *Brasil Açuc.*, 1972, **79**, 329–333.—Owing to the large tonnage of cane and sugar processed, the effect of even small improvements in reducing losses can be economically important, and it is necessary to measure such loseses accurately. Control determination methods are briefly discussed for bagasse, filter cake, evaporator losses, final molasses and inversion losses, while undetermined losses are also discussed.

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**Sugar loss through hyperthermophilic micro-organisms in beet sugar factory diffusers. II. Microbial decomposition of reducing sugars.** H. Klaushofer and G. Pollach. *Zucker*, 1972, **25**, 388–395.—Investigations showed that different strains of micro-organisms were responsible for decomposition of sucrose, glucose and fructose, and that many act preferentially on monosaccharides, while others decompose sucrose more rapidly than they decompose its monosaccharide components. Reasons for the differences in decomposition rates are suggested. Mention is made of the fact that a strain of hyperthermophilic bacillus frequently occurs in diffusion juices which primarily decomposes reducing sugars but not sucrose and has a marked nitrate-reducing capacity.

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**Hydrolysis of polysaccharides in raw juice.** R. Bretschneider, B. Kopřiva, V. Žídek and I. Bohačenko. *Listy Cukr.*, 1972, **88**, 103–107.—Descending paper chromatography has revealed the presence of mannose, xylose and ribose as well as glucose, galactose, arabinose, rhamnose and galacturonic acid in hydrolysates of dispersed colloids from raw juice. Full details of the experiments and results are given.

**Method of determining contamination in diffusion.** L. Vokounová and J. Smolík. *Listy Cukr.*, 1972, **88**, 108–111.—Descriptions are given of quick methods, selected from the literature, which are recommended for (i) determination of bacterial counts under the microscope after staining with Congo red, and (ii) determination of bacterial metabolic activity by methods of pH or acidity measurement, nitrite determination and the redox indicator method using triphenyl tetrazolium chloride and resazurine.

* * *

**Effect of ionizing radiation on the browning reaction of D-glucose, D-fructose, sucrose and raw cane sugar.** W. W. Binkley, M. E. Altenburg and M. L. Wolfrom. *Sugar J.*, 1972, **34**, (12), 25–28.—Irradiation of glycine and D-glucose separately before browning polymerization in aqueous solution caused a considerable increase in colour formation compared with a non-irradiated mixture. More colour was produced by irradiated D-fructose than irradiated D-glucose in a model system containing the reducing sugar and γ-amino-butyric acid. Irradiated sucrose contained products (probably irradiated reducing sugars) which participated in the browning reaction. Raw cane sugar received less protection from irradiation when stored in glass or plastic, which gave about the same protection.

* * *

**Ageing of white sugars.** P. Devillers and J. Roger. *Sucr. Franç.*, 1972, **113**, 303–309.—Tabulated values indicate the deterioration in colour aspect and solution colour of white sugar samples stored for 2 years at 20°C and 60% relative humidity. Conductimetric ash values did not change during storage.

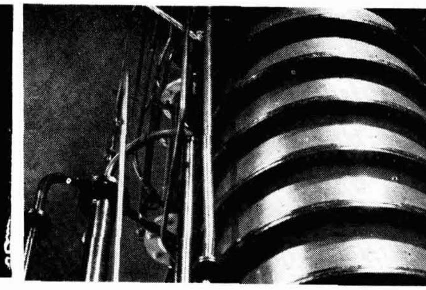
* * *

**Reducing the colour of solutions by means of aluminium hydroxide.** S. E. Kharin and V. V. Maslova. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 26–29.—Addition of $Al(OH)_3$ to 20 ml solutions (209 mg Al per litre) of melanoidins, caramels and sucrose alkaline degradation products reduced the colour content, the greatest effect being obtained with caramels and the smallest effect with melanoidins. The decolorizing efficiency fell with rise in pH (which also caused a rise in the initial colour), best results being achieved at about pH 4. The presence of up to 20% sucrose had no effect, but at higher concentrations sucrose in an alkaline medium caused a fall in decolorization.

* * *

**Coefficients of interdiffusion of molecules in the system sucrose-water.** L. P. Zhmyrya, M. N. Dadenkova, B. M. Lysyanskii. *Izv. Vuzov, Pishch. Tekh.*, 1972, (1), 131–133.—Experiments are reported in which the molecular diffusion coefficient $D$ was determined by light diffraction at 25°C for aqueous sucrose solutions in the concentration range 3–70%. Comparison of results with values obtained by others indicate reliable accuracy. At concentrations above 40% the $D$ *vs.* concentration curve is practically linear.

# By-products



**Torula yeast as a supplement to pasture plus molasses for Holstein × Brahman heifers in early lactation.** J. Guzmán. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 259–262.—In tests in which torula yeast (produced from fermented final molasses) was added to pasture plus restricted quantities of molasses with or without urea, none of the yeast quantities had any effect on milk yield or composition.

* * *

**Effect of diets based on concentrates or molasses on growth performance and rumen fermentation in early weaned dairy calves.** N. Perón. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 279–293.—Molasses-based diets caused lower dry matter and higher ash and water intakes than did concentrates, reduced the daily live weight gain and feed conversion compared with concentrates and had a number of effects on rumen fermentation.

* * *

**Digestibility and rate of passage through the gastro-intestinal tract of torula/molasses in pig diets.** O. Carrillo and M. C. Benavides. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 331–339.—Results are presented of comparative tests in which pigs were fed on two different rations, one containing molasses and the other based on maize; both contained torula yeast.

* * *

**A note on sucrase activity in the small intestine of growing pigs fed molasses.** J. Ly. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 347–350.—The specific activity of the intestinal sucrase in the pigs was significantly greater in pigs fed on maize meal than in pigs fed on molasses-based diets.

* * *

**Intestinal digestion of molasses in growing pigs.** J. Ly. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 351–361.—Studies are reported on the intestinal digestion of pigs fed on molasses-based diets. The carbohydrates comprised fructose and sucrose but not glucose, and their maximum concentration was 0·9 mM/litre. The organic acids resulting from intestinal fermentation of molasses did not affect the metabolizable energy values.

* * *

**Alcohol in rumen and blood pyruvate in animals affected by molasses toxicity.** F. Dixon. *Rev. Cubana Cienc. Agríc.*, 1971, **5**, 363–367.—In bulls fed on diets containing varying proportions of molasses, molasses toxicity was accompanied by a rise in blood pyruvate, the levels of which fell with thiamine administration or change of diet. Alcohol levels in blood and rumen liquor were considerably higher than in control animals fed only forage.

* * *

**Thiamine and molasses toxicity. I. Effects with roughage free diets.** H. Losada, F. Dixon and T. R. Preston. *Rev. Cubana Cienc. Agric.*, 1971, **5**, 369–378. Full details are given of investigations into molasses toxicity in bulls fed molasses *ad lib.* plus urea, fish meal or torula yeast. Thiamine treatment did not reduce the incidence or severity of toxicity symptoms nor did it affect the blood pyruvate levels. It is concluded that the pattern of rumen fermentation changes with molasses toxicity, so that very little propionic acid is produced. Brain damage found in affected animals may be due to an inadequate supply of glucose and/or its precursors.

* * *

**A review of production of MSG (monosidum glutamate) from sugar cane molasses and prospects in Pakistan.** Z. Said. *Proc. 9th Conv. Pakistan Soc. Sugar Tech.*, 1971, 95–100.—Some information is given on monosodium glutamate production from cane molasses of 5–6% sugar concentration. Fermentation with a culture of *Micrococcus glutamicus*, *Brevibacterium flavum* or other microbacterium for 30–35 hours gives a thin broth containing 4–7% glutamic acid (30% on reducing sugars) which after subsequent treatment finally yields a glutamate of 99·5% purity. Yield is not mentioned.

* * *

**Utilization of wastes and effluents as contribution towards soil fertility.** S. C. Gupta and A. P. Gupta. *Sugar News* (India), 1971, **3**, 19–21.—See *I.S.J.*, 1971, **73**, 123.

* * *

**Influence of the new Cuban cane varieties on the pulp and paper industry.** E. Batlle and J. A. Espinosa. *Bol. Azuc. Mex.*, 1971, (262), 13–20.—See *I.S.J.*, 1972, **74**, 349.

* * *

**Preparation of monosaccharides from sucrose. I. Preparation of D-fructose and calcium D-gluconate.** M. Kulhánek and M. Tadra. *Listy Cukr.*, 1972, **88**, 31–35. **II. Preparation of D-mannitol and L-sorbose.** *idem ibid.*, 36–39.

I. The production of monosaccharides from sucrose is briefly examined and processes for preparation of D-fructose surveyed. A process is described in which

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a glucose-fructose mixture is fermented with *Aspergillus niger* as glucose oxidase source. The gluconic acid is crystallized as its calcium salt and 75% of the fructose in the fermentate isolated as a product of medicinal quality.

II. In the processes described, invert syrup is subjected to catalytic hydrogenation or fermentation with *Lactobacillus brevis* to yield D-mannitol and D-sorbitol in 1:3 ratio. After separation of the mannitol, the residual sorbitol (containing about 5% mannitol) may be fermented with *Acetobacterium suboxydans* CCM 1784 to yield 66·2% L-sorbose on initial syrup solids.

* * *

**Kinetic study of the hydrolysis of bagasse pentosans by the action of dilute nitric acid.** L. HERNÁNDEZ C. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (2), 3–26.—Studies have been made on bagasse treatment with dilute nitric acid, of about 30–52 g/litre concentration, at 70–90°C and the kinetics of the pentosan hydrolysis process investigated.

* * *

**Influence of technical oxytetracycline on the alcoholic fermentation of cane molasses.** D. O. FERNÁNDEZ and J. A. SICARD. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (2), 27–39.—From experiments in which oxytetracycline was added in various concentrations to the propagation (aerobic) and fermentation (anaerobic) stages, it was found that it stimulated yeast growth, reduced fermentation time by as much as 15% and controlled infection by other microorganisms, the most marked effect being found under the worst culture conditions. The technical grade antibiotic (8% a.i.) should be added in concentrations of 100 ppm at the propagation stage while the concentration in the fermenter should be about 25 ppm, varying according to the culture conditions.

* * *

**The problems and achievements of the world's largest bagasse board plant.** K. RUCKSTUHL. *Sugar y Azúcar*, 1972, **67**, (1), 14–16.—The equipment and processes used at the bagasse board factory operated by Standard Building Products Ltd. in Jamaica are described[1].

* * *

**Dried beet pulp as balanced feed.** ANON. *British Sugar Beet Rev.*, 1971, **40**, 93.—Dried molassed sugar beet pulp in a new form is being marketed by the British Sugar Corporation on a limited scale under the name "Triple Nuts". The product is described as a balanced feed containing 17% protein including 8% protein equivalent of urea and a high phosphorus, mineral/vitamin supplement. The product is claimed to be a safe and suitable way of feeding urea to ruminants.

* * *

**Sugar beet pulp for the dairy cow.** R. J. BURT. *British Sugar Beet Rev.*, 1971, **40**, 94–95.—Reasons why beet pulp is such a good stock feed are discussed. In the UK some 500,000 tons of dried molassed beet pulp, which has a high digestible fibre content, is made every year, more than half of which is bought by dairy farmers and used in shredded form or as pulp nuts. Methods of using beet pulp are discussed.

* * *

**Catalytic action of sea salt on the process of obtaining furfural from bagasse.** A. MILOVANOV and E. CORONA. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (3), 9–23.—See *I.S.J.*, 1971, **73**, 124.

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**Influence of the sucrose concentration and the inoculation ratio on D.S.U. synthesis.** O. ALMAZÁN and R. RABELO. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (3), 39–48.—See *I.S.J.*, 1971, **73**, 187.

* * *

**Investigation of the reactivity of sugar cane bagasse cellulose by adiabatic acetylation.** Y. A. KOSTROV, C. J. TRIANA and I. F. GÓMEZ. *Sobre los derivados de la caña de azúcar*, 1972, **6**, (1), 14–19.—Two types of bagasse cellulose were studied: one obtained by the prehydrolysis-sulphate process and the other by nitric digestion. They were compared with a wood sulphite cellulose by treatment with glacial acetic acid at 80°C for one hour and recording of the heat curves. On this basis the nitric digestion bagasse cellulose was the most reactive. After neutralizing the acetic acid present in the acetylation syrups with triethanolamine, their characteristics were examined in respect of transparency, colour, filtration and viscosity. The poorest was from the bagasse sulphitation cellulose owing to the presence of impurities, particularly pentosans.

* * *

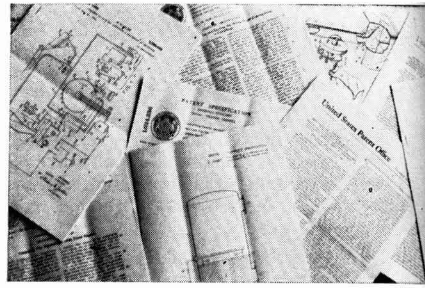
**Regeneration of lime from filter cake in the USA.** G. VERNOIS. *Zeitsch. Zuckerind.*, 1972, **97**, 324–326. Data obtained on a study tour in the USA are presented to show the economic advantage of natural gas used to fire a lime kiln at Carlton (California); but the waste gas $CO_2$ content is so low at 18% that, without the $CO_2$ from a coke-fired kiln at the same factory which yields a waste gas containing 35% $CO_2$, there would be insufficient $CO_2$ for carbonatation. A description is given of the plant at Mendota for filter cake lime recovery which includes an oil-fired rotary kiln producing 120–130 tons of CaO/day, i.e. sufficient for a 5,000 tons/day factory (Mendota has a daily capacity of 3,500 tons/day). No difficulties have been experienced as a result of the low $CO_2$ content of the waste gas, which averages 15%. The calcined lime costs about half that from a conventional kiln.

* * *

**Graphs of dried beet pulp pressing.** V. P. BORODYANSKII, N. N. DOVGAL' and G. A. PETRIK. *Sakhar. Prom.*, 1972, (6), 15–18.—Graphs, plotted from experimental data, are presented which relate pulp bulk weight, temperature and pressure in briquetting. Calculated values obtained from the associated formulae deviated from experimental values by no more than 10%.

[1] *I.S.J.*, 1972, **74**, 158.

# Patents



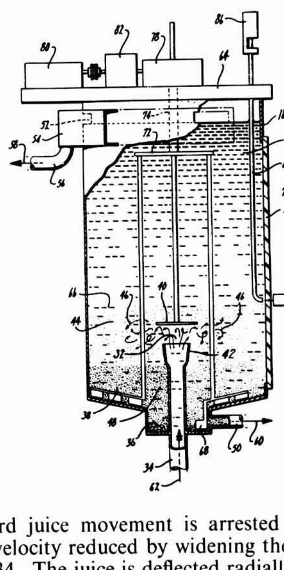
## UNITED KINGDOM

**Improvements in screw presses.** The French Oil Mill Machinery Co., of Piqua, Ohio, USA. **1,266,055.** 23rd May 1969; 8th March 1972.—See US Patent 3,592,128[1].

* * *

**Clarification.** American Sugar Co., of New York, N.Y., USA. **1,267,106.** 20th November 1969; 15th March 1972.

Separation of solids from e.g. first carbonatation juice in a beet sugar factory is achieved by passing it through a deaerator and treating with an organic polyelectrolyte settling aid (a copolymer of acrylamide of M.W. 2–3 million, added in a proportion of 0·1–30 parts per million). After adequate mixing the settling aid forms agglomerates with the insoluble particles which are present in the juice entering the settling tank 16 by the feed pipe 34.

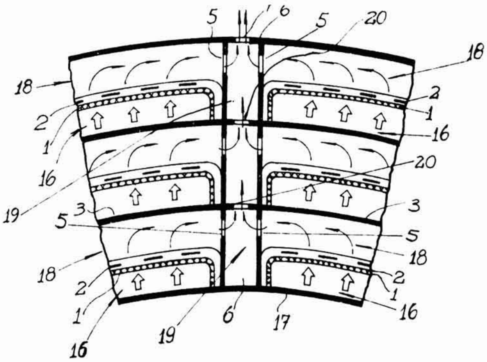


Upward juice movement is arrested by baffle 40 and its velocity reduced by widening the exit port 42 of pipe 34. The juice is deflected radially and further agglomeration of particles occurs within the settling zone 44. The larger agglomerates sink into the sludge zone 48 while clarified juice rises and is withdrawn through an overflow 51. The sludge is directed by rakes 68 into a central well 36 from which it is withdrawn through pipe 50. The depth of the settling bed may be regulated by means of a photoelectric cell 84 which gauges the clarity of the liquor as a function of light reaching it from a source 86 reflected within tube 88; the cell may be linked with the sludge discharge pump.

* * *

**Centrifugal.** F. Urbano G., of Buenos Aires, Argentina. **1,267,279.** 26th June 1970; 15th March 1972.

A horizontal rotating drum is provided with a number of concentric frustro-conical units, the innermost having a solid inner wall 17. Outside this in turn are a series of sections formed by filter grids 1 of wire, etc., supported by a perforated backing plate 2 held in place by fins extending from the solid back plate 3. Between each section is a channel element 6 of rectangular section having perforations 5 in the sides and end, the outermost channel's end perforations corresponding to perforations in the outermost solid frustro-conical shell.



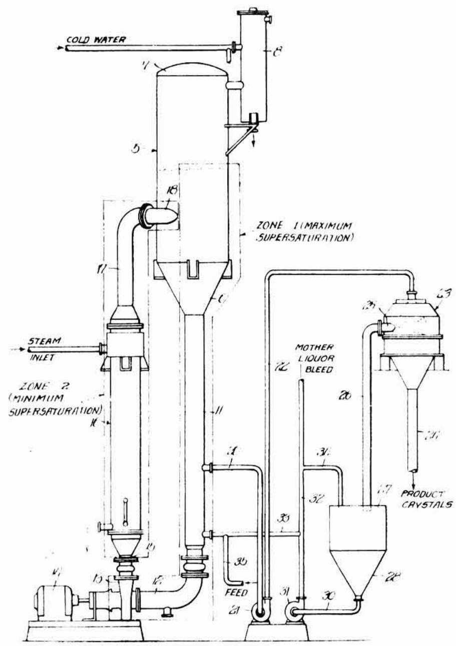
A manifold is provided on the stationary housing such that massecuite is delivered into the smaller end of the rotating frustro-conical unit. It enters the cavities 16 and is directed towards the wider end of the cavities. The molasses is directed by centrifugal force through the grids 1 and perforations in plates 2, entering the chambers 18. From these it passes through perforations 5 into the chambers 19 formed by elements 6 and so eventually through perforations 7 to the outside of the drum. The crystals meanwhile pass along the length of the grids and are discharged at the wider end of the drum, appropriate collecting equipment being provided for both sugar and molasses. The separating surface within the unit is much greater than in a single-cone centrifugal.

[1] *I.S.J.*, 1973, **75**, 91.

**Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price 25p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. 20231 USA (price 50 cents each)**

**Continuous sugar crystallization.** WHITING CORPORATION, of Harvey, Ill., USA. **1,268,563.** 17th March 1969; 29th March 1972.

The crystallizer vessel 5 is closed by a lid 7 and connected through a conical section 6 to a downpipe 11. This is connected by an elbow 12 to the inlet of a circulating pump 13 driven by a motor 14. The pump discharges to a tubular heat exchanger 16 fitted with a steam jacket and delivering to an elbow 17 connected at 18 to the bottom portion of vessel 5. Vapour withdrawn from the vessel is cooled by condenser 8. Near the bottom of column 11 is a withdrawal pipe 20 delivering to a pump 21 which feeds a continuous centrifuge 23 by way of pipe 22; in the centrifuge larger crystals of adequate product size are separated and the fine crystals and mother liquor are delivered through pipe 26 to tank 27.




The contents of the latter may be recirculated through pipes 30, 32 and 34 by pump 31; alternatively they may be returned to column 11 through pipe 33, with additional feed through pipe 35. The last is used for the initial feed of syrup which is brought to the desired level in vessel 5 and circulated by pump 13 while heated by steam admitted to heat exchanger 16. Vapour is evolved and withdrawn by condenser 8 while additional feed is supplied by way of pipe 35. When the supersaturation has reached the appropriate level a seed slurry is admitted with the feed and the crystals start to develop. A proportion of the massecuite is withdrawn through pipe 20, product crystals separated and the mother liquor with fines returned to the crystallizing system to act as nuclei for further growth. Sufficient mother liquor is discharged to prevent the impurities level in the liquor rising above 10% on total solids. Further nuclei may be introduced by other means including a high-speed rotating saw blade held within the crystallizer vessel 5, or a high-frequency sonic generator.

* * *

**Method of cleaning sugar crystals.** BIRD MACHINE COMPANY, of South Walpole, Mass., USA. **1,268,972.** 18th August 1969; 29th March 1972.—See US Patent 3,575,709[1].

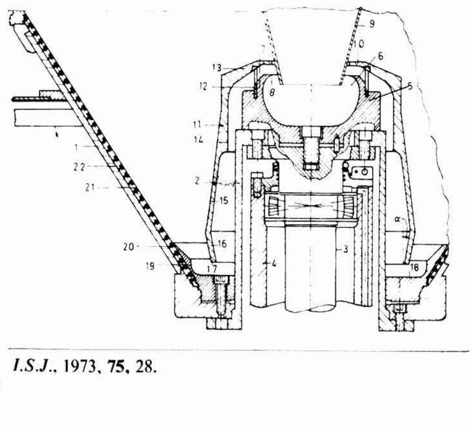
* * *

**Method of skimming sugar juices in countercurrent cossette machines.** BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **1,270,237.** 23rd November 1970; 12th April 1972.—Scum is formed in cossette scalders, as a result of liberation of inter-cellular air or gas during heating, as well as air carried with the supply of cossettes. This scum is a source of possible loss by spillage and can stagnate, encouraging microbial infection. To avoid such loss the scum carried by a minor juice stream (50–100% on beets) is skimmed off the surface of the major juice/cossette flow and transferred to an expander chamber where finely-divided steam is admitted through jets to the surface, so destroying the scum. Steam injected into the juice in the expander chamber or in a following separate chamber raises the temperature of the scum-free juice by 5–10°C and it is recycled to the scalder. Small quantities of scum-inhibiting materials may additionally be added to the juice entering the expander chamber.

* * *

**Continuous centrifugal.** BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **1,270,904.** 5th June 1970; 19th April 1972.

Uniform feeding of the continuous centrifugal 1 is achieved even with highly viscous massecuites by subjecting the feed to disturbance and partial "damming" in its passage through the accelerator cone 11. The massecuite is delivered by pipe 9 through an aperture 10 in the accelerating cone and enters the recess 6 within the feed plate 5. It fills this and overflows through the constriction formed by the upper surface 8.



[1] *I.S.J.*, 1973, **75**, 28.

It passes to the top portion 13 of the cone, being swirled to some extent after passing the struts 12 linking the cone to the plate (and thus the hub of the centrifugal). It continues to a cylindrical section 14 and a further conical section 15 and is then partially "dammed" by inward cone section 16 from which it is discharged over rim 17 to the bottom 18 of the centrifugal drum and thence onto the screen 19.

* * *

**Ion exchange treatment of sugar solutions.** N.V. OCTROOIEN MIJ. ACTIVIT, of Amsterdam, Holland. **1,273,911.** 4th June 1970; 10th May 1972.—Sugar solution is treated for removal of impurities by contacting with a macroporous insoluble polymer of one or more vinyl-aromatic or divinyl-aromatic compounds (in the form of beads), the polymer containing polar or polarizable, non-dissociable active groups which may be nitro, halogeno or acetyl groups [a copolymer of styrene and (20–80% w/w) divinylbenzene (having nitro groups)]. (The active groups may be introduced into the polymer after it has been formed from the monomeric constituents.)

* * *

**Sugar syrup.** TATE & LYLE LTD., of London E.C.3, England. **1,274,356.** 3rd February 1970; 17th May 1972.—A partially solidified sugar syrup, for household use as a spread, is produced by adding a fine particulate reducing sugar (invert sugar or glucose) to a (sucrose-containing) syrup, saturated or supersaturated with the reducing sugar (partially inverted refiners' syrup), and allowing the mixture to set.

* * *

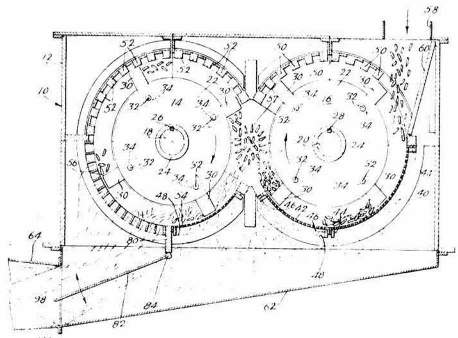
## UNITED STATES

**Cellulose pulp manufacture.** E. C. MILLS, of Seattle, Wash., USA, *assr.* ALSCOPE LTD. **3,461,028.** 1st February 1968; 12th August 1969.—Lignins present in a vegetable raw material, including bagasse, are broken down by presteaming to decrease the moisture content (thereby increasing the capacity of the raw material to absorb aqueous solutions) and then impregnating with dilute nitric acid containing 1 part by weight of $NH_4OH$ per 100–250 parts of $HNO_3$. The excess solution is removed and the raw material heated to initiate an exothermic reaction between the lignins and the $HNO_3$. The temperature is controlled so that it does not exceed 97°C. Alternatively the raw material may be impregnated first with dilute aqueous $NH_4OH$ (at 45–60°C), excess of the latter removed, and the raw material impregnated a second time with dilute $HNO_3$ (at $< 45$°C) before continuing the process.

* * *

**Bagasse defibring hammer mill.** K. RUCKSTUHL, of Basel, Switzerland, *assr.* FIBRELITE CORPORATION. **3,490,705.** 10th August 1967; 20th January 1970.

Within casing 12 are mounted two horizontal driven shafts 18, 20, each supported by bearings and carrying a rotor 14, 16 in the form of a series of discs 22 held apart by spacers 24 and prevented from rotating relative to the shafts by keys 26, 28. At intervals around the discs are horizontal rods 32 with spacers 34 and carrying hammers 30. Around the lower sector of rotor 16 are arcuate screens 40 and 42 supported by frames 44 and 46; above rotor 16 are arcuate toothed attrition plates 50. Similar plates 52 are located above rotor 14 but the lower sector includes only a small screen 54 and a screen 56.



The rotors are driven in the same sense, as indicated by the arrows, and bagasse is delivered through inlet port 58 and guided by plate 60 to the space between rotor 16 and the screens. The fines which separate drop through the screens into the discharge housing 62 while the remaining material is carried over to the zone of rotor 14, passes over screen 54 where more fines are separated, and thence to the screen 56 where the fibrous fraction is passed into the housing 62. Material which is not discharged is carried round by rotor 14, past the attrition plates 52 and collides in zone 57 with material discharged from rotor 16. By limiting the path swept by the hammers to less than 12% of the grinding zone (by restricting the width of the individual hammers to 2½% of the axial distance between them and restricting the width of the zone swept by the hammers to <12% of the screen width) and by allowing interaction of the two streams of fibrous material in zone 57, separation of the two fractions is aided. In addition, a suction control plate 82, pivoting about horizontal axis 84 in response to an external control mechanism, governs the suction applied to either side and thus to the screens 40, 42, 54 relative to the screen 56. This governs the length of time in which the raw material stays within the various grinding zones and thus the separation of its constituents.

* * *

**Beet or cane diffuser.** M. J. C. BARRE, of Faches Thumesnil, France, *assr.* SOCIÉTÉ SUCRIÈRE DE L'ATLANTIQUE (ENGINEERING). **3,632,445.** 10th March 1969; 4th January 1972.—See UK Patent 1,218,870[1].

[1] *I.S.J.*, 1972, **74**, 284.

**Dry cane cleaner.** M. W. CHAPMAN, of Middle Cove, N.S.W., Australia, *assr.* COLONIAL SUGAR REFINING CO. LTD. **3,635,336.** 15th January 1969; 18th January 1972.—See UK Patent 1,243,463[1].

* * *

**Apparatus for stirring, measuring viscosity and boiling of sugar.** H. THIELE, T. VON DORING AND G. WEGNER, of Wevelinghoven, Germany, *assrs.* PFEIFER & LANGEN. **3,636, 753.** 29th July 1968; 25th January 1972.—See UK Patent 1,221,124[2].

* * *

**Sugar crystallization method.** J. DE CREMOUX, of Lille, France, *assr.* SOC. FIVES LILLE-CAIL. **3,642,534.** 5th December 1969; 15th February 1972.—The method includes preparation of a magma of sugar crystals of predetermined size and adding this magma to syrup where it acts as seed for the crystallization of sugar from the syrup, the magma being prepared by comminution of sugar crystals in a massecuite, the latter or the magma being diluted with water. The syrup and magma are fed continuously to a crystallizer vessel while massecuite is withdrawn and the crystals comminuted in a rotary mill containing grinding bodies (e.g. a ball mill) having a surrounding screen which retains the latter but allows the comminuted crystals to pass. A temporary storage vessel may be provided for the treated massecuite.

* * *

**Tabletting sugar.** C. P. GRAHAM, L. FONTI and A. M. MARTINEZ, *assrs.* AMERICAN SUGAR CO., of New York, N.Y., USA. **3,642,535.** 21st January 1970; 15th February 1972.—Stable, substantially non-hygroscopic tablet sugar may be made by direct compaction into the desired shape of a free-flowing sugar composition consisting essentially of (98%) finely-divided (through 35 Tyler mesh) agglomerates of fondant-size sugar crystals (3–50 $\mu$), these crystals being uniformly mixed or coated with 0·5–7·5% (2%) malto-dextrin (by co-crystallization), the sugar composition having a moisture content of $\not>$1%.

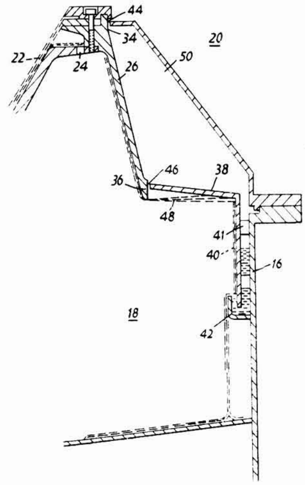
* * *

**Cane harvester.** F. P. GOMES and D. K. ANDREWS, of Hawi, Hawaii, USA, *assrs.* KOHALA SUGAR CO. **3,645,073.** 2nd June 1970; 29th February 1972.

* * *

**Continuous centrifugal.** A. MERCIER, of La Madeleine, France, *assr.* FIVES LILLE-CAIL. **3,647,135.** 8th December 1969; 7th March 1972.

The molasses passing through the screen surface 22 of the conical type continuous centrifugal travels up the space between it and the solid cone. The latter carries a flange 24 to which is bolted a skirt 26, and ducts machined in the two allow the molasses to pass into the chamber beneath the cone. It travels down the underside of the skirt and is discharged as a horizontal sheet 48 at the rim, thence draining along the inside of the housing under truncated cone 38 and baffle 40 through a hydraulic seal 42 and so to the discharge duct. Flat surfaces 34 and 36 on the




skirt correspond to cylindrical surfaces on the housing and with a narrow clearance prevent passage of the molasses into the chamber where the discharged sugar collects.

* * *

**Method of reducing the raffinose content of beet molasses.** H. SUZUKI, Y. OZAWA and O. TANABE, of Chiba-shi, Japan, *assrs.* AGENCY OF INDUSTRIAL SCIENCE & TECHNOLOGY. **3,647,625.** 5th March 1968; 7th March 1972.—The raffinose content of beet juice or molasses is reduced by treatment with the mycelium formed on culturing the mould *Mortierella vinacea* var. *raffinoseutilizer* on a medium containing galactose or an oligosaccharide having an $\alpha$- or $\beta$-galactoside bond. The mixture of mycelium and juice or molasses is maintained under suitable conditions (20–70°C, pH 3–7) until the $\alpha$-galactosidase present in the mycelium decomposes part of the raffinose present to give sucrose, increasing the yield of the latter.

* * *

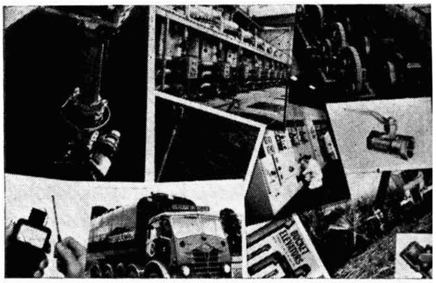
**Combating pigweed in sugar beet fields.** W. C. DOYLE and J. L. AHLE, *assrs.* GULF RESEARCH & DEVELOPMENT CO., of Pittsburgh, Pa., USA. **3,650,728.** 18th December 1969; 21st March 1972.—Pigweed is controlled by post-emergence application of a herbicidally-effective amount of a mixture of 1 part of methyl 3-(N'-*m*-tolylcarbamoyl) carbanilate and $\frac{1}{4}$–2 parts ($\frac{1}{2}$–1 part) of 2-(*m*-chlorophenyl)-4H-3,1-benzoxazin-4-one, in combination with an organic solvent and surface-active agent.

* * *

**Cane grab for a windrow loader.** H. A. WILLETT, of Thibodaux, La., USA, *assr.* CANE MACHINERY & ENGINEERING CO. **3,651,966.** 11th June 1970; 28th March 1972.

[1] *I.S.J.*, 1972, **74**, 189.
[2] *ibid.*, 1971, **73**, 381.

# Trade notices



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

**Tractors for cane plantations.** Muir-Hill, Bristol Rd., Gloucester, England.

The illustration shows a 110-hp, 4-wheel drive Muir-Hill tractor pulling a 3-shank subsoiler to a depth of 25–27 in (63·5–68·6 cm) on a cane plantation in Barbados. No wheel slip was experienced in 2nd and 3rd gears. The soil had already been turned by a disc plough pulled by the same tractor on overgrown ground with the disc at maximum depth. Properties of the Muir-Hill tractors which have proved invaluable under such conditions are the wheel track adjustment possibility, small turning circle at the end of rows, low overall weight (important during flood irrigation when cultivating between rows) and high tractive effort.

Excessive tyre wear is avoided by permitting the front-wheel drive to be disconnected for fast pulling of up to 60 tons of cane in a string of trailers from the field to the factory and by the use of disc brakes on all four wheels. The possibility of using Muir-Hill tractors to haul fire trucks when burning cane is being considered. Muir-Hill is a member of the Babcock & Wilcox Ltd. Construction Equipment Division.

* * *

**RT beet washer.** Soc. Sucrière d'Etudes et de Conseils S.A., 1 Aandorenstraat, Tienen, Belgium.

The RT beet washer comprises two troughs in series, the second one at a lower level than the first. The bottom sections slope to permit discharge of muddy water. The beet are washed by water sprayed from above and below them as they travel over a series of stepped flexible plates. The troughs undergo a slow oscillating movement, causing the beet to progress at a controlled rate along each. Total washing time is 16 sec, and maximum soil removal is obtained at a consumption of only 1·3 litres of recycled water per kg of beet (the water is returned from the muddy water basin via a filter). All parts in contact with the beet are of stainless steel.

* * *

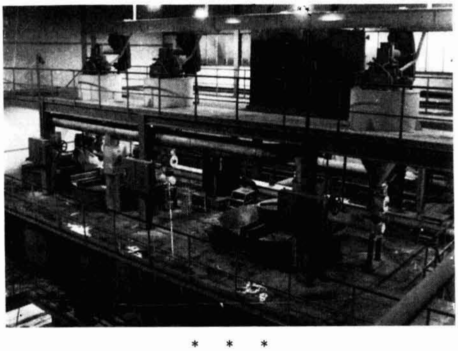
## PUBLICATIONS RECEIVED

**WATER JETTING ACCESSORIES.** F. A. Hughes & Co. Ltd., Blenheim Rd., Longmead, Epsom, Surrey, England.

Publication No. 3005 is an illustrated catalogue of water jetting accessories for pressures up to 1000 kg.cm$^{-2}$ (15,000 lb in$^{-2}$) of use in cleaning external and internal surfaces such as tubes, drains, etc. with flexible or rigid lances, and with jet guns or hydraulically-assisted foot valves.

* * *

**Molasses sugar extraction.**—Shown in the illustration is the Salzgitter Maschinen molasses sugar extraction plant supplied to Miandoab sugar factory in Iran and mentioned earlier[1].



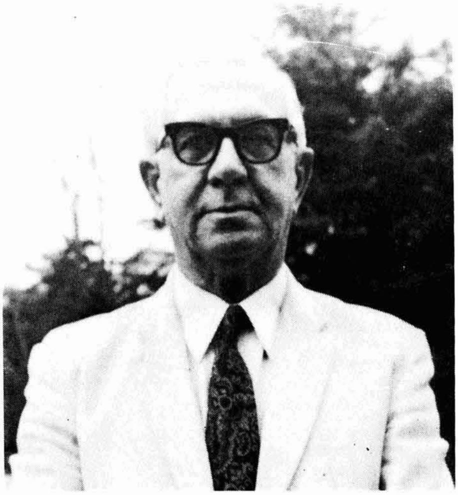
* * *

**Toft Bros. Industries Ltd.**—The Don Mizzi Harvester and Don Implement Division of Wyper Bros. Ltd., of Bundaberg, Queensland, Australia, has been acquired by Toft Bros. Industries Ltd., also of Bundaberg, specialists in cane harvesting and handling equipment. The merger will greatly increase the company's production facilities and its capacity for future expansion, while also providing for the continuation of manufacture and sale of tractor-mounted cane harvesters and the well-known "Don" cane farming implements. The announcement was made early in May by Milton H. Pickup, Chairman of Toft Bros. Industries Ltd. and President of Theo. H. Davies & Co. Ltd., of Hawaii.

[1] *I.S.J.*, 1973, **75**, 158.

# ISJ Panel of Referees

WE are happy to announce that Dr. HARRY EVANS, O.B.E., has consented to join our Panel of Referees. Dr. EVANS graduated from the University of Wales in 1928 and was subsequently awarded a Ph.D. for crop physiological research in 1931. After working in the Physiology Department of East Malling Research Station during 1931–32 he joined the regional staff of the newly-formed Sugar Cane Research Station in Mauritius in 1932 as Physiological Botanist, remaining there until he was seconded for war-time duties during 1940-45.



He rejoined the Station in 1946 and was Agricultural Officer-in-Charge during 1947 and 1948. In December 1948 he was appointed Senior Plant Physiologist in the newly-formed Cocoa Research Scheme and continued in this post until 1952 when he accepted an offer from Booker Sugar Estates Ltd. to become Agricultural Director in Guyana. He served in this position until 1967 when he retired from Guyana and became a Director of Booker Agricultural and Technical Services Ltd. He has served in a specialist capacity on many Commissions related to the sugar industry in several countries and in a consultative capacity almost continuously during the past six years. He was awarded the degree of Doctor of Science by the University of Wales for his researches in Tropical Agriculture and appointed O.B.E. for services to tropical agriculture by H.M. The Queen in 1961.

This Journal is most appreciative of its good fortune that Dr. EVANS is willing to make available his experience and expertise in examination of submitted manuscripts and thus ensure the continuing high standard of work published in our pages.

# US sugar supply quotas, 1973

| | *Initial quotas before changes* | *Quota changes dated 25th April* | *25th May* | *Quotas in effect* |
|---|---|---|---|---|
| | *(short tons, raw value)* | | | |
| Domestic Beet | 3,500,000 | — | — | 3,500,000 |
| Mainland Cane | 1,591,000 | — | — | 1,591,000 |
| Texas Cane .... | 20,000 | — | — | 20,000 |
| Hawaii ........ | 1,185,000 | — | — | 1,185,000 |
| Puerto Rico .... | 205,000 | —50,000 | —20,000 | 135,000 |
| Philippines .... | 1,347,591 | 15,040 | 26,896 | 1,389,527 |
| Argentina ...... | 77,182 | 881 | 3,105 | 81,168 |
| Australia ...... | 205,209 | — | —1,193 | 204,016 |
| Bolivia ........ | 6,558 | 75 | 264 | 6,897 |
| Brazil ........ | 556,916 | 6,355 | 22,413 | 585,684 |
| British Honduras | 34,303 | 391 | 1,380 | 36,074 |
| Colombia ...... | 68,605 | 783 | 2,762 | 72,150 |
| Costa Rica .... | 69,615 | 794 | 6,532 | 76,941 |
| Dominican Rep. | 645,698 | 7,368 | 25,987 | 679,053 |
| Ecuador ...... | 82,226 | 938 | 3,311 | 86,475 |
| Fiji .......... | 44,967 | — | — 262 | 44,705 |
| Guatemala .... | 59,525 | 679 | 5,586 | 65,790 |
| Haiti ........ | 31,276 | 357 | 1,258 | 32,891 |
| Honduras ...... | 12,107 | 138 | — 12,245 | 0 |
| India .......... | 82,165 | — | — 477 | 81,688 |
| Ireland ........ | 5,351 | — | — | 5,351 |
| Malagasy Republic | 12,264 | — | — 72 | 12,192 |
| Mauritius ...... | 30,250 | — | —176 | 30,074 |
| Mexico ...... | 571,040 | 6,517 | 22,981 | 600,538 |
| Nicaragua .... | 65,075 | 743 | 6,104 | 71,922 |
| Panama ...... | 65,075 | 743 | — 15,818 | 50,000 |
| Paraguay ...... | 6,558 | 75 | 264 | 6,897 |
| Peru .......... | 398,517 | 4,548 | 16,039 | 419,104 |
| Salvador ...... | 43,382 | 495 | 4,072 | 47,949 |
| South Africa.... | 58,047 | — | — 338 | 57,709 |
| Swaziland ...... | 30,250 | — | — 176 | 30,074 |
| Taiwan ...... | 85,436 | — | — 497 | 84,939 |
| Thailand ...... | 18,804 | — | — 110 | 18,694 |
| Venezuela ...... | 62,048 | 708 | 2,498 | 65,254 |
| West Indies .... | 207,835 | 2,372 | — 100,000 | 110,207 |
| | 11,500,000 | | | 11,500,000 |

# Brevities

**New sugar factory for Spain**[1].—The 1200 sugar beet growers of the "Onésimo Redondo" cooperative in Valladolid are planning to build a sugar factory with a daily processing capacity of 4000 tons.

* * *

**Environmental chemistry symposium.**—More than 200 specialists from Europe, the US and Japan are expected to attend a symposium on environmental chemistry organized by the i.b./c.c. (International Business Contact Club), which will take place during the 24th–25th October 1973 in the Hotel Atlanta, Brussels. Papers are to be presented by representatives of a number of companies and will cover filtration, ion exchange resins, water treatment, visible stack emissions, etc. The programme is available from the i.i./b.c. Administration, Nieuwelaan 65, B 1820 Strombeek, Belgium.

* * *

**Microbiology courses.**—The Department of Microbiology of University College, Cardiff, South Wales is holding two courses for chemists and engineers in industry in order to provide them with training in this speciality. The courses will be held during 16th–21st September and will be on the "Microbiology of Effluent Treatment" and an "Applied Microbiology Course", respectively. Further details may be obtained from Dr. C. F. FORSTER at the Department.

* * *

**New USSR sugar factory**[2].—One of the largest sugar factories in the Russian Federal Republic has started operations in Valuiki in the Belgorod district. It is the eleventh of a series of factories provided with full automation and electronic controls.

[1] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (5), 7.
[2] *ibid.*, (4), 5.

# Brevities

**The late Niels B. Bach.**—The death occurred recently of NIELS B. BACH, at his home in Vestervig, Denmark. He was 87. He studied chemical engineering in Copenhagen and Braunschweig, and subsequently travelled to Java and the Philippines where he owned and operated sugar factories. During his career, Mr. BACH obtained several patents on cane juice clarification and, in conjunction with The Mirrlees Watson Co. Ltd., installed close on two hundred Bach-Mirrlees subsiders and fifty Bach-Mirrlees "Poly-Cell" clarifiers around the world. His last patent, on an improved version of the "Poly-Cell" clarifier, was granted just two weeks before his death.

* * *

**Egyptian cane expansion[1].**—According to reports from Egypt, sugar production is to be increased by some 40,000 tons to 630,000 tons in 1974. This is to be achieved by opening up new cane areas in Central Egypt, involving extension of the area by 9–12%.

* * *

**Brazil sugar export finances[2].**—Decree-Law No. 1266 of the 26th March establishes that the proceeds from the Fundo Especial de Exportação de Açúcar will be used primarily to guarantee to producers the official export price for sugar and the operational and administrative costs involved in exporting. The balance will be channelled to providing finance for mergers, take-overs, relocations and modernization programmes for mills; the working capital requirements of cooperatives of producers and growers; the purchase of machinery and equipment by growers' cooperatives and companies formed with capital subscribed by them; the equalization of sugar cane and sugar prices throughout the country; and programmes to expand terminals and other facilities for exports and to improve quality standards of sugar cane and its cultivation. The Minister of Industry and Commerce announced in mid-April that financing of 800 million cruzeiros would be made available to sugar producers. It is proposed to raise sugar exports to 6 million tons a year by 1980; exports in 1972 amounted to 2,600,000 tons, valued at US$421,000,000, compared with 1,200,000 tons (US$153,000,000) in 1971. First official estimates show 1973/74 sugar production at 110 million bags (6·6 million metric tons); domestic consumption will amount to 70 million bags (4·2 million tons) and the remainder will be exported.

* * *

**New sugar factory for Lebanon[3].**—The Government of the Lebanon has authorized the construction of a second sugar factory which is to be completed by 1975 and, together with the existing beet sugar factory, will give a domestic production of 50–55,000 tons, compared with consumption of about 64,000 tons.

* * *

**Nigerian cube sugar plant closure[4].**—About 400 workers of the Tate & Lyle (Nigeria) Ltd. factory in Ilorin were laid off early in March. A spokesman for the company stated that the controlled price of cube sugar made it impossible for the factory to operate profitably.

* * *

**Animal fodder plant in Louisiana[5].**—A new plant is to be built at Lockwood, Louisiana, to produce animal fodder which includes molasses and bagasse pith as components. It is expected to be in production in August.

* * *

**Sri Lanka sugar development[6].**—The Asian Development Bank has approved a US$2,800,000 loan for a sugar industry project in Sri Lanka. The project will be situated in the south-eastern part of the country and the loan will cover foreign exchange costs of machinery, equipment, spare parts, imported materials and consultant services.

## USSR sugar imports and exports[7]

| | 1972 | 1971 |
|---|---|---|
| | *(metric tons, raw value)* | |
| IMPORTS | | |
| Australia | 119,564 | 0 |
| Brazil | 299,755 | 0 |
| Colombia | 10,000 | 0 |
| Cuba | 1,101,379 | 1,535,709 |
| Czechoslovakia | 21,740 | 0 |
| Dominican Republic | 23,152 | 0 |
| Ecuador | 10,617 | 0 |
| France | 53,738 | 0 |
| Germany, East | 81,525 | 0 |
| Holland | 10,870 | 0 |
| Mauritius | 25,187 | 0 |
| Poland | 108,700 | 0 |
| El Salvador | 24,196 | 0 |
| Venezuela | 34,019 | 0 |
| | 1,924,442 | 1,535,709 |
| EXPORTS | | |
| Afghanistan | 18,446 | 44,677 |
| Algeria | 0 | 116,844 |
| Bulgaria | 0 | 94,297 |
| Cyprus | 0 | 6,521 |
| Egypt | 0 | 9,705 |
| Finland | 188 | 136,472 |
| Germany, East | 0 | 75,239 |
| Ghana | 0 | 16,638 |
| Guinea | 0 | 1,175 |
| Hungary | 0 | 76,377 |
| Indonesia | 0 | 82,322 |
| Iran | 5,870 | 66,377 |
| Iraq | 0 | 168,262 |
| Italy | 0 | 545 |
| Jordan | 0 | 48,275 |
| Korea, North | 5,452 | 12,825 |
| Kuwait | 0 | 11,271 |
| Lebanon | 0 | 30,265 |
| Mali | 0 | 6,691 |
| Malta | 0 | 165 |
| Mongolia | 23,484 | 20,074 |
| Nigeria | 0 | 38,007 |
| Saudi Arabia | 0 | 10,632 |
| Sierra Leone | 0 | 4,414 |
| Somalia | 0 | 6,522 |
| Southern Yemen | 0 | 13,265 |
| Sri Lanka | 0 | 45,815 |
| Sudan | 0 | 71,536 |
| Sweden | 0 | 30,593 |
| Togo | 0 | 1,332 |
| UK | 0 | 86,078 |
| Vietnam, North | 10,747 | 16,245 |
| Yemen | 0 | 41,475 |
| Other countries | 0 | 10,617 |
| | 64,187 | 1,401,548 |

**Pakistan sugar factory plans[8].**—The Ministry of Industry has announced that the West Pakistan Industrial Development Corporation is studying the possibility of erection of a sugar factory in the neighbourhood of Sukkur. Two further new factories are to be built in the Rohri and Khairpur districts, while further plants are likely to be erected in Kot-Adu, Kamalia and Daska.

1 F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (5), 8.
2 *Bolsa Review*, 1973, 7, 243–244.
3 F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (6), 9.
4 *Barclays International Review*, April 1973, 21.
5 *Sugar y Azúcar*, 1973, **68**, (2), 32.
6 *Commonwealth Producer*, 1973, (454), 30.
7 *I.S.O. Stat. Bull.*, 1973, **32**, (3), 107–109.
8 *Zeitsch. Zuckerind.*, 1973, **98**, 295.

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# BUYERS' GUIDE

**Certain of the classifications have sub-headings for individual types of equipment. Specialist makers appear under these sub-headings, while inclusion of manufacturers under the general headings implies that they supply all or most of the types of equipment described by the sub-headings.**

---

**Accumulators, Hydraulic**
M. Dedini S.A. Metalúrgica.
Edwards Engineering Corporation.
Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.

**Accumulators, Steam**
*see* Steam accumulators.

**Activated carbon**
CECA.
Chemviron S.A.
Lurgi Apparate-Technik G.m.b.H.-Bereich Chemotechnik.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Suchar.

**Air clutches**
Farrel Company.
Renold Ltd.

**Air compressors**
Peter Brotherhood Ltd.
Cotton Bros. (Longton) Ltd.
Fives Lille-Cail.
Nash Engineering Company.

**Air compressors, Oil-free**
Peter Brotherhood Ltd.
Elliott Turbomachinery Ltd.
Nash Engineering Company.

**Air coolers**
Carter Industrial Products Ltd.
E. Green & Son Ltd.

**Air heaters**
M. Dedini S.A. Metalúrgica.
E. Green & Son Ltd.

**Air-operated portable stitchers**
Thomas C. Keay Ltd.
Thames Packaging Equipment Co.

**Alcohol plant**
A.P.V. Co. Ltd.
Bescon.
BMA Braunschweigische Maschinenbauanstalt.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
F. C. Schaffer & Associates Inc.
SPEICHIM.
Tate & Lyle Enterprises Ltd.

**Alcohol plant consultancy services**
Basico G.m.b.H.
Bookers Agricultural and Technical Services Ltd.

**Ammonia removal from condensates**
Akzo Chemie B.V.-Imacti.
Plenty & Son Ltd.
Robert Reichling & Co. K.G.

**Anti-foam agents**
Hodag Chemical Corporation.
Mazer Chemicals Inc.
Tate & Lyle Enterprises Ltd.

**Automatic beet laboratories**
Venema Automation N.V.
Ingeniörsfirman Nils Weibull AB.

**Automatic refractometers**
Bellingham and Stanley Ltd.

**Automatic saccharimeters and polarimeters**
Bellingham and Stanley Ltd.
Dr. Wolfgang Kernchen Optik-Elektronik-Automation.
Perkin-Elmer Ltd.
Rudolph Research Inc.
Schmidt + Haensch.
Thorn Automation Ltd.
Carl Zeiss.

**Automatic tare rooms**
Venema Automation N.V.
Ingeniörsfirman Nils Weibull AB.

**Bactericides**
Tate & Lyle Enterprises Ltd.

**Bag**
*see* Sack.

**Bagasse analysis apparatus**
A. H. Korthof N.V.

**Bagasse baling presses**
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
A. & W. Smith & Co. Ltd.

**Bagasse depithing equipment**
Stedman Foundry & Machine Co. Inc.
S. A. Verkor.

**Bagasse furnaces**
Babcock & Wilcox Ltd
M. Dedini S.A. Metalúrgica.
Foster Wheeler John Brown Boilers Ltd.
SEUM.

**Bagasse preparation equipment for particle board manufacture**
C F & I Engineers Inc.
Gruendler Crusher & Pulverizer Co.
S. A. Verkor.

**Bagasse presses**
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
French Oil Mill Machinery Co.
Sucatlan Engineering.

**Beet diffusers, Continuous**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
Extraction De Smet S.A.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.
Sucatlan Engineering.

**Beet flume equipment**
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.

**Beet harvesters**
Ransomes Sims & Jefferies Ltd.

**Beet mechanical discharging and storage equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Fives Lille-Cail.
Jenkins of Retford Ltd.

**Beet molasses sugar recovery**
Akzo Chemie B.V.-Imacti (*Quentin process*).
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
Robert Reichling & Co. K.G. (*Quentin process*).
Stork-Werkspoor Sugar N.V.

**Beet pulp presses**
BMA Braunschweigische Maschinenbauanstalt.
Fletcher and Stewart Ltd
Hein, Lehmann A.G.
Salzgitter Maschinen A.G.
Simon-Heesen B.V.
Stord Bartz Industri A/S
Ingeniörsfirman Nils Weibull AB.

**Beet seed**
A/S De Danske Sukkerfabrikker.
Kleinwanzlebener Saatzucht AG.

**Beet slicers**
Dreibholz & Floering Ltd.
H. Putsch & Comp.

**Beet tail utilization plant**
BMA Braunschweigische Maschinenbauanstalt.
H. Putsch & Comp

**Beet tare house equipment**
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.
Venema Automation N.V.
Ingeniörsfirman Nils Weibull AB.

**Beet washing plant**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Salzgitter Maschinen A.G.
Sucatlan Engineering.

**Beet water-jet unloading equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.

**Belting**
*see* Conveyor belting *and* Transmission belting

**Boiler tube brushes, Spiral and expanding**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.
Schaefer Brush Mfg. Co. Inc.

**Boiler tube cleaners, Air and electric**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

**Boiler water treatment**
Babcock & Wilcox Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Fabcon Inc.
The Permutit Co. Ltd.
Robert Reichling & Co K.G.
Werkspoor Water N.V.

**Boilers, Shell**
Babcock & Wilcox Ltd.
Robey of Lincoln Ltd.

**Boilers, Water tube**
Babcock & Wilcox Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Foster Wheeler John Brown Boilers Ltd
International Combustion Ltd.
M.E. Boilers Ltd.
Riley Stoker Corporation.
SEUM.
Stork-Werkspoor Sugar N.V.
Takuma Co. Ltd.
Wabash Power Equipment Co.

**Bone char**
British Charcoals & Macdonalds Ltd.
*see also* Char.

**Brushes**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Nordon & Cie.
Rotatools (U.K.) Ltd.
Schaefer Brush Mfg. Co. Inc.

**Bulk handling**
*see* Conveyors and Elevators, *etc.*

**Bulk liquid sugar handling plants.**
T. Giusti & Son Ltd.

**Bulk storage hoppers**
A.P.V.-Kestner Ltd.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newman Fabrications Ltd.
A. & W. Smith & Co. Ltd.
Tecomatic Ltd.

**Bulk sugar containers, Transportable**
Tecomatic Ltd.

**Bunker discharge equipment.**
Newman Fabrications Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

**Burners, Sulphur**
*see* Sulphur furnaces, Continuous.

**Calciners, Fluidized bed**
A.P.V.-Mitchell (Dryers) Ltd.
Buell Ltd.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.

**Cane car tippers**
CAMECO.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Walkers Ltd.

**Cane cars and trailers**
CAMECO.
Fletcher and Stewart Ltd.
Tate & Lyle Enterprises Ltd.
Volvo BM AB.
Walkers Ltd.

**Cane carts**
CAMECO.
Fletcher and Stewart Ltd.
Martin-Markham (Stamford) Ltd.
Ransomes Sims & Jefferies Ltd.
Tate & Lyle Enterprises Ltd.

**Cane conveyor drives**
CAMECO.
M. Dedini S.A. Metalúrgica.
Edwards Engineering Corporation.

**Cane cultivation equipment**
CAMECO.
Gebr. Claas Maschinenfabrik G.m.b.H.
Massey-Ferguson (Export) Ltd.
Ransomes Sims & Jefferies Ltd.
Rome Industries.

**Cane diffusers, Continuous**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
CAMECO.
C F & I Engineers Inc.
A/S De Danske Sukkerfabrikker.
Extraction De Smet S.A.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Sucatlan Engineering.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Cane grapples**
CAMECO.
Mennesson & Cie.

**Cane harvesters**
CAMECO.
Gebr. Claas Maschinenfabrik G.m.b.H.
Massey-Ferguson (Export) Ltd.
Toft Bros. Industries Ltd.

**Cane infield transport units**
CAMECO
Toft Bros. Industries Ltd.

**Cane loaders**
CAMECO.
F. W. McConnel Ltd.
Tate & Lyle Enterprises Ltd.
Toft Bros. Industries Ltd.
Volvo BM AB.

**Cane maturity testers**
A. H. Korthof N.V.

**Cane planters**
CAMECO.
Massey-Ferguson (Export) Ltd.

**Cane preparation equipment for diffusion**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Gruendler Crusher & Pulverizer Co.
The Mirrlees Watson Co. Ltd
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.

**Cane shredders**
*see* Shredders.

**Cane slings**
Parsons Chain Co. Ltd.

**Cane trash shredders**
C F & I Engineers Inc.
Gruendler Crusher & Pulverizer Co.

**Cane washing plants**
CAMECO.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Sucatlan Engineering.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

**Cane washing tables**
CAMECO.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Tate & Lyle Enterprises Ltd.

**Cane wash water cleaning systems**
Dorr-Oliver Inc., Cane Sugar Division.

**Cane wet disintegrators for analysis**
Jeffress Bros. Ltd.
Sugar Manufacturers' Supply Co. Ltd.

**Carbon, Decolorizing**
Chemviron S.A.
Lurgi Apparate-Technik G.m.b.H.-Bereich Chemotechnik.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Suchar.
The Sugar Manufacturers' Supply Co. Ltd.

**Carbon decolorizing systems**
CECA.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Suchar.
Tate & Lyle Enterprises Ltd.

**Carbon reactivation**
Chemviron S.A.
Pittsburgh Activated Carbon Division, Calgon Corporation.

**Carbonatation equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Neyrpic.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

**Castings**
Babcock & Wilcox Ltd.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
E. Green & Son Ltd.
Newell Dunford Engineering Ltd.
Stork-Werkspoor Sugar N.V.

**Castings, Non-ferrous**
Blundell & Crompton Ltd.
Fletcher and Stewart Ltd.

**Centrifugal backings**
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
Krieg & Zivy Industries.
The Western States Machine Co.

**Centrifugal clarifiers**
Dorr-Oliver Inc., Cane Sugar Division.

**Centrifugal motors**
ACEC.
Hinz Elektromaschinen und Apparatebau G.m.b.H.
Siemens A.G.
The Western States Machine Co.

**Centrifugal screens**
ASEA-Weibull.
Balco Filtertechnik G.m.b.H.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Cotton Bros. (Longton) Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Hein, Lehmann A.G.
Krieg & Zivy Industries.
The Mirrlees Watson Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
The Western States Machine Co.

**Centrifugals and accessories**
ACEC.
BMA Braunschweigische Maschin enbauanstalt.
A. Bosco S.p.A.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
Fives Lille-Cail.
Hein, Lehmann A.G.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
The Sugar Manufacturers' Supply Co. Ltd.
The Western States Machine Co

**Centrifugals—Complete electrical equipment**
ACEC.
Hinz Elektromaschinen und Apparatebau G.m.b.H.
Siemens A.G.

**Centrifugals, Continuous**
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Escher Wyss Ltd.
Fives Lille-Cail.
Hein, Lehmann A.G.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
Western States Machine Co

**Centrifugals—Fully automatic batch-type**
ASEA-Weibull.
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
The Western States Machine Co.

**Centrifugals—Semi-automatic batch-type**
ASEA-Weibull.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
The Mirrlees Watson Co. Ltd.
The Western States Machine Co.

**Chain cane slings**
Codistil–Construtora de Distilarias Dedini S.A.
Kettenfabrik Unna G.m.b.H. & Co. K.G.
Parsons Chain Co. Ltd.

**Chains**
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Kettenfabrik Unna G.m.b.H. & Co. K.G.
Parsons Chain Co. Ltd.
Renold Limited.

**Chemical plants**
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
T. Giusti & Son Ltd.
SPEICHIM.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

**Chemicals**
Allied Colloids Ltd.
Fabcon Inc.
Hodag Chemical Corporation.
May & Baker Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.

**Clarifiers**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Enviro-Clear Company Inc.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Tecomatic Ltd.

**Clarifiers, Tray-type**
Dorr-Oliver Inc., Cane Sugar Division.

**Collapsible containers for transporting sugar**
Tecomatic Ltd.

**Colorimeters**
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.

**Complete cane sugar factories**
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Condensers, Water jet ejector**
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Condensing plant, Barometric**
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

**Continuous belt weighing machines**
Herbert & Sons Ltd.
International Combustion Riley Ltd.
Neyrpic.
Siemens AG.

**Controls, Hydraulic**
Edwards Engineering Corporation.

**Conveyor belting**
Habasit A.G.

**Conveyor chains**
Codistil–Construtora de Distilerias Dedini S.A.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
Redler Conveyors Ltd.
Renold Limited.
A. & W. Smith & Co. Ltd.

**Conveyor cleaners**
Schaefer Brush Mfg. Co. Inc.

**Conveyors and elevators**
Babcock & Wilcox Ltd.
BMA Braunschweigische Maschin enbauanstalt.
British Ropeway Engineering Co. Ltd.
C F & I Engineers Inc.
Fives Lille-Cail.
Hein, Lehmann A.G.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Sucatlan Engineering
Techserve (Pty.) Ltd.
Walkers Ltd.
Ulrich Walter Maschinenbau.
Ingeniörsfirman Nils Weibull AB.

*Belt and bucket elevators*
Barry Henry & Cook Ltd.
Ewart Chainbelt Co. Ltd.
Jenkins of Retford Ltd.
Newman Fabrications Ltd.
Nordon & Cie.
Redler Conveyors Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Belt conveyors*
Barry Henry & Cook Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Codistil-Construtora de Distilarias Dedini S.A
Jenkins of Retford Ltd.
Newman Fabrications Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Bucket elevators*
Barry Henry & Cook Ltd.
Ewart Chainbelt Co. Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newman Fabrications Ltd.
Redler Conveyors Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Chain and bucket elevators*
Barry Henry & Cook Ltd.
Ewart Chainbelt Co. Ltd.
Jenkins of Retford Ltd.
Newman Fabrications Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Chain conveyors*
Barry Henry & Cook Ltd.
Codistil-Construtora de Distilarias Dedini S.A.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
Newman Fabrications Ltd.
Nordon & Cie.
Redler Conveyors Ltd.
Geo. Robson & Co. (Conveyors) Ltd.
The Thames Packaging Equipment Co.

*Feeder conveyors*
Barry Henry & Cook Ltd.
M. Dedini S.A. Metalúrgica.
Redler Conveyors Ltd.
*see also* Vibrating feeders.

*Grasshopper conveyors*
Barry Henry & Cook Ltd.
Thomas Broadbent & Sons Ltd
Buckau-Wolf Maschinenfabrik A.G.
The Mirrlees Watson Co. Ltd.

*Pneumatic conveyors*
Codistil-Construtora de Distilarias Dedini S.A.
Newell Dunford Engineering Ltd.
Newman Fabrications Ltd.
Nordon & Cie.
Tecomatic Ltd.

*Scraper conveyors*
Barry Henry & Cook Ltd.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart.
Jenkins of Retford Ltd.

*Screw conveyors*
Barry Henry & Cook Ltd.
Brencede Ltd.
Ewart Chainbelt Co. Ltd.
The Mirrlees Watson Co. Ltd.
Newman Fabrications Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

*Telescopic belt conveyors.*
Geo. Robson & Co. (Conveyors) Ltd.

*Vibratory conveyors*
Eriez Magnetics.
Ewart Chainbelt Co. Ltd.

**Conveyors and elevators, Mobile**
The Thames Packaging Equipment Co.

**Coolers, Fluidized bed**
A.P.V.-Mitchell (Dryers) Ltd.
Buell Ltd.
Codistil-Construtora de Distilarias Dedini S.A.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.

**Coolers, Pellet**
Simon-Heesen B.V.

**Coolers, Sugar**
A.P.V.-Mitchell (Dryers) Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Codistil-Construtora de Distilarias Dedini S.A.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stansteel Corporation.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Ingeniörsfirman Nils Weibull AB.

**Coolers, Water**
Carter Industrial Products Ltd.
Codistil-Construtora de Distilarias Dedini S.A.
Film Cooling Towers (1925) Ltd.

**Cranes**
Babcock & Wilcox Ltd.
CAMECO.
Fives Lille-Cail.
John M. Henderson & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Stothert & Pitt Ltd.

**Crystallization aids**
Fabcon Inc.
Hodag Chemical Corporation.
Mazer Chemicals Inc.
Techserve (Pty.) Ltd.

**Crystallizers**
Barry Henry & Cook Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Geo. Robson & Co. (Conveyors) Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division

**Crystallizers, Continuous**
C F & I Engineers Inc.
Fives Lille-Cail.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Cube-making machinery**
Buckau-Wolf Maschinenfabrik A.G.
Chambon Ltd.
Elba Machinefabrieken B.V.
Stansteel Corporation.
Stork-Amsterdam B.V.
Ingeniörsfirman Nils Weibull A.B.

**Cube sugar moulding, ranging and packeting plant**
Buckau-Wolf Maschinenfabrik A.G.
Chambon Ltd.
Elba Machinefabrieken B.V.
Stork-Amsterdam B.V.

**Cube wrapping machines**
SAPAL.

**Deaerators**
The Permutit Co. Ltd.
Robert Reichling & Co. KG..
Stork-Werkspoor Sugar N.V.

**Decolorizing agents**
Tate & Lyle Enterprises Ltd.

**Decolorizing plants**
Akzo Chemie B.V.-Imacti.
BMA Braunschweigische Maschinenbauanstalt.
Chemviron S.A.
The Permutit Co. Ltd.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Robert Reichling & Co. K.G.
Tate & Lyle Enterprises Ltd.

**Decolorizing resins**
Akzo Chemie B.V.-Imacti.
Diamond Shamrock Chemical Co., Nopco Chemical Division.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Rohm and Haas Company.

**Deliming plants**
Akzo Chemie B.V.-Imacti.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Division.
Robert Reichling & Co. K.G.

**Demineralization plants**
Akzo Chemie B.V.-Imacti.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Division.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Werkspoor Water N.V.

**Diatomaceous earth**
*see* Filter-aids.

**Diesel alternator sets**
ACEC.
Stork-Werkspoor Sugar N.V.

**Distillery plant**
*see* Alcohol plant.

**Drives, Chain**
Ewart Chainbelt Co. Ltd.
Renold Limited.

**Drives, Hydraulic**
Edwards Engineering Corporation.

**Drives, Variable speed**
Mawdsleys Ltd.
Renold Limited.
Thorn Automation Ltd.

**Drives**
*see also* Cane conveyor drives, Flexible drives, Knives, Milling—Drives *and* Shredder drives.

**Dryers**
A.P.V.-Mitchell (Dryers) Ltd.
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
Codistil-Construtora de Distilarias Dedini S.A.
Escher Wyss Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
Stansteel Corporation.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

**Dryers, Fluidized bed**
A.P.V.-Mitchell (Dryers) Ltd.
A. Bosco S.p.A.
Buell Ltd.
Escher Wyss Ltd.
Fives Lille-Cail.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.
Stork-Werkspoor Sugar N.V.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

**Dust control equipment**
Buell Ltd.
Carter Industrial Products Ltd.
Dust Control Equipment Ltd.
Mikropul Ltd.
Newell Dunford Engineering Ltd.
Stansteel Corporation.
Takuma Co. Ltd.
Tecomatic Ltd.
Zurn Air Systems.

**Dust sleeves and bags**
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
JK Industrial Fabrics.
Lainyl Filter Cloths.
P. & S. Textiles Ltd.
Weco Filter Sleeve Manufacturing Co. Ltd.

**Economizers**
E.Green & Son Ltd.
International Combustion Ltd.

**Effluent treatment**
The Davenport Engineering Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Film Cooling Towers (1925) Ltd.
Foster Wheeler John Brown Boilers Ltd.
International Combustion Ltd.
Perkin-Elmer Ltd.

**Effluent treatment—*continued***
The Permutit Co. Ltd.
Plenty & Son Ltd.
Tate & Lyle Enterprises Ltd.
Werkspoor Water N.V.

**Electric heaters for pipes**
Stabilag Engineering Ltd.

**Electric heaters for vessels**
Stabilag Engineering Ltd.

**Electric motors**
ACEC.
Weir Pumps Ltd.

**Electric motors, Fractional horsepower**
The Thames Packaging Equipment Co.

**Electric power generators**
ACEC.
Stork-Werkspoor Sugar N.V.

**Electric tube cleaning machines**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Nordon & Cie.
Rotatools (U.K.) Ltd.

**Electronic control systems for process plant**
Bailey Meters & Controls Ltd.
C F & I Engineers Inc.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
Tate & Lyle Enterprises Ltd.
Taylor Instrument Companies (Europe) Ltd.

**Electronic equipment**
ACEC.
Bailey Meters & Controls Ltd.

**Engineering design and contracting services**
Basico G.m.b.H.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
CAMECO
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
Jenkins of Retford Ltd.
Lucks & Co. G.m.b.H.
The Mirrlees Watson Co. Ltd.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Sucatlan Engineering.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Tecomatic Ltd.

**Engines, Diesel**
Stork-Werkspoor Sugar N.V.

**Engines, Steam**
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Entrainment separators**
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Plenty & Son Ltd.
A. & W. Smith & Co. Ltd.
Techserve (Pty.) Ltd.
York Export Corporation.

**Enzymes**
A.B.M. Industrial Products Ltd.
Tate & Lyle Enterprises Ltd.

**Evaporator additives**
Allied Colloids Ltd.
M. Dedini S.A. Metalúrgica.
Fabcon Inc.
Hodag Chemical Corporation.

**Evaporator tube cleaners**
*see* Tube cleaners.

**Evaporators and condensing plant**
Alfa-Laval AB.
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Escher Wyss Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
A. & W. Smith & Co. Ltd.
SPEICHIM.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.
Wiegand Karlsruhe G.m.b.H.

**Evaporators, Falling film**
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division
Wiegand Karlsruhe G.m.b.H.

**Expanders, Tube**
*see* Tube expanders.

**Fans, Induced and forced draft**
M. Dedini S.A. Metalúrgica.
Stork-Werkspoor Sugar N.V.
Zurn Air Systems.

**Feasibility studies for sugar projects**
F. C. Schaffer & Associates Inc.

**Filter aids**
CECA.
Dicalite/GREFCO Inc., International Division.
Fabcon Inc.
Sil-Flo Incorporated.
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.
Witco Chemical Corp.—Kenite Division.

**Filter cloths**
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
N. Greening (Warrington) Ltd.
JK Industrial Fabrics.
Lainyl Filter Cloths.
P. & S. Textiles Ltd.
Sankey Green Wire Weaving Co. Ltd.
A. & W. Smith & Co. Ltd.
Weco Filter Sleeve Manufacturing Co. Ltd.

**Filter leaves**
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Sankey Green Wire Weaving Co. Ltd.
Stockdale Engineering Ltd.

**Filter papers**
Evans, Adlard & Co. Ltd.
A. H. Korthof N.V.
H. Reeve Angel & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

**Filter screens**
Cotton Bros. (Longton) Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
JK Industrial Fabrics.
Krieg & Zivy Industries.
Paxman Process Plant Division.
J. & F. Pool Ltd.
Sankey Green Wire Weaving Co. Ltd.
Stockdale Engineering Ltd.
Weco Filter Sleeve Manufacturing Co. Ltd.

**Filters**
Fives Lille-Cail.
SPEICHIM.
Sucatlan Engineering.
Werkspoor Water N.V.
Wire Weaving Co. Ltd.

*Automatically controlled filters*
Chemap A.G.
Paxman Process Plant Division.
Schumacher'sche Fabrik.
Stella Meta Filters.
Stockdale Engineering Ltd.
U.S. Filter Systems.

*Bag pressure filters*
A. F. Craig & Co. Ltd.

*Candle filters*
BMA Braunschweigische Maschinenbauanstalt.
H. Putsch & Comp.
Schumacher'sche Fabrik.
Stella Meta Filters.
Stockdale Engineering Ltd.

*Diatomite filters*
Chemap A.G.
The Mirrlees Watson Co. Ltd.
Paxman Process Plant Division.
Schumacher'sche Fabrik.
Stockdale Engineering Ltd.
U.S. Filter Systems.

*Filter presses*
BMA Braunschweigische Maschinenbauanstalt.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.

*Filter thickeners*
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc., Cane Sugar Division.
Paxman Process Plant Division.
H. Putsch & Comp.
Schumacher'sche Fabrik.
Stockdale Engineering Ltd.

*Gravity and pressure filters*
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.
Stockdale Engineering Ltd.

*Iron removal filters*
Rapid Magnetic Ltd.
Stockdale Engineering Ltd.

*Laboratory filters*
*see* Laboratory filters.

*Leaf filters*
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Sankey Green Wire Weaving Co. Ltd.
A. & W. Smith & Co. Ltd.
Stockdale Engineering Ltd.
Stork-Werkspoor Sugar N.V.
Suchar.
U.S. Filter Systems.

*Plate and frame filters*
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.

*Pressure filters*
BMA Braunschweigische Maschinenbauanstalt.
Chemap A.G.
Dorr-Oliver Inc., Cane Sugar Division.
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.
Plenty & Son Ltd.
H. Putsch & Comp.
Schumacher'sche Fabrik.
A. & W. Smith & Co. Ltd.
Stockdale Engineering Ltd.
Suchar.
U.S. Filter Systems.

*Rotary vacuum filters*
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Paxman Process Plant Division.
H. Putsch & Comp.
Stockdale Engineering Ltd.

**Flanges, Non-Ferrous**
Blundell & Crompton Ltd.

**Flexible drives**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

**Flexible shaft couplings**
David Brown Gear Industries Ltd.
Renold Limited.

**Flexible shafting**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

**Flocculants**
Allied Colloids Manufacturing Co. Ltd.
The Dow Chemical Company.
Hodag Chemical Corporation.
Tate & Lyle Enterprises Ltd.

**Flotation agents**
Tate & Lyle Enterprises Ltd.

**Flotation equipment**
Tate & Lyle Enterprises Ltd.

**Flowmeters**
Bailey Meters & Controls Ltd.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
Negretti & Zambra Ltd.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
Wallace & Tiernan Ltd.
Ulrich Walter Maschinenbau.

**Gas purifying equipment**
Maschinenfabrik H. Eberhardt.
Newell Dunford Engineering Ltd.
Plenty & Son Ltd.
Stork-Werkspoor Sugar N.V.

**Gear couplings**
David Brown Gear Industries Ltd.
M. Dedini S.A. Metalúrgica.
Renold Limited.

**Gearing**
*see* Reduction gears.

**Gearmotors**
David Brown Gear Industries Ltd.
Renold Limited.

**Granulators**
*see* Dryers.

**Harvesters**
*see* Beet harvesters *and* Cane harvesters.

**Heat exchangers, Air-cooled**
E. Green & Son Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.

**Heat-exchangers, Lamella-type**
Alfa-Laval AB.

**Heat exchangers, Plate-type**
Alfa-Laval AB.
A.P.V. Co. Ltd.

**Heat exchangers, Spiral-type**
Alfa-Laval AB.

**Heat exchangers, Tubular**
Alfa-Laval AB.
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
International Combustion Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
A. & W. Smith & Co. Ltd.
SPEICHIM.
Ingeniörsfirman Nils Weibull A.B.

**Heat sealers**
The Thames Packaging Equipment Co.

**Herbicides**
Tate & Lyle Enterprises Ltd.

**Instruments, Process control**
Bailey Meters & Controls Ltd.
Bellingham & Stanley Ltd.
Chemap A.G.
A/S De Danske Sukkerfabrikker.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
Negretti & Zambra Ltd.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
Ronald Trist Controls Ltd.
Ulrich Walter Maschinenbau.
Westinghouse Brake and Signal Co. Ltd.
G. H. Zeal Ltd.

**Ion exchange plants**
Akzo Chemie B.V.–Imacti.
BMA Braunschweigische Maschinenbauanstalt.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Tate & Lyle Enterprises Ltd.
Werkspoor Water N.V.

**Ion exchange resins**
Akzo Chemie B.V.–Imacti.
Diamond Shamrock Chemical Co., Nopco Chemical Division.
The Dow Chemical Company.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Rohm and Haas Company.

**Irrigation equipment**
Evenproducts Ltd.
Farrow Irrigation Ltd.
Irrigation & Industrial Development Corp.
SPP Systems Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.
Wright Rain Irrigation (Pty.) Ltd.

**Juice heaters**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.

**Juice scales**
Fletcher and Stewart Ltd.
N.V. Servo-Balans.
*see also* Weighing Machines.

**Juice strainers and screens**
C F & I Engineers Inc.
The Deister Concentrator Co. Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Farrel Company.
Ferguson Perforating & Wire Co.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fontaine & Co. G.m.b.H.
Fulton Iron Works Company.
N. Greening (Warrington) Ltd.
The Mirrlees Watson Co. Ltd.
Plenty & Son Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
Walkers Ltd.

**Juice and syrup mixers**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
The Mirrlees Watson Co. Ltd.
Plenty & Son Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.

**Knives, Beet**
Dreibholz & Floering Ltd.
H. Putsch & Comp.

**Knives, Milling**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Knives, Milling—Drives**
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fletcher and Stewart Ltd.
Mawdsleys Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Thorn Automation Ltd.

**Laboratory apparatus and equipment**
Bellingham & Stanley Ltd.
Chemap A.G.
A. H. Korthof N.V.
The Permutit Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.
Carl Zeiss.
*see also* Laboratory instruments, *etc.*

**Laboratory cane grinders**
Jeffress Bros. Ltd.

**Laboratory filters**
Paxman Process Plant Division.
H. Reeve Angel & Co. Ltd.
Stockdale Engineering Ltd.

**Laboratory glassware**
Fischer & Porter Ltd.

**Laboratory instruments**
Bellingham & Stanley Ltd.
A. H. Korthof N.V.
The Sugar Manufacturers' Supply Co. Ltd.
G. H. Zeal Ltd.
*see also* Automatic saccharimeters and polarimeters, Laboratory apparatus and equipment, Refractometers, Saccharimeters and polarimeters, *etc*

**Laboratory reagents**
A. H. Korthof N.V.
May & Baker Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

**Level indicators and controllers**
von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke.
Bailey Meters & Controls Ltd.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
Negretti & Zambra Ltd.
Siemens A.G.
Ronald Trist Controls Ltd.

**Lime kilns**
A.P.V.-Mitchell (Dryers) Ltd.
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Maschinenfabrik H. Eberhardt.
Koppers-Wistra-Ofenbau G.m.b.H.
Newell Dunford Engineering Ltd.

**Lime slaking equipment**
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Maschinenfabrik H. Eberhardt.
Stork-Werkspoor Sugar N.V.
Wallace & Tiernan Ltd.

**Liming equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Maschinenfabrik H. Eberhardt.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
Techserve (Pty.) Ltd.

**Locomotives, Battery-electric**
International Combustion Ltd.

**Locomotives, Diesel**
International Combustion Ltd.

**Locomotives, Diesel-hydraulic**
Plymouth Locomotives Division.

**Magnetic lifting equipment**
Brimag Ltd.
Electromagnets Ltd.
Eriez Magnetics.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.

**Magnetic separators**
Brimag Ltd.
Electromagnets Ltd.
Eriez Magnetics.
Fletcher and Stewart Ltd.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.
Ulrich Walter Maschinenbau.

**Massecuite heat treating equipment**
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
E. Green & Son Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.)Ltd.
Walkers Ltd.
The Western States Machine Co.

**Mill hydraulics**
M. Dedini S.A. Metalúrgica.
Edwards Engineering Corporation.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Mill roll movement indicators and recorders**
Edwards Engineering Corporation.

**Mill rolls**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Milling plant**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.). Ltd.
Walkers Ltd.

**Mill sanitation agents**
Tate & Lyle Enterprises Ltd.

**Mixing machines**
Babcock & Wilcox Ltd.

**Moisture expellers**
Richard Simon & Sons Ltd.
Sucatlan Engineering.

**Molasses addition plants for beet pulp**
Amandus Kahl Nachf.
Ulrich Walter Maschinenbau.

**Molasses scales, Fully automatic**
N.V. Servo-Balans.

**Molasses tanks**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Codistil–Construtora de Distilarias Dedini S.A.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
KIW Construction Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.

**Molasses water blending units**
Bescon.

**Muds sugar recovery systems**
Tate & Lyle Enterprises Ltd.

**Packeting machinery**
Thomas C. Keay Ltd.

**Pan boiling aids**
Allied Colloids Ltd.
Fabcon Inc.
Hodag Chemical Corporation.
Techserve (Pty.) Ltd.

**Pan boiling automatic control**
Siemens A.G.

**Pan circulators**
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

**Pans, Vacuum**
A.P.V.-Mitchell (Dryers) Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Fives Lille-Cail.

**Pans, Vacuum**—*continued*
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
KIW Construction Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
SEUM.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division

**Pelleting presses for bagasse and pith**
Amandus Kahl Nachf.
Simon-Heesen B.V.

**Pelleting presses for dried pulp**
Amandus Kahl Nachf.
Simon-Heesen B.V.

**Perforated metals**
Ferguson Perforating & Wire Co.
N. Greening (Warrington) Ltd.
Krieg & Zivy Industries.
J. & F. Pool Ltd.
Ulrich Walter Maschinenbau.

**Pipe fittings**
*see* Tube fittings

**Pipes, Non-ferrous**
Birmingham Battery Tube Company.

**Pipework installation**
Babcock & Wilcox Ltd.
Blundell & Crompton Ltd.
Nordon & Cie.

**Polythene bag sealers**
The Thames Packaging Equipment Co.

**Power plants**
Stork-Werkspoor Sugar N.V.

**Power transmission equipment**
Thomas Broadbent & Sons Ltd.
David Brown Gear Industries Ltd.
Farrel Company.
Renold Limited.

**Preliming equipment**
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc., Cane Sugar Division.
Stork-Werkspoor Sugar N.V.

**Pressure feeders**
Walkers Ltd.

**Pressure gauges**
The British Rototherm Co. Ltd.
Negretti & Zambra Ltd.
Serseg (Seguin-Sergot).
Wallace & Tiernan Ltd.
G. H. Zeal Ltd.

**Pressure vessels**
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
International Combustion Ltd.
Robey of Lincoln Ltd.
SEUM.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

**Printing machinery for sugar cartons, etc.**
Chambon Ltd.

**Pulp screens**
C F & I Engineers Inc.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.

**Pulverizers, Sugar**
Mikropul Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

**Pumps**
Dorr-Oliver Inc., Cane Sugar Division.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
Weir Pumps Ltd.

*Beet pumps*
Ateliers de Construction d'Ensival S.A.
FosterPump Works Inc.
KSB Klein, Schanzlin & Becker A.G.
Weise & Monski, Weise Soehne G.m.b.H.

*Boiler feed pumps*
Ateliers de Construction d'Ensival S.A.
Howard Pneumatic Engineering Co. Ltd.
KSB Klein, Schanzlin & Becker A.G.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski. Weise Soehne G.m.b.H.

*Centrifugal pumps*
ACEC.
A.P.V. Co. Ltd.
A.P.V.-Kestner Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
Irrigation & Industrial Development Corp.
KSB Klein, Schanzlin & Becker A.G.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski, Weise Soehne G.m.b.H.

*Corrosion-proof pumps*
The Albany Engineering Co. Ltd.
A.P.V.-Kestner Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
KSB Klein, Schanzlin & Becker A.G.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.

*Dosing pumps*
BMA Braunschweigische Maschinenbauanstalt.
Fabcon Inc.
Howard Pneumatic Engineering Co. Ltd.
The Permutit Co. Ltd.
Tate & Lyle Enterprises Ltd.
Wallace & Tiernan Ltd.

*Filtrate pumps*
A.P.V.-Kestner Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
KSB Klein, Schanzlin & Becker A.G.
Mono Pumps Ltd.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski, Weise Soehne G.m.b.H.

*Gas pumps*
George Waller & Son Ltd.

*Irrigation pumps*
Ateliers de Construction d'Ensival S.A.
Farrow Irrigation Ltd.
Irrigation & Industrial Development Corp.
KSB Klein, Schanzlin & Becker A.G.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.
Wright Rain Irrigation (Pty.) Ltd.

*Massecuite pumps*
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Deplechin.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Mirrlees Pumps Ltd.
A. & W. Smith & Co. Ltd.
Techserve (Pty.) Ltd.

*Membrane pumps*
Saunders Valve Co. Ltd.

*Molasses pumps*
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
Fletcher and Stewart Ltd.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
Irrigation & Industrial Development Corp.
Amandus Kahl Nachf.
KSB Klein, Schanzlin & Becker A.G.
Mirrlees Pumps Ltd.
The Mirrlees Watson Co. Ltd.
Mono Pumps Ltd.
A. & W. Smith & Co. Ltd.
Stothert & Pitt Ltd.
Ulrich Walter Maschinenbau.

*Positive-action pumps*
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Fletcher and Stewart Ltd.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
Mirrlees Pumps Ltd.
Mono Pumps Ltd.
Stothert & Pitt Ltd.

*Rotary pumps*
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
Irrigation & Industrial Development Corp.
Mono Pumps Ltd.
Stothert & Pitt Ltd.

*Self-priming pumps*
The Albany Engineering Co. Ltd.
Flexible Drives (Gilmans) Ltd.
Foster Pump Works Inc.
Houttuin-Pompen N.V.
KSB Klein, Schanzlin & Becker A.G.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.
Stothert & Pitt Ltd.

*Sump pumps*
The Albany Engineering Co. Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Deplechin.
KSB Klein, Schanzlin & Becker A.G.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski, Weise Soehne G.m.b.H.

*Syrup pumps*
Foster Pump Works Inc.
KSB Klein, Schanzlin & Becker A.G.
Mirrlees Pumps Ltd.

*Vacuum pumps*
*see* Vacuum pumps.

**Railway**
*see* Cane cars *and* Locomotives.

**Raw sugar scales, Fully automatic**
N.V. Servo-Balans.
Ingeniörsfirman Nils Weibull A.B.

**Rectifiers**
ACEC.

**Reduction gears**
David Brown Gear Industries Ltd.
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
The Mirrlees Watson Co. Ltd.
Renold Limited.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Refinery equipment**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Dorr-Oliver Inc., Cane Sugar Division.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.

**Refinery equipment**—*continued*
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Suchar.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

**Refractometers**
Bellingham & Stanley Ltd.
Dr. Wolfgang Kernchen Optik-Elektronik-Automation.
A. H. Korthof N.V.
Schmidt + Haensch.
Carl Zeiss.

**Refractory bricks**
GR–Stein Refractories Ltd.
Lucks & Co. G.m.b.H.

**Refractory cement**
GR–Stein Refractories Ltd.

**Roller chain**
Ewart Chainbelt Co. Ltd.
Renold Limited.

**Rubber belt cane carriers**
Codistil–Construtora de Distilarias Dedini S.A.
Farrel Company.

**Saccharimeters and polarimeters**
Bellingham & Stanley Ltd.
Dr. Wolfgang Kernchen Optik-Elektronik-Automation.
A. H. Korthof N.V.
Perkin-Elmer Ltd.
Rudolph Research Inc.
Schmidt + Haensch.
The Sugar Manufacturers' Supply Co. Ltd.
Thorn Automation Ltd.
Carl Zeiss.

**Sack closing machines**
Greif-Werk Maschinenfabrik.
Thomas C. Keay Ltd.
Librawerk Pelz & Nagel K.G.
Reed Darnley Taylor Ltd.
The Thames Packaging Equipment Co.

**Sack counting equipment**
The Thames Packaging Equipment Co.

**Sack filling machines**
Cellier S.A.
Greif-Werk Maschinenfabrik.
Thomas C. Keay Ltd.
Librawerk Pelz & Nagel K.G.
Reed Darnley Taylor Ltd.
Richard Simon & Sons Ltd.
Ingeniörsfirman Nils Weibull AB.

**Sack openers**
Thames Packaging Equipment Co

**Sack printing machines**
Thomas C. Keay Ltd.

**Sampling equipment**
Cocksedge & Co. Ltd.
The Thames Packaging Equipment Co.
Ingeniörsfirman Nils Weibull AB.

**Sand removal systems for juice and effluent**
Dorr-Oliver Inc., Cane Sugar Division.

**Scale removal and prevention**
Allied Colloids Ltd.
Fabcon Inc.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd
Hodag Chemical Corporation.
Rotatools (U.K.) Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
*see also* Tube cleaners.

**Screens, Centrifugal**
*see* Centrifugal screens.

**Screens, Filter**
*see* Filter screens.

**Screens, Rotary**
J. & F. Pool Ltd.

**Screens, Vibrating**
BMA Braunschweigische Maschinenbauanstalt.
The Deister Concentrator Co. Inc.
Electromagnets Ltd.
Eriez Magnetics.
Fletcher and Stewart Ltd.
Hein, Lehmann A.G.
The Sugar Manufacturers' Supply Co. Ltd.
*see also* Juice strainers and screens

**Screens, Wire**
Dorr-Oliver Inc., Cane Sugar Division.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.

**Sedimentation accelerators**
Allied Colloids Ltd.
Fabcon Inc.
Hodag Chemical Corporation.
Tate & Lyle Enterprises Ltd.

**Sedimentation tanks and clarifiers**
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Enviro-Clear Company Inc.
Fletcher and Stewart Ltd.
Werkspoor Water N.V.

**Settling basins for flume water treatment**
Lucks & Co. G.m.b.H.

**Sewing threads, Heavy grade**
Thames Packaging Equipment Co.

**Ship loading installations**
Babcock & Wilcox Ltd.
British Ropeway Engineering Co. Ltd.
Stothert & Pitt Ltd.
Tate & Lyle Enterprises Ltd.

**Shredder drives**
M. Dedini S.A. Metalúrgica.
Farrel Company.
Mawdsleys Ltd.
Stork-Werkspoor Sugar N.V.

**Shredders**
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gruendler Crusher & Pulverizer Company.
The Mirrlees Watson Co. Ltd.
Stedman Foundry & Machine Co. Inc.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Silos**
Lucks & Co. G.m.b.H.
Tecomatic Ltd.
Ingeniörsfirman Nils Weibull AB.

**Slats for slat conveyors**
William Bain & Co. Ltd.
Ewart Chainbelt Co. Ltd.
Geo. Robson & Co. (Conveyors) Ltd.

**Spectrophotometers**
Perkin-Elmer Ltd.
Tate & Lyle Enterprises Ltd.

**Spectropolarimeters**
Bellingham & Stanley Ltd.
Dr. Wolfgang Kernchen Optik-Elektronik-Automation.
Perkin-Elmer Ltd.
Rudolph Research Inc.
Schmidt + Haensch.

**Sprockets**
Ewart Chainbelt Co. Ltd.
Renold Ltd.

**Stainless steel pipelines, Large diameter**
Welding Technical Services Ltd.

**Starch removal enzymes for cane juice**
A.B.M. Industrial Products Ltd.
Tate & Lyle Enterprises Ltd.

**Steam accumulators**
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.

**Steam storage equipment**
*see* Steam accumulators.

**Steam superheaters**
Babcock & Wilcox Ltd.
Foster Wheeler John Brown Boilers Ltd.
International Combustion Ltd.
M.E. Boilers Ltd.
Stork-Werkspoor Sugar N.V.

**Steam turbines for mill drives, etc.**
Peter Brotherhood Ltd.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Elliott Turbomachinery Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hiro Zoki Co. Ltd.
A.G. Kühnle, Kopp & Kausch.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Steam turbo-alternator sets**
ACEC.
Peter Brotherhood Ltd.
M. Dedini S.A. Metalúrgica.
Elliott Turbomachinery Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hiro Zoki Co. Ltd.
A.G. Kühnle, Kopp & Kausch.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Wabash Power Equipment Co.

**Steel framed buildings**
William Bain & Co. Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Lucks & Co. G.m.b.H.

**Stokers**
Riley Stoker Corporation.

**Storage vessels, Stainless steel**
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
T. Giusti & Son Ltd.
SEUM.
Stork-Werkspoor Sugar N.V.
Tecomatic Ltd.

**Strainers**
Elliott Turbomachinery Ltd.

**Sugar agronomy consultancy services**
Basico G.m.b.H.
Bookers Agricultural & Technical Services Ltd.
Hawaiian Agronomics Company (International).
F. C. Schaffer & Associates Inc.
Soc. Sucrière d'Etudes et de Conseils S.A.
Tate & Lyle Technical Services Ltd.

**Sugar factory consultancy services**
Basico G.m.b.H.
Bescon.
Bookers Agricultural & Technical Services Ltd.
C F & I Engineers Inc.
Cowiconsult.
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
Industrieprojekt A.G.
Chr. Ostenfeld & W. Jonson.
F. C. Schaffer & Associates Inc.
Soc. Sucrière d'Etudes et de Conseils S.A.
Tate & Lyle Technical Services Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Sugar factory design and erection (Cane and Beet)**
Basico G.m.b.H.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Waschinenfabrik A.G
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Lucks & Co. G.m.b.H.
The Mirrlees Watson Co. Ltd.
Reggiane O.M.I. S.p.A.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.)

**Sugar machinery, General**
Babcock & Wilcox Ltd.
Barry Henry & Cook Ltd.
BMA Braunschweigische Maschinenbauanstalt.
A. Bosco S.p.A.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Dorr-Oliver Inc., Cane Sugar Division.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fulton Iron Works Company.
Hitachi Shipbuilding & Engineering Co. Ltd.

**Sugar machinery, General**—*continued*
Kay Iron Works (Pvt.) Ltd.
K.I.W. Construction Ltd.
The Mirrlees Watson Co. Ltd.
Reggiane O.M.I. S.p.A.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.

**Sugar refinery consultancy services**
Basico G.m.b.H.
C F & I Engineers Inc.
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
Industrieprojekt A.G.
F. C. Schaffer & Associates Inc.
Tate & Lyle Technical Services Ltd.
Techserve (Pty.) Ltd.

**Sugar refinery design and erection**
Basico G.m.b.H.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Lucks & Co. G.m.b.H.
The Mirrlees Watson Co. Ltd.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

**Sugar silos**
Cowiconsult.
A/S De Danske Sukkerfabrikker.
Fives Lille-Cail.
Lucks & Co. G.m.b.H.
Chr. Ostenfeld & W. Jonson.
Tecomatic Ltd.
Ingeniörsfirman Nils Weibull A.B.

**Sugar tabletting machinery**
Chambon Ltd.
Elba Machinefabrieken B.V.
Stansteel Corporation.
Ingeniörsfirman Nils Weibull A.B.

**Sulphur furnaces, Continuous**
Buckau-Wolf Maschinenfabrik A.G.
Cocksedge & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Maschinenfabrik H. Eberhardt.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

**Switchgear**
ACEC.

**Temperature recorders and controllers**
Bailey Meters and Controls Ltd.
The British Rototherm Co. Ltd.
Chemap A.G.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Kent Instruments Ltd.
A. H. Korthof N.V.
Negretti & Zambra Ltd.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
G. H. Zeal Ltd.

**Test sieves, B.S. and A.S.T.M.**
International Combustion Riley Ltd.
A. H. Korthof N.V.

**Thermometers**
The British Rototherm Co. Ltd.
A. H. Korthof N.V.
Negretti & Zambra Ltd.
G. H. Zeal Ltd.

**Thickeners, Tray-type**
Dorr-Oliver Inc., Cane Sugar Division.

**Trailers**
Martin-Markham (Stamford) Ltd.
Ransomes Sims & Jefferies Ltd.
Tate & Lyle Enterprises Ltd.
Toft Bros. Industries Ltd.

**Transmission belting**
Habasit A.G.

**Tube brushes, Wire**
Flexible Drives (Gilmans) Ltd.
Rotatools (U.K.) Ltd.

**Tube cleaners, Rotary (Electric and air)**
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool)Ltd.
Nordon & Cie.
Rotatools (U.K.) Ltd.
*see also* Scale removal and prevention.

**Tube expanders**
Rotatools (U.K.) Ltd.

**Tube fittings**
Realm Engineering Works Ltd. (*stainless steel*).

**Tubes, Bimetal**
Birmingham Battery Tube Company.

**Tubes for boilers, evaporators, juice heaters, vacuum pans, etc.**
Babcock & Wilcox Ltd.
Birmingham Battery Tube Company.
Fives Lille-Cail.
General Tubing Pty. Ltd.

**Tubes, Stainless steel**
General Tubing Pty. Ltd.
Welding Technical Services Ltd.

**Urea addition plant for molasses fodder mixtures**
Bescon.
Ulrich Walter Maschinenbau.

**Used sugar machinery**
Brill Equipment Company.
Wabash Power Equipment Company.

**Used sugar refinery machinery**
Brill Equipment Company.
Wabash Power Equipment Company.

**Vacuum conveying systems for sugar**
Tecomatic Ltd.

**Vacuum pans**
*see* Pans.

**Vacuum pumps**
Ateliers de Construction d'Ensival S.A.
A. Bosco S.p.A.
Cotton Bros (Longton) Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
KSB Klein, Schanzlin & Becker A.G.
The Mirrlees Watson Co. Ltd.
Nash Engineering Company.
Neyrpic.
Siemens A.G.
A. & W. Smith & Co. Ltd.

**Vacuum pumps, Oil-free**
Nash Engineering Company.
Siemens A.G.
George Waller & Son Ltd.

**Valve actuators, Hydraulic**
Edwards Engineering Corporation.
Kent Instruments Ltd.

**Valves**
von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke.
Chemap A.G.
M. Dedini S.A. Metalúrgica.
George Waller & Son Ltd.

*Ball valves*
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot).

*Diaphragm valves*
Negretti & Zambra Ltd.
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot)

*Diverter valves*
Tecomatic Ltd.
Westinghouse Brake and Signal Co. Ltd.

*Glass ball valves*
Fischer & Porter Ltd.

*Relief valves*
Blundell & Crompton Ltd.

*Rotary valves*
Tecomatic Ltd.
Westinghouse Brake and Signal Co. Ltd.

*Slide valves*
The Reiss Engineering Co. Ltd.

*Stainless steel valves*
A.P.V. Co. Ltd.
Realm Engineering Works Ltd.
The Reiss Engineering Co. Ltd.
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot).

*Vacuum pan discharge valves*
Fletcher and Stewart Ltd.
The Reiss Engineering Co. Ltd.

**Vibrating feeders**
Electromagnets Ltd.
Eriez Magnetics.
International Combustion Riley Ltd.

**Vibrators**
Electromagnets Ltd.
Eriez Magnetics.
International Combustion Riley Ltd.

**Water cooling towers**
The Davenport Engineering Co. Ltd.
Film Cooling Towers (1925) Ltd.
Foster Wheeler John Brown Boilers Ltd.
*see also* Coolers, Water

**Water treatment**
Babcock & Wilcox Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Fabcon Inc.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Wallace & Tiernan Ltd.

**Weed control chemicals**
May & Baker Ltd.
Tate & Lyle Enterprises Ltd.

**Weighing machines**
Cellier S.A.
Fletcher and Stewart Ltd.
Greif-Werk Maschinenfabrik.
Herbert & Sons Ltd.
Librawerk Pelz & Nagel K.G.
N.V. Servo-Balans.
Richard Simon & Sons Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
*see also* Juice scales.

**Wire brushes, Rotary and manual**
Flexible Drives (Gilmans) Ltd
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

**Wire cloth**
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Sankey Green Wire Weaving Co. Ltd.
Wire Weaving Co Ltd.

**Wire gauze strainers**
N. Greening (Warrington) Ltd.

**Wire tying sack tool**
Thames Packaging Equipment Co.

**Woven wire**
N. Greening (Warrington) Ltd.
Sankey Green Wire Weaving Co. Ltd.

**Wrapping machines**
SAPAL.

**Yeast plants**
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Hitachi Shipbuilding & Engineering Co. Inc.
Nordon & Cie.
SPEICHIM.
Tate & Lyle Enterprises Ltd.

# BUYERS' GUIDE–ADDRESS LIST

**A.B.M. Industrial Products Ltd.,**
Woodley, Stockport, Cheshire, England.
*Tel.:* 061–430 4391. *Cable:* Chrievan, Stockport.
*Telex:* 667835.

**ACEC Ateliers de Constructions Electriques de Charleroi SA.,**
Boite Postale 4, B 6000 Charleroi, Belgium.
*Tel.:* 07/36.20.20. *Cable:* Ventacec, Charleroi.
*Telex:* Acec Charleroi 51.227.

**Azko Chemie B.V.–Imacti,**
P.O. Box 4038, Amsterdam, Holland.
*Tel.:* (20) 918918. *Cable:* Chemsales, Amsterdam.
*Telex:* 16532.

**The Albany Engineering Co. Ltd.,**
Church Road, Lydney, Glos., GL15 5EQ England.
*Tel.:* Lydney 2275. *Cable:* Bolthead, Lydney.
*Telex:* 43363.

**Alfa-Laval AB.,**
Box 1008, S-221 03 Lund 1, Sweden.
*Tel.:* 046-14 03 20. *Cable:* Alfalaval, Lund.
*Telex:* 3145.

**Allied Colloids Ltd.,**
P.O. Box 38, Low Moor, Bradford, Yorkshire, BD12 0JZ England.
*Tel.:* Bradford 671267. *Cable:* Colloidall, Bradford.
*Telex:* 51646.

**The A.P.V. Co. Ltd.,**
P.O. Box 4, Crawley, Sussex, RH10 2QB England.
*Tel.:* Crawley 27777. *Cable:* Anaclastic, Crawley, Telex.
*Telex:* 87237.

**A.P.V.-Kestner Ltd.,**
Greenhithe, Kent, England.
*Tel.:* Greenhithe 3281. *Cable:* Kestnerato, Dartford.
*Telex:* 896356.

**A.P.V.-Mitchell (Dryers) Ltd.,**
Denton Holme, Carlisle, Cumberland, CA2 5DU England.
*Tel.:* Carlisle 24205. *Cable:* Dryers, Carlisle.
*Telex:* 64139.

**von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke,**
605 Offenbach/Main, Friedrichsring 32–34, Germany.
*Tel.:* 83 20 54. *Cable:* Kondenstopf, Offenbachmain.
*Telex:* 04 152899 shof.

**ASEA-Weibull,**
P.O. Box 4015, S-28104 Hässelholm 4, Sweden.
*Tel.:* (0451) 83000. *Cable:* Nilswei, Hässelholm.
*Telex:* 48086.

**Ateliers de Construction d'Ensival S.A.,**
44 rue Hodister, B-4851 Wegnez, Belgium.
*Tel.:* 087-60166. *Cable:* Pompensi, Pepinster.
*Telex:* 49058.

**Babcock & Wilcox Ltd.,**
Cleveland House, St. James's Square, London, SW1Y 4LN England.
*Tel.:* 01–930 9766. *Cable:* Babcock, London S.E.1.
*Telex:* 884151/2/3.

**Bailey Meters & Controls Ltd.,**
218 Purley Way, Croydon, CR9 4HE England.
*Tel.:* 01–686 0400. *Cable:* Bailemeta, London.
*Telex:* 262335.

**William Bain & Co. Ltd.,**
Lochrin Works, Coatbridge, Lanarkshire, Scotland.
*Tel.:* Coatbridge 23471. *Cable:* Lochrin, Coatbridge.
*Telex:* 778809.

**Balco-Filtertechnik G.m.b.H.,**
3300 Braunschweig, Am Alten Bahnhof 5, Germany.
*Tel.:* 830 71–2. *Cable:* Balco, Braunschweig.
*Telex:* 952509.

**Barry Henry & Cook Ltd.,**
West North St., Aberdeen, AB9 2TD Scotland.
*Tel.:* 0224–26333. *Cable:* Barry, Aberdeen.

**Basico Gesellschaft fur internationale Projekte der Landwirtschaft, Forstwirtschaft und Agrarindustrie m.b.H.,**
D-6370 Oberursel, Postbox 547, Germany.
*Tel.:* (06171) 51054. *Cable:* Basico, Oberursel.
*Telex:* 4-10 730.

**Bellingham & Stanley Ltd.,**
61 Markfield Rd., London N.15, England.
*Tel.:* 01–808 2675. *Cable:* Polyfract, London, N.15.
*Telex:* 23784.

**Bescon,**
Hambridge Road, Newbury, Berks., England.
*Tel.:* Newbury 2363. *Cable:* Plenty, Newbury.
*Telex:* 848110.

**Birmingham Battery Tube Company,**
Selly Oak, Birmingham 29, England.
*Tel.:* 021–472 1151. *Cable:* Batmetco, Birmingham, Telex.
*Telex:* 338285.

**Blundell & Crompton Ltd.,**
West India Dock Road, London, E14 8HA England.
*Tel.:* 01–987 6001. *Cable:* Blundell, London, E14 8HA

**BMA Braunschweigische Maschinenbauanstalt,**
33 Braunschweig, Am Alten Bahnhof 5, Postfach 3225, Germany.
*Tel.:* (0531) 804-1. *Cable:* Bema, Braunschweig.
*Telex:* 952 456.

**Bookers Agricultural & Technical Services Ltd.,**
Bucklersbury House, 83 Cannon St., London EC4N 8EJ England.
*Tel.:* 01–248 8051. *Cable:* Considerer, London E.C.4.
*Telex:* 888169.

**A. Bosco S.p.A.,**
Piazzale A. Bosco 3, 05100 Terni, Italy.
*Tel.:* (0744) 55.341. *Cable:* Bosco, Terni.
*Telex:* 66032.

**Brencede Ltd.,**
23a Bridge Street, Saint Ives, Huntingdonshire, England.
*Tel.:* 0480–64406.

**Brill Equipment Company,**
35–65 Jabez Street, Newark, N.J., 07105 U.S.A.
*Tel.:* (201) 589-7420. *Cable:* Bristen, Newark, N.J.
*Telex:* 138944.

**Brimag Ltd.,**
Amington Colliery, Glascote Heath, Tamworth, Staffs, England.
*Tel.:* Tamworth 3581.
*Telex:* 27769 Minsep London for Brimag.

**British Charcoals & Macdonalds Ltd.,**
21 Dellingburn St., Greenock, Scotland.
*Tel:* 20273. *Cable*: Brimac, Greenock.

**British Ropeway Engineering Co. Ltd.,**
Tubs Hill House, London Rd., Sevenoaks, Kent, England.
*Tel.:* Sevenoaks 55233. *Cable:* Boxhauling, Sevenoaks
*Telex:* 95164.

**The British Rototherm Co. Ltd.,**
Margam, Port Talbot, Glamorgan, SA13 2PW S. Wales.
*Tel.:* 0656–740551. *Cable:* Rototherm, Margam.
*Telex:* 497341.

**Thomas Broadbent & Sons Ltd.,**
Queen Street South, Huddersfield, Yorkshire, HD1 3EA England.
*Tel.:* 0484–22111. *Cable:* Broadbent, Huddersfield.
*Telex:* 51515.

**Peter Brotherhood Ltd.,**
Peterborough, England.
*Tel.:* 71321. *Cable:* Brotherhoods, Peterborough
*Telex:* 32154 Brotherhd Pboro.

**David Brown Gear Industries Ltd.,**
Park Gear Works, Huddersfield, Yorkshire, HD4 5DD England.
*Tel.:* 0484–22180. *Cable:* Gearing, Huddersfield.
*Telex:* 51562/3.

**Buckau-Wolf Maschinenfabrik A.G.,**
D 4048 Grevenbroich, Postfach 69, Germany.
*Tel.:* 02181/421. *Cable:* Buckauwolf, Grevenbroich.
*Telex:* 0851 7111.

**Buell Ltd.,**
George Street Parade, Birmingham, B3 1QQ England.
*Tel.:* 021–236 5391. *Cable:* Buellon, Birmingham.
*Telex:* 338458.

**CAMECO Cane Machinery & Engineering Co. Inc.,**
P.O. Box 968, Thibodaux, La., 70301 U.S.A.
*Tel.:* (504) 447–7285. *Cable:* Cameco, Thibodaux.
*Telex:* 584183.

**John R. Carmichael Ltd.,**
Kenmore Works, Broad Lane, Liverpool, L11 1AE England.
*Tel.:* 051–226 1336/7. *Cable:* Filclo, Liverpool L11 1AE.

**Carter Industrial Products Ltd.,**
Redhill Road, Birmingham, B25 8EY England.
*Tel.:* 021–722 4300. *Cable:* Midheat, Birmingham.
*Telex:* 339219.

**CECA,**
11 Ave. Morane-Saulnier, B.P. 66, 78140 Velizy-Villacoublay, France.
*Tel.:* 946 96.35. *Cable:* Carbacti, Velizy.
*Telex:* 60–584.

**Cellier S.A.,**
B.P.58, 73102 Aix-les-Bains, France.
*Tel.:* (79) 35.05.65. *Cable:* noxel, Aix-les-Bains.
*Telex:* 32.053 F Inoxel.

**C F & I Engineers Inc.,**
3309 Blake Street, Denver, Colo., 80205 U.S.A.
*Tel.:* (303) 623-0211. *Cable:* Cfienginer, Denver.
*Telex:* 45-567.

**Chambon Ltd.,**
Riverside Works, Standish Rd., London W.6, England.
*Tel.:* 01–748 6086. *Cable:* Chambonted, London W.6.
*Telex:* 261476.

**Chemap A.G.,**
Alte Landstrasse 415, 8708 Männedorf/ZH, Switzerland.
*Tel.:* (01) 73 91 01. *Cable:* Servochemie, Männedorf.
*Telex:* 75 508.

**Chemviron S.A.,**
P.O. Box 17, Ixelles 1, B-1050 Brussels, Belgium.
*Tel.:* (02) 13 40 66. *Cable:* Chemviron, Brussels.
*Telex:* 22 481 Chemviron Bru B.

**Gebr. Claas Maschinenfabrik G.m.b.H.,**
4834 Harsewinkel/Westfalen, Postfach 140, Germany.
*Tel.:* 05247/41-325. *Cable:* Merkur, Harsewinkel.
*Telex:* 0933863.

**Cocksedge & Co. Ltd.,**
P.O. Box 41, Grey Friars Rd., Ipswich, Suffolk, IP1 1UW England.
*Tel.:* 56161. *Cable:* Cocksedge, Ipswich.
*Telex:* 98583.

**Codistil–Construtora de Distilarias Dedini S.A.,**
*see* M. Dedini S.A. Metalúrgica.

**Cotton Bros (Longton) Ltd.,**
Crown Works, Portland Rd., Longton, Stoke-on-Trent, ST3 1EN England.
*Tel.:* 0782-33021. *Cable:* Cotbro, Stoke-on-Trent.

**Cowiconsult,**
(formerly Chr. Ostenfeld & W. Jonson),
Skjoldsgade 8, 2100 Copenhagen, Denmark.
*Tel.:* (0176) TRIA 5050. *Cable:* Cowiconsult, Copenhagen.
*Telex:* 19705.

**A. F. Craig & Co. Ltd.,**
Caledonia Engineering Works, Paisley, PA3 2NA Scotland.
*Tel.:* 041–889 2191. *Cable:* Craig, Paisley.
*Telex:* 778051.

**A/S De Danske Sukkerfabrikker,**
(The Danish Sugar Corporation).
Langebrogade 5, Copenhagen K, Denmark.
*Tel.:* (01) AS 6130. *Cable:* Sukkerfabrikker, Copenhagen.
*Telex:* 27030 dansuk dk.

**The Davenport Engineering Co. Ltd.,**
Harris Street, Bradford, BD1 5JD England.
*Tel.:* 29361. *Cable:* Humidity, Bradford.
*Telex:* 517153.

**M. Dedini S.A. Metalúrgica,**
Ave. Mario Dedini 201, Piracicaba, Est. São Paulo, Brazil.
*Tel.:* 3-1122.

**The Deister Concentrator Co. Inc.,**
901/935 Glas ow Ave., Fort Wayne, Indiana, 46801 U.S.A.
*Tel.:* (219) 742–7213. *Cable:* Retsied, Fort Wayne.

**Deplechin,**
28 Avenue de Maire, 7500 Tournai, Belgium.
*Tel.:* 069 281.52. *Cable:* Deplechin, Tournai.

**Diamond Shamrock Chemical Company, Nopco Chemical Division,**
P.O. Box 829, 1901 Spring Street, Redwood City, Calif., 94064 U.S.A.
*Tel.:* (415) 369–0071. *Cable:* Diashamres, Redwood City.
*Telex:* 910 389-5412.

**Dicalite/GREFCO Inc., International Division,**
3450 Wilshire Boulevard, Los Angeles, Calif., 90010 U.S.A.
*Tel.:* (213) 381–5081. *Cable:* Dicalite, Losa.
*Telex:* 67-4224.

**John Dore & Co. Ltd.,**
51–55 Fowler Road, Hainault, Essex, England.
*Tel.:* 01-500 4144. *Cable:* Cuivre, Ilford.

**Dorr-Oliver Inc., Cane Sugar Division,**
Stamford, Conn., 06904 U.S.A.
*Tel.:* (203) 348-5871.
*Telex:* 965912.

**The Dow Chemical Company,**
Midland, Mich., 48640 U.S.A.

**Dreibholz & Floering Ltd.,**
Dereham, Norfolk, England.
*Tel.:* Dereham 3145. *Cable:* Slicing, Dereham.
*Telex:* 97357.

**Dust Control Equipment Ltd.,**
Thurmaston, Leicester, LE4 8HP England.
*Tel.:* 053723–3333. *Cable:* Dust, Leicester, Telex.
*Telex:* 34500.

**Maschinenfabrik H. Eberhardt,**
3340 Wolfenbüttel, Frankfurterstr. 14/17, Postfach 266, Germany.
*Tel.:* (0 53 31) 22002/3263. *Cable:* Eberhardt, Wolfenbüttel.
*Telex:* 09 52620 ebhdt d.

**Edwards Engineering Corporation,**
1170 Constance Street, New Orleans, La., 70130 U.S.A.
*Tel.:* (504) 524–0175. *Cable:* Joedco, New Orleans.
*Telex:* 058-342.

**Elba Machinefabrieken B.V.,**
P.O. Box 21, Ambachtsweg 3 (Industrieterrein), Huizen, N.H., Holland.
*Tel.:* (02152) 51956. *Cable:* Elbamachines, Huizen.

**Electromagnets Ltd.,**
Bond Street, Hockley, Birmingham, B19 3LA England.
*Tel.:* 021–236 9071. *Cable:* Boxmag, Birmingham, Telex.
*Telex:* 339192 Electromag Birmingham.

**Elliott Turbomachinery Ltd.,**
15 Portland Place, London, W1N 3AA England.
*Tel.:* 01–637 1591. *Cable:* Carell, London.
*Telex:* 25969.

**Enviro-Clear Company Inc.,**
1251 Avenue of the Americas, New York, N.Y., 10020 U.S.A.
*Tel.:* (212) 489-9060. *Cable:* Enclear, New York.

**Eriez Magnetics, International Division,]**
70724 Magnet Drive, Erie, Pa., U.S.A.
*Tel.:* (814) 833-9881. *Cable:* Eriez, Erie.
*Telex:* 91-4470.

**Escher Wyss Ltd.,**
Case Postale-Gare Centrale, 8023 Zurich, Switzerland.
*Tel.:* 444451. *Cable:* Escherwyss, Zurich.
*Telex:* 53906/7/8.

**Evans, Adlard & Co. Ltd.**
Postlip Mills, Winchcombe, Cheltenham, Glos., GL54 5BB England.
*Tel.:* 0242-602227. *Cable:* Adlard, Winchcombe.
*Telex:* 43316.

**Evenproducts Ltd.,**
Evesham, Worcs., WR11[4TS England.
*Tel.:* Evesham 41212.

**Ewart Chainbelt Co. Ltd.,**
Colombo Street, Derby, England.
*Tel.:* Derby 45451. *Cable:* Chainbelt, Derby.
*Telex:* 37575.

**Extraction De Smet S.A.,**
265 Ave. Prince Baudouin, B-2520 Edegem-Antwerp, Belgium.
*Tel.:* (03) 49.42.40. *Cable:* Extraxsmet, Antwerp.
*Telex:* 31824 Desmet B.

**Fabcon Inc.,**
1275 Columbus Avenue, San Francisco, Calif., 94133 U.S.A
*Tel.:* (415) 928-2400/1/2. *Cable:* Fabcon, San Francisco

**Farrel Company,**
Division of USM Corporation,
Ansonia, Conn., 06401 U.S.A.
*Tel.:* (203) 734-3331. *Cable:* Farrelmach, Ansonia.

**Farrow Irrigation Ltd.,**
Horseshoe Road, Spalding, Lincs., PE11 3JA England.
*Tel.:* Spalding 3764. *Cable:* Farrow, Spalding.
*Telex:* 22404 Sugrengine Bmly.

**Ferguson Perforating & Wire Co.,**
130-140 Ernest Street, Providence, R.I., 02905 U.S.A.
*Tel.:* (401) 941-8876. *Cable:* Ferguson, Providence.
*Telex:* 927539.

**Film Cooling Towers (1925) Ltd.,**
Chancery House, Parkshot, Richmond, Surrey, England.
*Tel.:* 01-940 6494. *Cable:* Aloof, Richmond, Surrey.
*Telex:* 27451.

**Fischer & Porter Ltd.,**
Salterbeck Trading Estate, Workington, Cumberland, England.
*Tel.:* 0946-830611. *Cable:* Saltfisch, Harrington.
*Telex:* 64114.

**Fives Lille-Cail,**
7 Rue Montalivet, 75 Paris 8e, France.
*Tel.:* 742.21.19. *Cable:* Fivcail, Paris.
*Telex:* Fivcail 65328.

**Fletcher and Stewart Ltd.,**
Masson Works, Litchurch Lane, Derby, England.
*Tel.:* Derby 40261. *Cable:* Amarilla, Derby, Telex.
*Telex:* 37514.

**Flexible Drives (Gilmans) Ltd.,**
Skatoskalo Works, Millers Road, Warwick, CV34 5AR England.
*Tel.:* Warwick 44331/5. *Cable:*Skatoskalo, Warwick.
*Telex:* 31451.

**Flexotube (Liverpool) Ltd.,**
25 Hope Street, Liverpool, L1 9BL England.
*Tel.:* 051-709 3345. *Cable:* Flexotube, Liverpool.

**Fontaine & Co. G.m.b.H.,**
51 Aachen, Grüner Weg 31, Germany.
*Tel.:* Aachen 21233. *Cable:* Fontaineco, Aachen.
*Telex:* 832558 fonte d.

**Foster Pump Works Inc.,**
07-73 Airport Road, Westerly, R.I., 02891 U.S.A.
*Tel.:* (401) 596-7711. *Cable:* Fostrpump, Westerly.
*Tel.:* 96-6451.

**Foster Wheeler John Brown Boilers Ltd.,**
P.O. Box 160, Greater London House, Hampstead Rd., London, NW1 7QN England.
*Tel.:* 01-388 1212. *Cable:* Rewopsteam, London.
*Telex:* 263984.

**Foxboro-Yoxall Ltd.,**
Redhill, Surrey, RH1 2HL England.
*Tel.:* Redhill 65000. *Cable:* Yoxbri, Redhill.
*Telex:* 25560.

**French Oil Mill Machinery Co.,**
1035 West Greene St., Piqua, Ohio, 45356 U.SA.
*Tel.:* (513) 773-3420. *Cable:* French, Piqua.
*Telex:* 228-009.

**Fulton Iron Works Company,**
Subsidiary of Katy Industries Inc.,
3844 Walsh Street, St. Louis, Mo., 63116 U.S.A.
*Tel.:* (314) 752-2400. *Cable:* Castiron, St. Louis.
*Telex:* 44-2381.

**General Tubing Pty. Ltd.,**
P.O. Box 124, Alexandria, N.S.W. 2015, Australia.
*Tel.:* Sydney 51-8645. *Cable:* Gentube, Sydney.
*Telex:* Sydney 21610.

**T. Giusti & Son Ltd.,**
202-228 York Way, Kings Cross, London N.7, England.
*Tel.:* 01-607 5021. *Cable:* Giustison, London N.7.
*Telex:* 22592.

**GR-Stein Refractories Ltd.,**
Castlecary Works, Bonnybridge, Stirlingshire, Scotland.
*Tel.:* 032484-255. *Cable:* Stein, Bonnybridge.
*Telex:* 77506.

**E. Green & Son Ltd.,**
Calder Vale Road, Wakefield, Yorkshire, England.
*Tel.:* Wakefield 71171. *Cable:* Economiser, Wakefield.
*Telex:* 55452.

**N. Greening (Warrington) Ltd.,**
Britannia Works, Warrington, Lancs., WA5 5JX England.
*Tel.:* Warrington 35991. *Cable:* Greenings, Warrington.
*Telex:* 62195.

**Greif-Werk Maschinenfabrik,**
24 Lübeck, Postfach 1183, Germany.
*Tel.:* 5303-1. *Cable:* Greifwerk, Lübeck.
*Telex:* 026895.

**Gruendler Crusher & Pulverizer Company,**
2915 North Market Street, St. Louis, Mo., 63106 U.S.A.
*Tel.:* (314) 531-1220. *Cable:* Grupulco, St. Louis.
*Telex:* 44-7415.

**Habasit A.G.,**
CH-4153 Reinach-Basel, Switzerland.
*Tel.:* 061 76 70 70. *Cable:* Habasit, Reinach-Basel.
*Telex:* 62 859.

**Hawaiian Agronomics Company (International),**
P.O. Box 3470, Honolulu, Hawaii, 96801 U.S.A.
*Tel.:* (808) 536-4461. *Cable:* Agronomics, Honolulu.
*Telex:* (RCA) 723326; (ITT) 430173.

**Hein, Lehmann A.G.,**
P.O. Box 4109, Fichtenstr. 75, 4000 Düsseldorf, Germany.
*Tel.:* 77011. *Cable:* Heinlehmann, Duesseldorf.
*Telex:* 8582740 hl d.

**John M. Henderson & Co. Ltd.,**
P.O. Box 26, King's Works, Aberdeen AB9 8BU, Scotland.
*Tel.:* 0224-24262. *Cable:* Cranes, Aberdeen.
*Telex:* 73109.

**Herbert & Sons Ltd.,**
18 Rookwood Way, Haverhill, Suffolk, England.
*Tel.:* 0440-3551.

**Hinz Electromaschinen und Apparatebau G.m.b.H.,**
3300 Braunschweig, P.O. Box 2749, Hansestrasse 30, Germany.
*Tel.:* (0531) 3 15 95. *Cable:* Hinzmotoren, Braunschweig.
*Telex:* 9 52 753 himot d.

**Hiro Zoki Co. Ltd.,**
Nihonbashi 2-3-10, Chuo-ku, Tokyo, Japan.
*Tel.:* 03-274-5821. *Cable:* Hirozoki Co., Tokyo.
*Telex:* 2223197.

**Hitachi Shipbuilding & Engineering Co. Ltd.,**
1-1 Hitotsubashi 1-chome, Chiyoda-ku, Tokyo, 100 Japan.
*Tel.:* 231-6611. *Cable:* Hitachizosen, Tokyo
*Telex:* J 24490/J 22363.

**Hodag Chemical Corporation,**
7247 North Central Park Avenue, Skokie, Ill., 60076 U.S.A
*Tel.:* (312) 675-3950. *Cable:* Hodag, Skokieill

**Houttuin-Pompen N.V.,**
Postbus 76, Utrecht, Holland.
*Tel.:* (030) 44 16 44.
*Telex:* 47280.

**Howard Pneumatic Engineering Co. Ltd.,**
Fort Road, Eastbourne, Sussex, England.
*Tel.:* 22804/5/6. *Cable:* Howmatic, Eastbourne
*Telex:* 87672.

**Industrial Magnets Ltd.,**
Enfield Industrial Estate, Redditch, Worcs.
*Tel.:* Redditch 66611. *Cable:* Unimag, Redditch

**Industrieprojekt A.G.,**
Badenerstrasse 281, CH-8003 Zurich, Swizterland.
*Tel.:* (01) 23.36.26. *Cable:* Indarchag, Zurich.
*Telex:* 54803.

**Ingeniörsfirman Nils Weibull A.B.,**
*see* Weibull.

**International Combustion Ltd.,**
Sinfin Lane, Derby, DE2 9GJ England.
*Tel.:* 0332–23223. *Cable:* Lopulco, Derby.
*Telex:* 37581/2.

**International Combustion Riley Ltd.,**
Sinfin Lane, Derby, DE2 9GJ England.
*Tel.:* 0332–21252. *Cable:* Rileypro, Derby.
*Telex:* 37581.

**Irrigation & Industrial Development Corp.,**
260 Madison Ave., New York, N.Y., 10016 U.S.A.
*Tel.:* (212) 679–4428. *Cable:* Irridelco, New York.
*Telex:* RCA NY 4182; ITT 420856.

**Jeffress Bros. Ltd.,**
351 Melton Rd., Northgate East, Brisbane, Queensland 4013, Australia.
*Tel.:* 67-1677. *Cable:* Telejeff, Brisbane.

**Jenkins of Retford Ltd.,**
Retford, Nottinghamshire, England.
*Tel.:* Retford 2231. *Cable:* Jenkins, Retford.
*Telex:* 56122.

**JK Industrial Fabrics,**
Division of James Kenyon & Son Ltd.,
P.O. Box 28, Pilsworth Rd., Bury, Lancs., BL9 8QE England.
*Tel.:* 061–766 7531-7. *Cable:* Kenyon, Bury.
*Telex:* 667440.

**Amandus Kahl Nachf.,**
2000 Hamburg 26, Eiffestrasse 432, Postfach 260 343, Germany.
*Tel.:* 722 2024. *Cable:* Kahladus, Hamburg.
*Telex:* 0217875.

**Kay Iron Works (Pvt.) Ltd.,**
P.O. Yamuna Nagar, East Punjab, India.
*Tel.:* Yamuna Nagar 4/4A. *Cable:* Mithal, Yamuna Nagar.

**Thomas C. Keay Ltd.,**
P.O. Box 30, Densfield Works, Dundee, DD1 9DY Scotland.
*Tel.:* 0382–89341. *Cable:* Keay, Dundee.
*Telex:* 76278.

**Kent Instruments Ltd.,**
Biscot Road, Luton, Beds., England.
*Tel.:* Luton 21151.
*Telex:* 825161.

**Dr. Wolfgang Kernchen Optik-Elektronik-Automation,**
D-3011 Letter/Hannover, Postf. 129, Germany.
*Tel.:* Hannover 40 19 61. *Cable:* Optronic, Hannover.

**Kettenfabrik Unna G.m.b.H. & Co. K.G.**
475 Unna, Postfach 186, Germany.
*Tel.:* (02303) 8411. *Cable:* Kettenfabrik, Unna.
*Telex:* 08 229250.

**KIW Construction Ltd.,**
595½ Spanish Town Road, P.O. Box 138, Kingston 11, Jamaica, West Indies.
*Tel.:* 923–7444/6841. *Cable:* Industrial, Kingston.

**Kleinwanzlebener Saatzucht AG.,**
vorm. Rabbethge & Giesecke,
3352 Einbeck, Grimsehlstr. 29, Postfach 146, Germany.
*Tel.:* 05561/3111. *Cable:* Original, Einbeck.
*Telex:* 0965612.

**Koppers-Wistra-Ofenbau G.m.b.H.**
4000 Düsseldorf-Heerdt, Wiesenstrasse 134, Germany.
*Tel.:* 50 11 97. *Cable:* Wistraofen, Duesseldorf.
*Telex:* 08 584518.

**A. H. Korthof N.V.,**
Hertshooiweg 18, Postbus 73, Bergen, N.H., Holland.
*Tel.:* 02208–5526. *Cable:* Sugarlab, Amsterdam.

**Krieg & Zivy Industries,**
10 Avenue Descartes, 92 Le Plessis-Robinson, France.
*Tel.:* 644-62-26. *Cable:* Zedka, Plessis-Robinson.
*Telex:* 27328 F.

**KSB Klein, Schanzlin & Becker AG.,**
6710 Frankenthal, Postfach 225, Johann-Klein-Strasse 9, Germany.
*Tel.:* (06233) 861. *Cable:* Kleinschanzlin, Frankenthal.
*Telex:* 0465211 KSB.

**A.G. Kühnle, Kopp & Kausch,**
D 6710 Frankenthal/Pfalz. Friedrich-Ebert-Str. 16, Germany.
*Tel.:* (06233) 85-1. *Cable:* Turbomaschinen, Frankenthalpfalz.
*Telex:* 0465221.

**Lainyl Filter Cloths,**
4200 Ougrée-Sclessin, Belgium.
*Tel.:* (04) 52.21.50. *Cable:* Lainière, Sclessin.
*Telex:* 41.496.

**Librawerk Pelz & Nagel K.G.,**
33 Braunschweig, P.O. Box 3712, Germany.
*Tel.:* (0531) 37 60 51. *Cable:* Librawerk, Braunschweig.
*Telex:* 0952 866.

**Lucks & Co. G.m.b.H.,**
D-33 Braunschweig, Celler Strasse 66–67, P.O. Box 382, Germany.
*Tel.:* 0531/5971. *Cable:* Baulucks, Braunschweig.
*Telex:* 09-52713 luco d.

**Lurgi Apparate-Technik G.m.b.H.—Bereich Chemotechnik,**
6 Frankfurt (Main), Lurgihaus, Gervinusstr. 17–19, Germany.
*Tel.:* (0611) 157. *Cable:* Lurgitechnik, Frankfurt.
*Telex:* 04 12 36.

**Martin-Markham (Stamford) Ltd.,**
Lincolnshire Works, Stamford, Lincs., England.
*Tel.:* Stamford 2621/4. *Cable:* Marktrac, Stamford.

**Massey-Ferguson (Export) Ltd.,**
P.O. Box 62, Banner Lane, Coventry, CV4 9GF England.
*Tel.:* Coventry 465211. *Cable:* Masferg, Coventry.
*Telex:* 31-655.

**Mawdsleys Ltd.,**
Dursley, Gloucestershire, GL11 5AE England.
*Tel.:* Dursley 4131. *Cable:* Zone, Dursley.
*Telex:* 43128.

**May & Baker Ltd.,**
Dagenham, Essex, England.
*Tel.:* 01–592 3060. *Cable:* Bismuth, Dagenham.
*Telex:* London 28691.

**Mazer Chemicals Inc.,**
3938 Porett Drive, Gurnee, Ill., 60031 U.S.A.
*Tel.:* (312) 244-3410. *Cable:* Mazchem, Gurnee.

**F. W. McConnel Ltd.,**
Temeside Works, Ludlow, Shropshire, England.
*Tel.:* Ludlow 3131.
*Cable:* McConnel 35313, Ludlow Shropshire Telex.
*Telex:* 35313.

**M.E. Boilers Ltd.,**
23 Bedford Row, London W.C.1., England.
*Tel.:* 01–242 2214.
*Telex:* 32138 Micontrac, Peterborough.

**Mennesson & Cie.,**
Route de Nimes, 30200 Bagnols-sur-Cèze, France.
*Tel.:* 16-66-89.50.75.
*Telex:* 48146 Telexer Nimes Code 25.

**Mikropul Ltd.,**
Towerfield Industrial Estate, Shoeburyness, Essex, SS3 9QU England.
*Tel.:* Shoeburyness 2373. *Cable:* Mikropul, Southend-on-Sea.
*Telex:* 99346.

**Mirrlees Pumps Ltd.,**
Hambridge Rd., Newbury, Berks., England.
*Tel.:* Newbury 2363. *Cable:* Plenty, Newbury.
*Telex:* 848110.

**The Mirrlees Watson Co. Ltd.,**
Cosmos House, 1 Bromley Common, Bromley, BR2 9NA England.
*Tel.:* 01–464 5346. *Cable:* Mirwat, Bromley, Kent.
*Telex:* 22404.

**Mono Pumps Ltd.,**
Mono House, Sekforde Street, Clerkenwell Green, London, EC1R 0HE England.
*Tel.:* 01-253 8911. *Cable:* Monopumps London EC1.
*Telex:* 24453.

**Nash Engineering Company,**
Norwalk, Conn., 06856 U.S.A.
*Tel.:* (212) 421-4200. *Cable:* Hytor, Norwalk, Conn.
*Telex:* 96-5971.

**Negretti & Zambra Ltd.,**
Stocklake, Aylesbury, Bucks., England.
*Tel.:* Aylesbury 5931. *Cable:* Negretti, Aylesbury, Telex.
*Telex:* 83285.

**Newell Dunford Engineering Ltd.,**
143 Maple Road, Surbiton, Surrey, England.
*Tel.:* 01–546 7799. *Cable:* Lindaresco, London, Telex.
*Telex:* 22413.

**Newman Fabrications Ltd.,**
Feeder Road, Bristol, BS2 0TU England.
*Tel.:* 0272–74201. *Cable:* Machplant, Bristol.
*Telex:* 44834/5.

**Neyrpic,**
Rue Général Mangin, 38 Grenoble, France.
*Tel.:* (76) 96.48.30. *Cable:* Neyrpic, Grenoble.
*Telex:* 32.750.

**Nordon & Cie.,**
9 Avenue du XXeme Corps, B.P. 441, 54001 Nancy Cedex, France.
*Tel.:* 28–52 2060. *Cable:* Frernordon, Nancy.
*Telex:* 85040.

**Chr. Ostenfeld & W. Jonson,**
3 rue d'Aguesseau, Paris 8, France.
*Tel.:* 2660840. *Cable:* Cowiconsult, Paris.
*Telex:* 28233.

**Parsons Chain Co. Ltd.,**
Worcester Road, Stourport-on-Severn, Worcs., DY13 9AT England.
*Tel.:* Stourport 2551. *Cable:* Chainwork, Stourport-on-Severn.
*Telex:* 339711 Chainwire Strpt.

**Paxman Process Plant Division, GEC Diesels Ltd.,**
P.O. Box 8, Colchester, Essex, CO1 2HW England.
*Tel.:* 0206–5151. *Cable:* Paxman, Colchester.
*Telex:* 98151.

**Perkin-Elmer Limited,**
Beaconsfield, Bucks., HP9 1QA England.
*Tel.:* Beaconsfield 6161. *Cable:* Peco, Beaconsfield.
*Telex:* 83257.

**The Permutit Co. Ltd.,**
632–652 London Rd., Isleworth, Middx., England.
*Tel.:* 01–560 5199. *Cable:* Permutit, Hounslow.
*Telex:* 24440.

**Pittsburgh Activated Carbon Division, Calgon Corporation,**
Calgon Center, Box 1346, Pittsburgh, Pa., 15230 U.S.A.
*Tel.:* (412) 923-2345. *Cable:* Pitcarb, Pittsburgh.
*Telex:* 086739.

**Plenty & Son Ltd.,**
Hambridge Road, Newbury, Berks., England.
*Tel.:* Newbury 2363. *Cable:* Plenty, Newbury
*Telex:* 848110.

**Plymouth Locomotives Division, Banner International Inc.,**
51 Bank Street (Suite 402), Stamford, Conn., 06901 U.S.A.
*Tel.:* (203) 327-5084. *Cable:* Plylocomot, New York.
*Telex:* 965887.

**J. & F. Pool Ltd.,**
Hayle, Cornwall, England.
*Tel.:* Hayle 3571. *Cable:* Perforator, Hayle.
*Telex:* 45286 A.B. Poolperf Hayle.

**P. & S. Textiles Ltd.,**
Broadway Mills, Haslingden, Lancs., BB4 4EJ England.
*Tel.:* Rossendale 3421. *Cable:* Neotex, Haslingden, Telex.
*Telex:* 63127 Neotex Hasden.

**H. Putsch & Comp.,**
Postfach 4221, Frankfurter Str. 5–25, 58 Hagen, Germany.
*Tel.:* (02331) 31031. *Cable:* Putsch, Hagen.
*Telex:* 823795.

**Ransomes Sims & Jefferies Ltd.,**
Nacton Works, Ipswich, Suffolk, IP3 9QG England.
*Tel.:* 0473–72222. *Cable:* Ransomes, Ipswich, Telex.
*Telex:* 98174.

**Rapid Magnetic Ltd.,**
Lombard St., Birmingham, B12 0QW England.
*Tel.:* 021–773 1361. *Cable:* Magnetism, Birmingham.
*Telex:* 338671 Magnetism Birmingham.

**Realm Engineering Works Ltd.,**
Milton Avenue, Croydon, CR9 2JP England.
*Tel.:* 01–684 8391. *Cable:* Realmard, Croydon.

**Redler Conveyors Ltd.,**
Dudbridge Works, Stroud, Gloucestershire, GL5 3EY England.
*Tel.:* (04536) 3611. *Cable:* Redler, Stroud.
*Telex:* 43228.

**Reed Darnley Taylor Ltd.,**
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