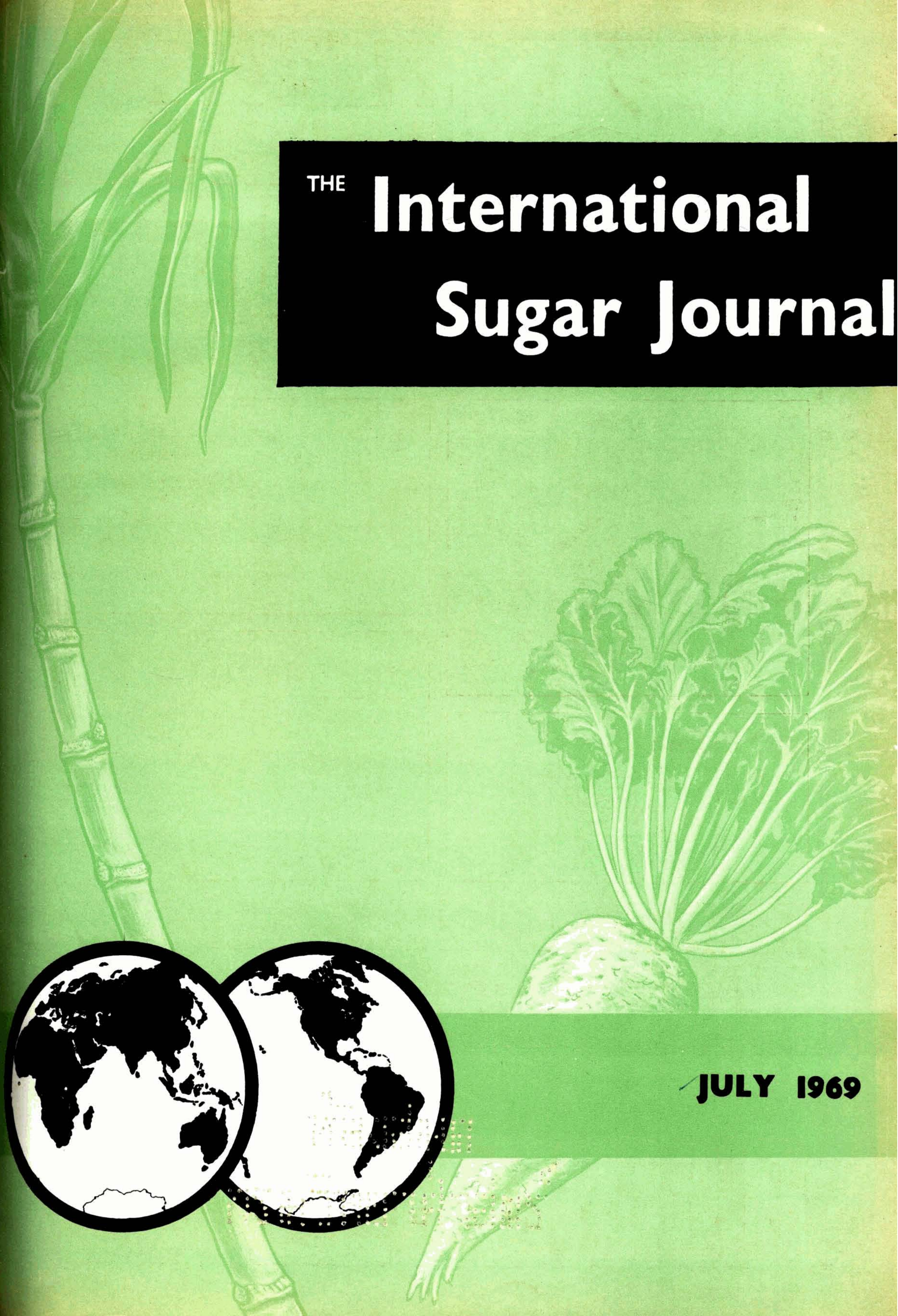
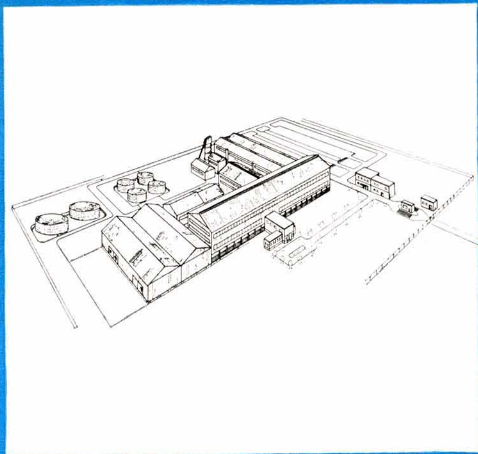
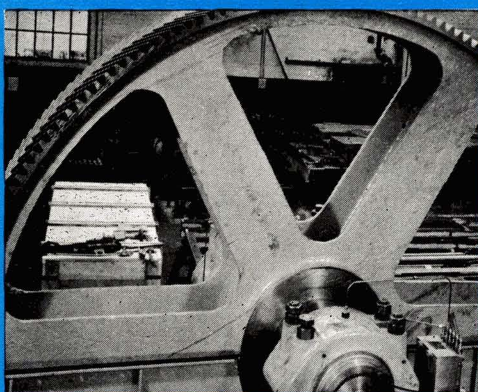
THE

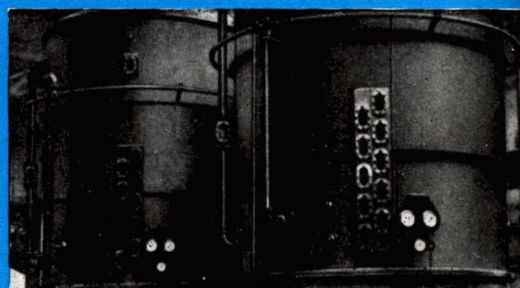
International Sugar Journal

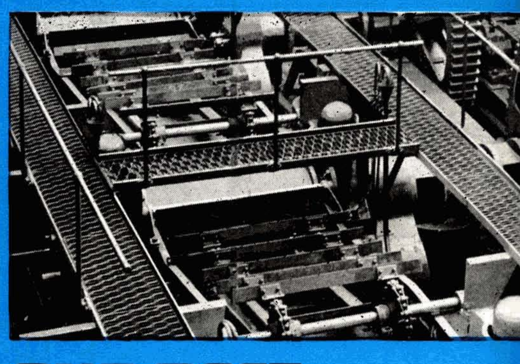


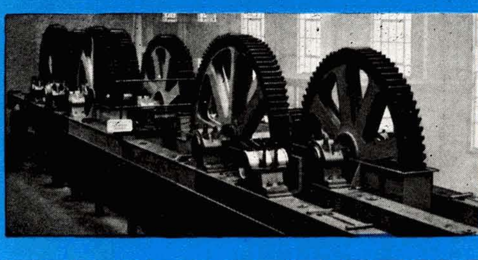
JULY 1969



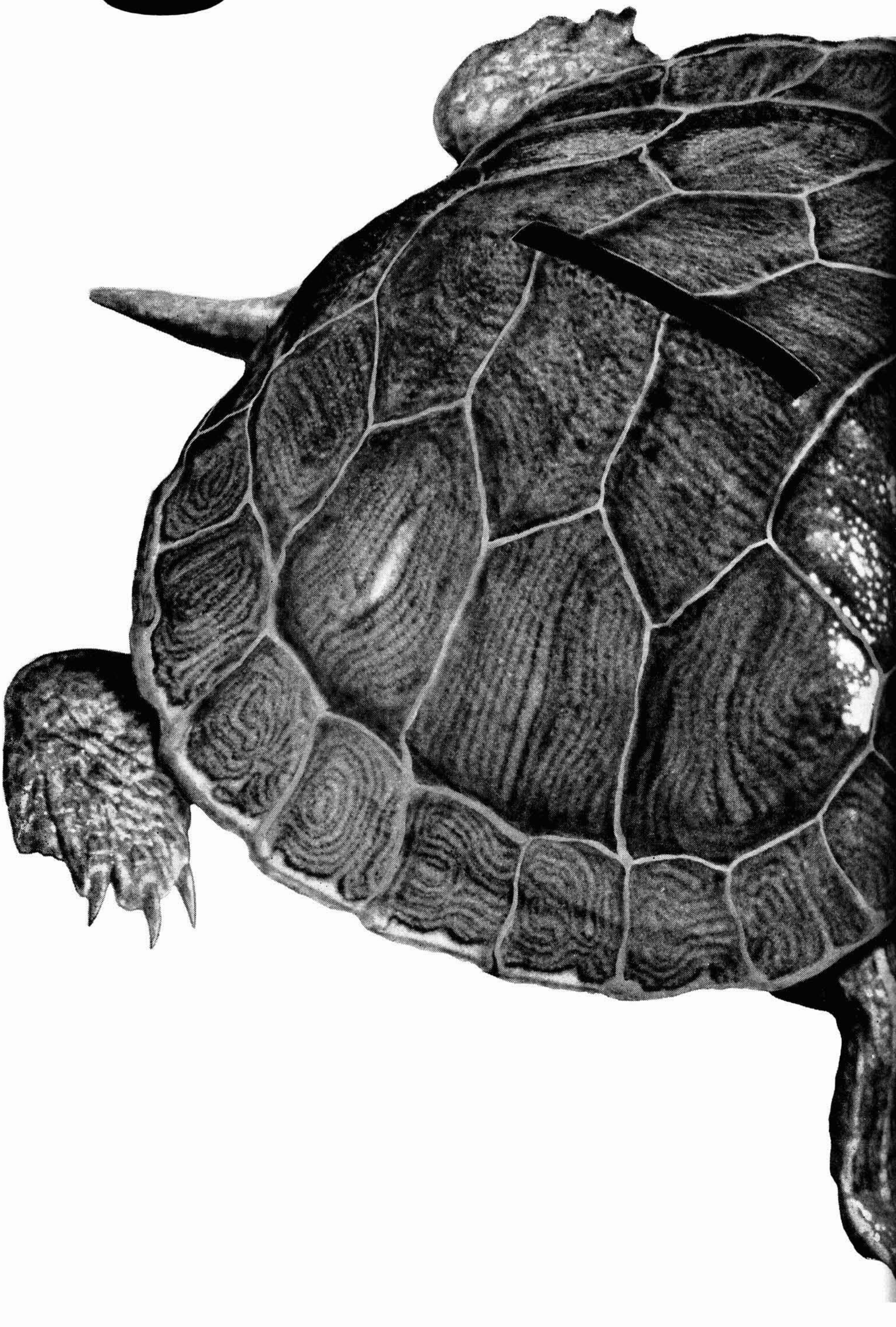


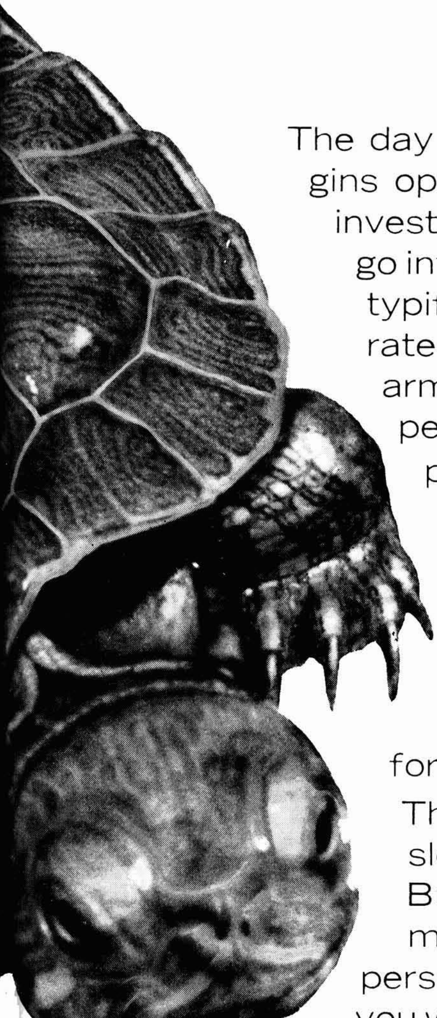


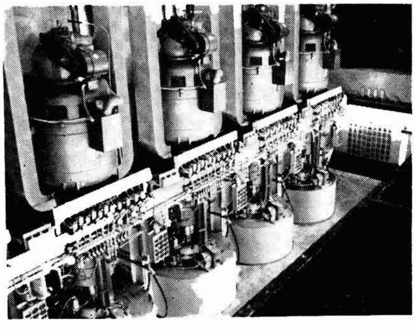




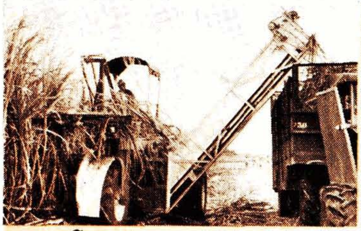
get rich







This team solves labor shortages, puts more profit in sugar cane.



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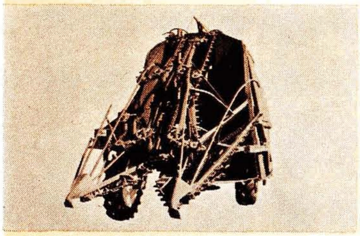

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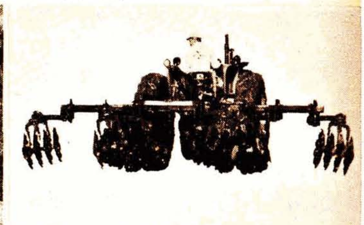

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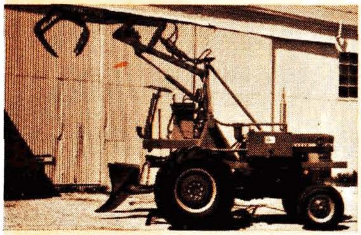

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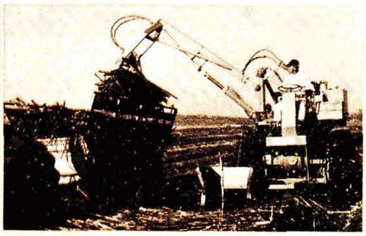

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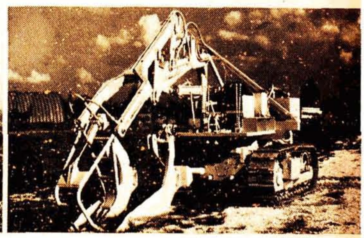

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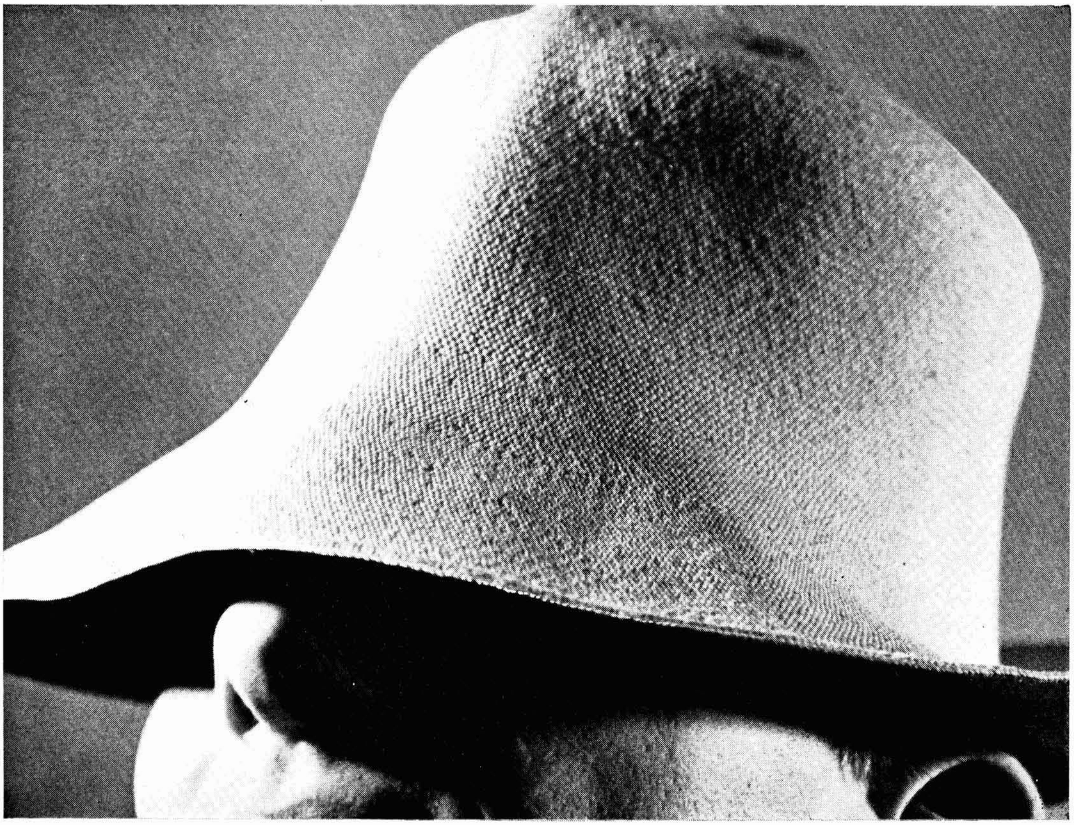

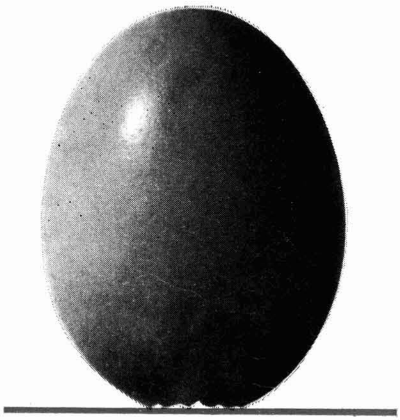

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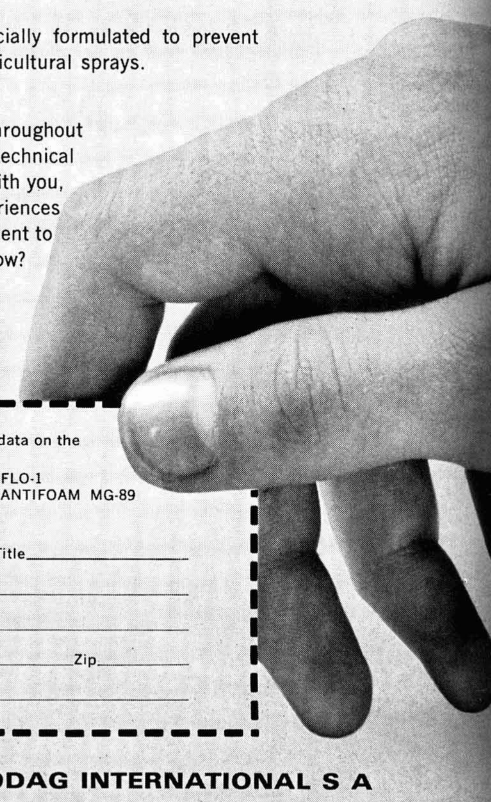

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Published by
The International Sugar Journal Ltd.
23a Easton Street, High Wycombe,
Bucks, England.
Telephone: High Wycombe 29408
Cable: Sugaphilos, High Wycombe

Annual Subscription: 50s 0d or $8.00 post free

Single Copies: 6s 0d or $1 post free

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On rapport des études avec la spectroscopie infra-rouge de polymères "brunissants" à partir de mélasse à canne finale. Les études ont montré la présence de groupes hydroxyles et carboxylatés, pendant que le spectre de la modification protonée du polymère a indiqué la présence probable d'un ion Zwitter.

* * *

Cassures dans les arbres de cylindres de moulins et quelques investigations. R. N. CULLEN et J. R. ALLEN. *p.* 197–201

On esquisse les causes de cassures d'arbres de cylindres de moulins à canne et décrit des moyens d'empêcher quelques des causes, par exemple la corrosion et des concentrations de tension. On donne quelques détails d'une investigation expérimentale pour déterminer les niveaux de tension dans un arbre d'un cylindre d'un moulin sous les conditions d'opération.

* * *

Evaluation de "Vap-99" de Hodag. R. MALONEY. *p.* 202–205

L'auteur décrit quelques essais avec Hodag "Vap-99", agent à surface active, pour déterminer son utilité comme inhibiteur d'incrustations dans un évaporateur à quadruple effet et en aidant entretenir le taux d'évaporation pendant des périodes d'opération plus longues.

Infrarot-Spektra der dialysierten, bräunenden Produkten aus Rohrenmelasse und von einigen ihrer Modifikationen. W. W. BINKLEY. *S.* 195–197

Infrarotspektroskopische Studien von "bräunenden" Polymeren aus Rohrenmelasse werden berichtet. Die Gegenwart von Hydroxyl- und Carboxylat- Gruppen wurde gezeigt, während das Spektrum der protonierten Modifikation des Polymers auf die wahrscheinliche Gegenwart eines Zwitterions hinwies.

* * *

Zusammenbrüche der Achsen von Mühlenwalzen und einige Untersuchungen. R. N. CULLEN und J. R. ALLEN. *S.* 197–201

Man umreisst die Ursachen von Zusammenbrüchen von Rohrmühlenwalzenachsen und beschreibt Wege für die Beseitigung einiger von diesen Ursachen, z.B. der Korrosion und der Anspannungskonzentrationen. Einzelheiten einer experimentellen Untersuchung, um die Anspannungsgrade bei einer Mühlenwalzenachse unter Betriebsverhältnissen werden dargestellt.

* * *

Abschätzung von Hodag "Vap-99". R. MALONEY. *S.* 202–205

Versuche mit Hodag "Vap-99" Oberflächenaktivmittel, um seine Nützlichkeit als Kesselsteinverhütungsmittel in einem Vierkörperverdampfer und als Hilfsmittel für die Erhaltung der Verdampfungsgeschwindigkeit während längerer Operationsperioden werden gegeben.

Espectros infra-rojos de los productos dorandos dialisados de melaza final de caña y de algunas de su modificaciones. W. W. BINKLEY. *Pág.* 195–197

Se hace un informe acerca de estudios de los espectros infra-rojos de los polimeres dorandos de melaza final de caña. Revelan la presencia de grupos hidroxílico y carbóxilato, mientras el espectro de la modificación protonada del polimer sugiere la presencia probable de un ión "Zwitter".

* * *

Roturas de los árboles de mazas de molinos de caña y sus investigaciones. R. N. CULLEN y J. R. ALLEN. *Pág.* 197–201

Se trazan razones para rotura de árboles de mazas de molinos de caña y se describen métodos de evitar algunas de las causas tal como corrosión y concentración de carga. Se presentan detalles de un investigación experimental para determinar las niveles de carga en un árbol de un maza sobre condiciones de la marcha.

* * *

Evaluación del "Hodag-99". R. MALONEY. *Pág.* 202–205

Se presentan detalles de ensayos con "Hodag-99", un agente tenso-activo, para determinar su utilidad como inhibidor de incrustación en un evaporador de cuatro efectos y para ayudar mantenimiento del grado de evaporación durante períodos prolongados de operación.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXI | JULY 1969 | No. 847

Notes & Comments

European beet area, 1969.

As expected when the first estimates[1] were issued, F. O. Licht K.G. have produced revised figures for beet sowings in Europe[2]. However, apart from the major reduction in the area for France resulting from the inclusion in the earlier figure of the beet area for alcohol production, only minor changes have been noted and these only in Western Europe, the largest variation being an increase of 2000 ha for Greece. As a result of the changes the total area for Western Europe is set at 1,949,515 hectares (previously 1,979,750 hectares) while the Eastern Europe estimate is unchanged at 4,768,000 hectares.

* * *

Cuban sugar crop[3].

Reports from Cuba during recent weeks have indicated that the crop has run into difficulties again this year and the Cuban Prime Minister is understood to have stated in a recent speech that output to that date had reached only 4·3 million tons, compared with 4·7 million tons to the corresponding date in 1968. Final details of last season's crop have not yet been announced but, according to the estimates of C. Czarnikow Ltd., production probably did not exceed 5·0 million tons by much, if indeed it did actually reach that figure. This year it seems probable that output will be well below that level.

This situation raises problems as to Cuba's ability to fulfil her ISA quota. Consumption figures as submitted to the International Sugar Council in recent years show a remarkable level of internal requirements, rising to about 630,000 tons in 1967, of which some 200,000 tons were presumably used for purposes other than human consumption. Rationing has since been introduced but it seems unlikely that offtake will thereby be reduced below about 450,000 tons.

The new crop 1969/70 is due to commence in October or November of this year and additional sugar may already be available for shipment before the end of the year from that campaign; on the other hand, of the current season's output, no less than 491,000 tons is reported to have been produced prior to the end of last year and probably part of this tonnage was exported before 1st January, It seems, then, taking these various factors into consideration, that Cuba will not have more than some 4·5 million tons available for export during the current calendar year, and part of this will become available only very late in the year, at a time when the greatest demand among Cuba's traditional clients is over.

The problem which will interest the market, of course, is how this quantity can be shared between the free market and the socialist group of countries as defined in the ISA, to whom Cuba may export without such sugar being charged to quota. Some guidance may be obtained from the schedule of exports in the comparable crop year of 1966, which in total amounted to 4,435,000 tons. In that year 3,258,000 tons were shipped to Cuba's socialist trade partners; if this pattern were repeated this year only some 1·25 million tons could be exported against Cuba's world market quota. Her current ISA entitlement is 1,935,000 tons, which would indicate a possible shortfall of nearly 700,000 tons. Such a situation appears unlikely in view of Cuba's known commitments this year, but if the world market is not to suffer, then deliveries to the socialist group will have to be curtailed. In 1966 the USSR received 1,815,000 tons from Cuba and China 620,000 tons. It is possible that deliveries to these destinations could be curtailed, but both have been prominent in the re-export trade this year and it would be surprising if these were marked down substantially. Several European countries could well manage their affairs with smaller deliveries from Cuba than they received in 1966 and it may be that economies in sugar will be effected in this direction. However, freight market reports indicate a steady flow of vessels carrying sugar to east Europe, so here again it must be assumed that deliveries will not be reduced to a marked degree below the 1966 level. So far as concerns shipments to Asian socialist countries other than China, these are already higher than the total for the year 1966.

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[1] *I.S.J.*, 1969, **71**, 129, 160.
[2] *International Sugar Rpt.*, 1969, **101**, (12), 1–4.
[3] C. Czarnikow Ltd., *Sugar Review*, 1969, (920), 93.

What, then, is the indicated pattern of Cuban disposals of sugar this year? Domestic consumption will certainly be reduced. Shipments to some trade partners will be maintained, while others will be reduced. Almost certainly the current ISA quota is beyond reach. To some extent those countries which have export quotas or entitlements as a counterpart to their imports from Cuba will be able to call upon stocks; this will not be the case for all such countries, however, and it must be assumed that Cuba will not be alone among the socialist bloc in being unable to fulfil her ISA entitlement this year.

* * *

International Sugar Council.

The International Sugar Council met on the 28th May but at the time of writing no communiqué had been released. However, the Council announced at the end of its first day's session that it had been informed of shortfalls amounting to 378,000 tons but that it had been decided not to re-distribute these during the current period of stable market structure. Should prices rise in the future, the Executive Committee can take steps to re-distribute shortfalls and the announcement indicated that the Committee would keep the market situation under continuous review.

C. Czarnikow Ltd.[1] referred to rumours that the USSR had notified the Council of its inability to deliver the full entitlement of 1,100,000 tons to the world market but pointed out that, although it is quite possible that lower deliveries from Cuba may lead to a drop in Russian re-exports this year, the USSR is a net importer and, as such, had no need to make any such notification.

* * *

World sugar balance.

F. O. Licht K.G. recently published their second estimates of the world sugar balance for 1968/69[2] and these appear below with amended figures for the two previous crop years, September/August, in each case.

	1968/69	1967/68	1966/67
	(*metric tons, raw value*)		
Initial stocks ..	18,679,092	18,655,227	18,561,040
Production ..	68,379,858	67,552,336	65,800,724
Imports	21,879,843	21,512,976	21,407,823
	108,937,793	107,720,539	105,769,687
Exports ..	22,010,898	21,447,196	21,533,535
Consumption ..	69,665,936	67,594,251	65,580,925
Final stocks ..	17,260,959	18,679,092	18,655,227

The most important adjustment has been the reduction in the Cuban crop estimate from six to five million tons (a figure held by many to be still too high), partly offset by higher production levels in other countries, particularly India. Reduction in the estimated level of consumption for 1968/69 compared with Licht's earlier figure[2] is largely due to a fall in expected usage in Western Europe for animal feeding, other decreases in the Western Hemisphere being offset by increases expected in Africa and Asia.

Nevertheless production is expected to be only 1·22% higher in 1969/69 than in 1967/68 while consumption is set at 3·06% higher, so that final stocks are expected to be reduced to only 17,260,959 tons or 24·7% of annual production.

* * *

Booker McConnell Ltd. 1968 report.

Bookers Sugar Estates Ltd. in Guyana were frustrated in their hope of a record sugar crop by intermittent strikes, but 263,000 tons of sugar were made as against 283,000 tons in 1967 and a 5-year average of 247,000 tons. Given no interruptions, very abnormal weather or other unexpected setbacks, a crop of the order of a record 290,000 tons is expected for 1969.

Despite drought and industrial unrest in Jamaica, Innswood Estates Ltd. made 23,100 tons of sugar and earned a small profit, while Holland Estate Ltd. built its production to 8700 tons and plans to make 10,500 tons in 1969. The 1967/68 crop in Nigeria yielded 19,400 tons of white sugar, and the Nigerian Sugar Co. Ltd. made a small profit; the management plans to make nearly 24,000 tons in 1968/69 and should earn a substantial profit. The hostilities in Nigeria have brought stringent exchange and import controls which have added to the company's problems and it cannot be foretold how long they will last.

Bookers Agricultural and Technical Services, the Group's agricultural consultancy company, has strengthened its technical staff and is providing managerial, technical and training services. Activities are continuing in Nigeria, St. Kitts and Jamaica, and other studies in 1968 have been located in Kenya and Ghana, while work in 1969 is to include operations in Kenya, Tanzania and Trinidad[3].

1968 was a better year for the engineering firms within the Group, with some improvement in profits. Fletcher and Stewart Ltd. have experienced a marked quickening of enquiries following the new International Sugar Agreement, while the capabilities of the Sigmund Pulsometer Pumps Ltd. division have been augmented by the acquisition in early 1969 of Plenty & Son Ltd., makers of mixers, filters and positive displacement pumps.

United Rum Merchants Ltd. achieved significant increases in the volume of their UK and export trades, while profits were maintained by Guyana Distilleries Ltd. and improved by Estate Industries Ltd. in Jamaica. Booker Line Ltd.'s three cargo liners and the bulk carrier *Booker Venture* carried a total of 140,000 tons from the Caribbean in 1968.

[1] *Sugar Review*, 1969, (919), 89.
[2] *International Sugar Rpt.*, 1969, **101**, (13), 1–2.
[3] See also *I.S.J.*, 1969, **71**, 158.

Infrared spectra of the dialysed browning products from cane final molasses and of certain of their modifications

By W. W. BINKLEY

(New York Sugar Trade Laboratory, 37 Warren Street, New York, N.Y., 10007 U.S.A.)

THE structure of the cane final molasses "browning" polymers is yet to be elucidated. Their apparent complexity is understandable since these polymers are formed in a media containing nearly fifty potential reactants[1]. Even so, some characterization of certain of the polymers has been achieved by the classical functional group methods[2]. Cognizant of their potentialities, we have undertaken to enrich these findings with contemporary instrumentation in a new phase of our studies of the structure of the cane final molasses "browning" polymers. The current contribution is the first in a series of papers utilizing spectroscopic methods. We report herein the application of infrared spectroscopy to these polymers and to certain of their modifications.

EXPERIMENTAL

Materials.—The isolation of the cane final molasses "browning" polymer(s)[3] and of its acetylated[2b] and periodate-oxidized[2a,c] modifications have been described.

Protonation of the Cane Final Molasses "Browning" Polymer(s)

Nine grams of the polymer(s) in 200 ml of water were allowed to pass through a 40 cm high by 7·5 cm dia. column of a cation exchange resin* in the hydrogen (H^+) form at 25°C. The column was washed with 3 litres of water. The column effluent was concentrated at 35–40°C under reduced pressure to 500 ml and dewatered further by freeze-drying, to yield 7·0 g.

Technique.—The polymeric materials were dispersed in potassium bromide (about 1 mg per 400 mg KBr). The data presented in Fig. 1 were obtained with an infrared spectrophotometer†.

RESULTS

The infrared spectrum of the cane final molasses "browning" polymer(s) (Fig. 1A) showed four significant bands: at 3·07 microns (μ) a strong, broad band characteristic of H—O bond absorption; at 3·53μ a medium, sharp band indicative of C—H absorption; at 6·20 μ a strong, broad C=O absorption band and at 9·54μ a strong, very broad band.

The spectrum for the acetylated molasses polymer(s) (Fig. 1B) possessed at least four informative bands: at 3·10μ a weak, broad band in the H—O region of the spectrum; at 3·54μ a medium sharp band characteristic of C—H absorption; at 5·79μ a strong, sharp band indicative of the C=O of the acetate ester[4a] along with the medium, sharp band at 7·36μ (acetoxy methyl[4a]) and the large, broad band at 8·25μ ("acetate band"[4a]), and at 9·50μ a very strong, broad band.

The spectrum of the protonated molasses polymer(s) (Fig. 1C) displayed at least five significant bands: at 3·05μ a strong, broad band for H—O absorption; at 3·52μ a medium, sharp band for C—H absorption; at 5·87μ a strong, sharp band overlapping with a second strong, sharp band at 6·14μ, both bands being in the region for C=O absorption; at 9·50μ a very broad, strong band.

The spectrum of the periodate-oxidized polymer(s) (Fig. 1D) possessed at least five significant bands also. These were noted at 3·12μ strong and broad, at 3·57μ medium and sharp, at 5·89μ medium and sharp overlapping a strong, broad band at 6·12μ and at 9·40μ a very broad, strong band.

DISCUSSION

The empirical formula for the cane final molasses "browning" polymer(s) of 27,000 molecular weight, $C_{17-18}H_{26-27}O_{10}N$, had strongly suggested the presence in the polymer of a substantial hydroxyl group content[2a]. Acetylation studies[2d] indicated that the polymer repeating units did possess 6 or 7 groups. The infrared spectrum of the polymer (Fig. 1A) without derivatization verified this high hydroxyl content by the presence of a strong, broad band at 3·07μ. Support for the soundness of the acetylation technique used in the assay for these groups was seen in the near disappearance of this band in the spectrum of the acetylated polymer (Fig. 1B, weak band at 3·10μ). The strong, broad band at 6·20μ in Fig. 1A was assigned to the C=O bond absorption of the carboxylate group expected to be present in "browning" polymers generated from glycosyl-amino acids [the carboxylate group band of *N*-(carboxymethyl)-1-amino-1-deoxy-D-fructose, D-fructose-glycine, occurred at 6·20μ[5]]. This carboxylate group band was noted in both the protonated and periodate-oxidized molasses polymers (6·14 and 6·12μ, respectively).

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[1] BINKLEY: *Zeitsch. Zuckerind.*, 1966, **91**, 195.
[2] *idem*: *I.S.J.*, (a) 1957, **59**, 178; (b) 1958, **60**, 62; (c) 165, (d) 322; (e) 1961, **63**, 112, (f) 239.
[3] *idem ibid*: *I.S.J.*, 1957, **59**, 64.
* "Amberlite IR-120". Mallinckrodt Chemical Works, St. Louis, Mo., USA.)
† Model 21, Perkin-Elmer Corp., Norwalk, Conn., USA.
[4] NAKANISHI: "Infrared Absorption Spectroscopy" (Holden-Day, Inc., San Francisco) 1962, (a) pp. 142, 213; (b) p. 196.
[5] ANET: *Australian J. Chem.*, 1959, **12**, 280.

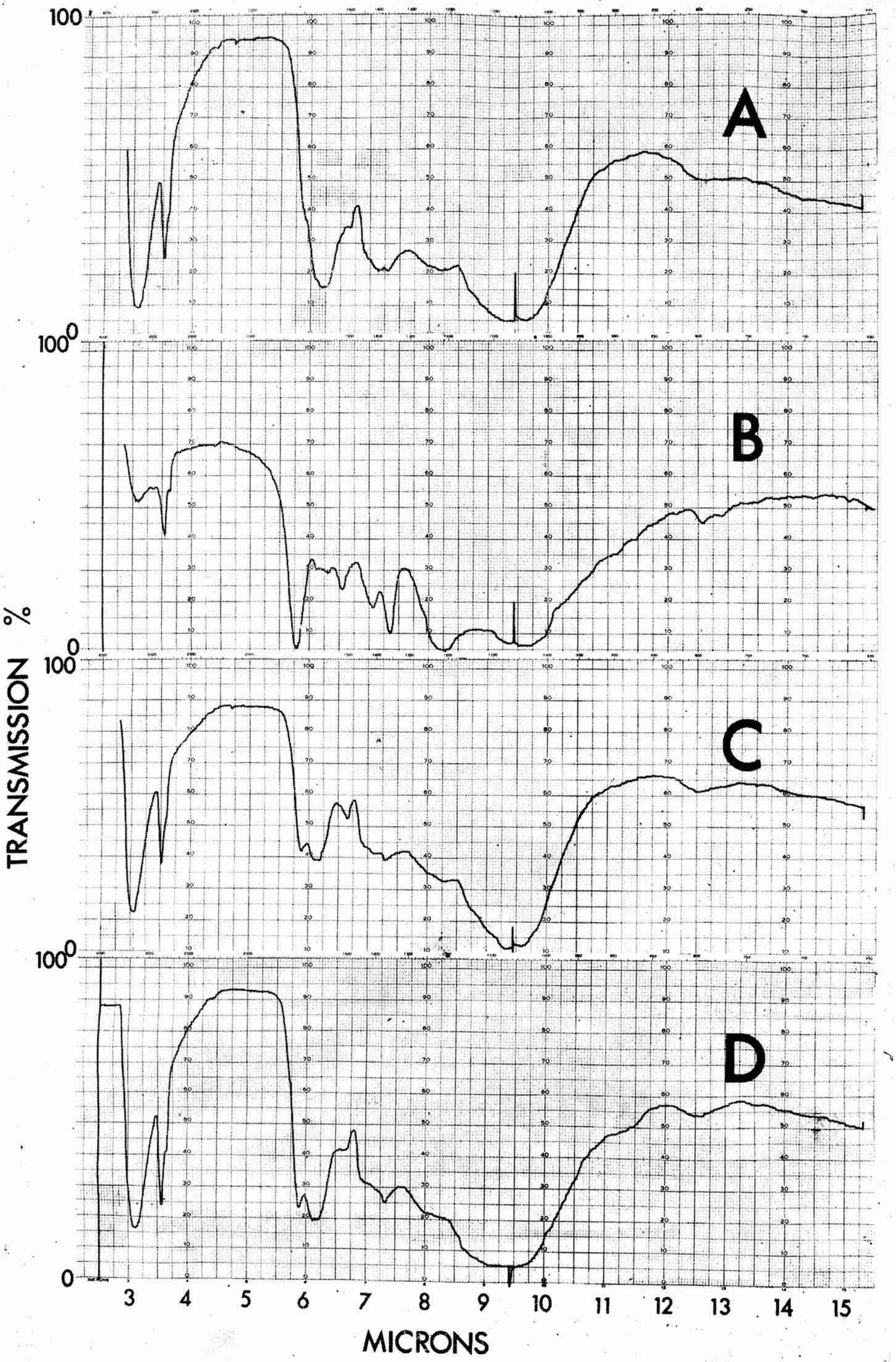


Fig. 1

The strong, very broad band at 9·54μ is characteristic of certain carbohydrate polymers, such as inulin[6] and a colorant from maple syrup[7]. No bands were observed in the "finger print" region, 10–15μ, of the spectrum of the cane final molasses "browning" polymer(s).

The spectrum of the acetylated molasses polymer (Fig. 1B) possessed at least four bands which were not present in the untreated polymer (Fig. 1A). Three of these bands were attributable to the acetate group[4a], the C=O bond at 5·79μ, the methyl portion at 7·36μ and the so-called "acetate band" at 8·25μ.

Protonation of the cane final molasses "browning" polymer(s) with ion exchange resins produced a notable change in its infrared spectrum. Overlapping bands appeared at 5·85 and 6·12μ in the spectrum of the protonated polymer (Fig. 1C). These bands are characteristic of the dipolar ions of amino acids (Zwitter ions)[4b]. The band at 6·12μ is that of the carboxylate ion as observed in the molasses polymer (Fig. 1A). The band at 5·85μ is probably that of the protonated nitrogen in the amino acid residues[4b] of this polymer modification.

Although the spectra for the protonated and periodate oxidized molasses polymers possessed essentially the same principal bands, the new strong band at 5·90μ (overlapping the band at 6·20μ in Fig. 1D) is attributable to the C=O absorption of the carbonyl group produced by the oxidation. The intensity of this band is dependent upon the extent of the oxidation; it is detectable after the consumption of 3·9 moles of periodate per hexose residue in the polymer, very intense after the uptake of 10·9 moles of oxidant[2e]. Identical C=O band development has been noted in periodate-oxidized cellulose[8]. This relationship between carbonyl group production and periodate consumption supports earlier findings[2a,c,d,3] indicating the probable presence of hexose units or hydroxylated residues in the cane final molasses "browning" polymers.

SUMMARY

Infrared spectroscopy confirmed a high constituent hydroxyl content in certain cane final molasses "browning" polymer(s). The spectrum of the acetylated polymer supported the presence of these hydroxyl groups with bands representing acetate ester groups and the near disappearance of the hydroxyl band. The emergence of a carbonyl band in the periodate-oxidized modification was additional evidence for the abundance of hydroxyl groups in the polymer. The spectrum of the polymer also revealed the presence of carboxylate groups and the spectrum of its protonated modification strongly suggested the probable presence of a Zwitter ion.

ACKNOWLEDGMENT

The counsel of Professor R. W. BINKLEY of the Cleveland State University in the interpretation of the infrared spectra is gratefully acknowledged.

[6] VERSTRAETEN: *Anal. Chem.*, 1964, **36**, 1040.
[7] UNDERWOOD *et al.*: *J. Food Science*, 1961, **26**, 397.
[8] GUTHRIE: *Advances in Carbohydrate Chem.*, 1961, **16**, 147.

Mill roller shaft failures and investigations

By R. N. CULLEN and J. R. ALLEN

Paper presented to the 13th Congress I.S.S.C.T., 1968

Introduction

IN Queensland, mills are worked hard and in 1962 it became apparent that the failure of mill shafts was an industry problem to which the Sugar Research Institute should give attention.

The use of ultrasonic flaw detection had been tried without much success a few years earlier, but a more modern version of this equipment was inspected in 1962 and a searching test programme was undertaken by Sugar Research Institute officers using this much improved equipment. Techniques were developed which made it possible for an experienced operator to detect with confidence cracks in shafts and give a good indication of the magnitude of the defect.

A survey of hundreds of shafts in the industry was made and many of the shafts were found to be faulty. Some were condemned, some kept under observation, some transferred to lighter duty and in a few cases the cracks were machined out and the shaft repaired by welding. Many of the faults occurred in the journal fillets and these were verified using the magnetic particle inspection method of crack detection. Those occurring just inside the shell were not verified other than by employing various ultrasonic testing techniques such as testing from both ends of the shaft and employing angle probes.

The immediate problem of knowing the condition of available rollers was solved in this way but the longer range issues were to determine the reasons for the failures and eliminate these causes.

Attempts to calculate the stress at the journal fillet of a shaft introduce a number of unknowns upon which the bending moment, shear forces and torque depend. There is no reliable measure of the friction in the guides of the bearing, the distribution of load in the bearing is unknown, there is no information available on the position through which the resultant force acts. The twisting moment is almost certainly varying with the position of the muff coupling as well as the position and state of the gearing. The stress concentration at the fillet may be calculated but uses data available from work on smaller diameters.

Some of these may be considered to be second order quantities, but the bending moment assumptions, for example, can have such a large influence on the final stress value that no reliance may be placed on what might appear to be a reasonable estimate of the position of the resultant force at the bearing. Add to this the probable fluctuation of the dynamic case which must be considered with a mill in operation and calculations alone appear to be impracticable.

This concept of working with unknown quantities is nothing new to an engineering designer and it might be considered pedantic to worry over such details since some mill roller shafts have been in operation for years without the designer having access to full information. It is not pedantic, however, for a mill manager to be concerned that a new shaft breaks within a few weeks of the mill starting date. This has happened on occasions and good reasons must be found for such failures which occur usually at the drive end journal inside fillet or just inside the shell loading.

Corrosion

An inspection of many shaft failures shows corrosion to be present and the appearance of the failures are typically fatigue failures. Corrosion fatigue failures are to be expected in this type of application and to minimize the danger it is appropriate to try to exclude the corrosive environment and to reduce the level at which the alternating and intermittently variable stresses are present during mill operation. The material from which the shafts are made must also be suspect and extensive physical and chemical tests would naturally be undertaken where premature failures occur.

The prevention of corrosion in general presents some problems but there were a large number of shaft faults found in the shell landings and it was evident that some penetration of juice with consequent pitting had occurred. This pitting and local corrosion can be effectively dealt with by providing a convenient rubbery seal at the end of the shell at the shaft shell interface. This is preferably done without mechanically constrained rings.

Investigations were carried out using various viscous liquids and pastes which are required to set and give a good bonding yet remain flexible. A test rig was designed to provide alternating stressing of fillets of these sealants in a bath of hot juice. The material "Lastomeric hard" which was the least expensive of those used in these tests proved to be the best. It has a heavy rubber base which is used in conjunction with a curing agent and this curing process takes approximately 14 hours.

A shaft which had been treated by applying a fillet of this material to prevent ingress of juice between shell and shaft was examined at reshelling and there was no evidence of pitting in the shell landing area.

Stress concentrations

The fact that a number of comparatively new shafts have broken at the inside fillet of the journal at the drive end clearly indicates some inadequacy in design or material. Chemical analysis, physical testing, metallographic studies and macroscopic examination have been used to evaluate the condition of the metal. These tests have not generally shown any unsuspected properties or inadequacies of the material which would be likely to cause failure in service without severe stressing.

It is certain that a stress-raising effect occurs at the fillet of the journal and the stress concentration can be calculated. For many designs using a one-inch fillet radius this stress concentration factor is approximately 1·7 and in accordance with PETERSON's experimental evidence[1] this value could be reduced by approximately 30% if the radius were increased to five inches.

In adopting this solution there is some danger, since the bending moment increases linearly as successive positions along the shaft are considered towards the shell. At the same time removal of metal by increasing the radius reduces the section modulus which varies as the cube of the roll shaft diameter. The bending stress will depend upon the particular configuration of the bearings and shaft design and must be calculated for each case.

The unfortunate fact is that, whereas the calculation to be performed is simple, doubtful assumptions must be made regarding the position of the line of action of the resultant force from the bearing pressure on the shaft. The distance of this resultant force from the cross-section of shaft considered determines the lever arm which, when multiplied by the magnitude of the force, gives the bending moment at the cross section considered.

From these considerations and after assessing the range of possible bending moments, it became clear that it was highly desirable to obtain measurements of bending moments, shear stresses and torque on a mill shaft in operation.

EXPERIMENTAL

Method

The shaft chosen for the experiments was the top roller shaft on the 5th mill of a five-mill train. The top roller was hydraulically loaded.

Strain gauges were fixed to the shell landings at each end of the shaft. This location was necessary to prevent gauge damage during mill operation. The levels of stress at this location were related to the critical fillet locations by direct calibration of the shaft when stationary.

[1] PETERSON: "Stress Concentration Design Factors" (Wiley, New York), 1962, p. 75.

Fig. 1 shows the preparation of the shaft and equipment used to bring out the signals from the strain gauges. Holes A, B, C and D were drilled and a groove E was provided in the shell. These provided conduits through which wires from both pintle and drive end gauge positions could be brought to the pintle end of the shaft where slip rings were located.

Gauge protection was a major problem which was solved finally by the use of adhesives and mechanical techniques which preserved the gauges from damage in the extremely humid and high temperature ambient conditions.

The strain gauges were arranged in sets on the shaft to measure the bending, shear, and torsional stresses on the drive end and the bending and shear stresses on the pintle end. Because the outputs of those gauge sets measuring bending and shear stresses were sinusoidal owing to shaft rotation, it was necessary to arrange the angular positioning of the guage sets so that each set could be sampled by the switching unit strain gauge amplifier combination twice each shaft revolution when the output was a maximum. Roll lifts at both ends were measured with strain gauge beams. The results were recorded on a digital voltmeter-printer combination.

Results

The roll was calibrated for bending and shear stresses by applying hydraulic loads at fixed lever arms from the fillets. Gauges were positioned on the fillet to enable the stress concentration factor to be determined and to obtain a relationship between stress measured at the shell landing and the stress at the fillet. It was found that the stress concentration factor at the fillet was 1·39 compared with a theoretical value of 1·30 obtained from small diameter tests. This 7% increase is in agreement with experiences of other workers using large diameter shafts. The torque calibration was achieved by applying weights to a 4·5-metre arm rigidly attached to the roll.

The experiments to determine bending and shear stresses were performed at 16 combinations of drive and pintle loads giving top roll loads from 1·5 × 10^5 to 2·2 × 10^5 kg/metre. Five replications were done for each combination. The period of each test was 10 minutes or approximately 30 revolutions.

The points shown in Figs. 2 to 7 represent the average values of the variables for the five replications.

(*a*) *Pintle shear and pintle bending stress*

The values obtained for pintle shear stress at the inside fillet of the pintle journal are shown in Fig. 2. It can be seen that pintle shear stress is independent

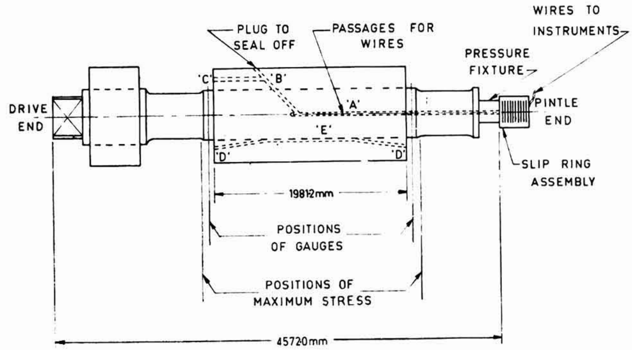


Fig. 1. Diagram of mill roller shaft showing positions of strain gauges and passages for connecting wires

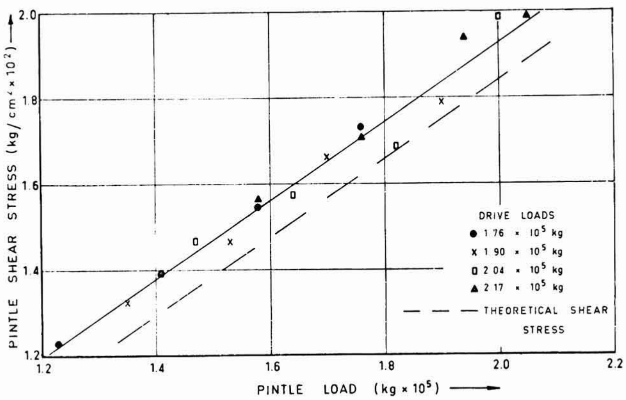


Fig. 2. Effect of pintle load on pintle shear stress

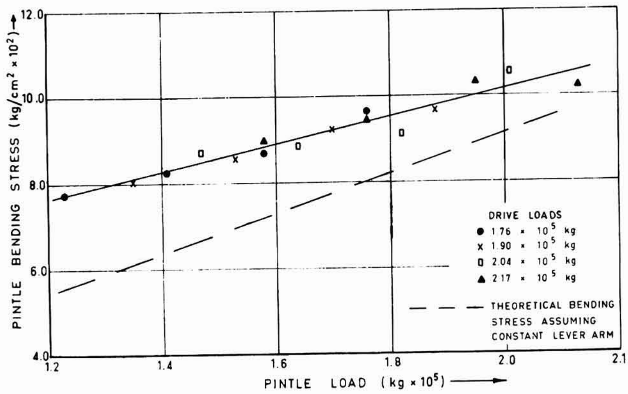


Fig. 3. Effect of pintle load on pintle bending stress

of drive load (ram pressure × ram area) and is within 5% of the theoretical value determined from the geometry of the shaft and the applied pintle load. This close agreement is not surprising when the simple geometry of the pintle end bearing is considered.

The values of pintle bending stress at the journal inside fillet are shown in Fig. 3. The pintle bending stress is seen to be approximately 20% higher than the theoretical value calculated from the applied pintle load and the lever arm (distance between line of action of load and journal inside fillet) on the assumption that the load acts at the centre of the bearing.

However the pintle lever arm was found to vary with difference in drive and pintle lifts as shown in Fig. 4. The pintle lever arm, on the assumption that the load acted at the centre of the bearing, was 25·4 cm. The high values of the experimentally determined lever arm account for the higher values of pintle bending stress.

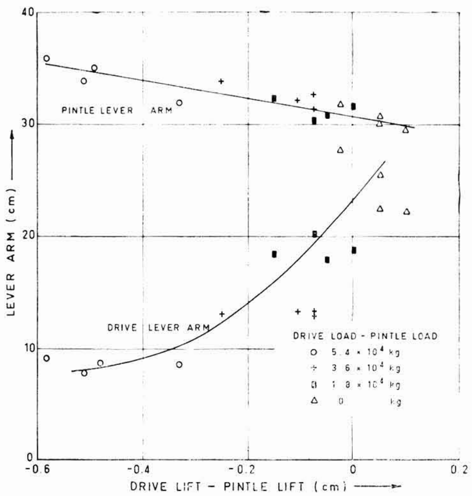


Fig. 4. Effect of difference in drive and pintle lift on drive and pintle lever arm

(b) Drive shear and drive bending stress

The values obtained for drive shear stress at the inside fillet of the drive journal are shown in Fig. 5. The magnitude of the nominal drive shear stress $\left(\frac{\text{ram pressure} \times \text{ram area}}{\text{cross sectional area of shaft}}\right)$ is higher than the theoretical value and is dependent on the value of pintle load as well as the value of drive load.

It is higher for the greater difference between drive and pintle loads. This is because of the greater downward force exerted by the tail bar when the difference in lifts between the drive and pintle ends is greatest. The relationship between applied load and difference in lift is shown in Fig. 6.

The values obtained for drive bending stress at the inside fillet of the drive journal are shown in Fig. 7.

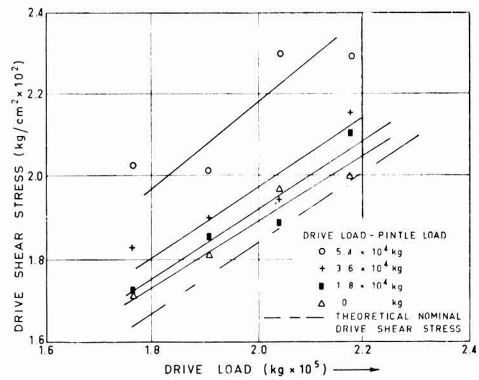


Fig. 5. Effect of drive load and difference between drive load and pintle load on drive shear stress

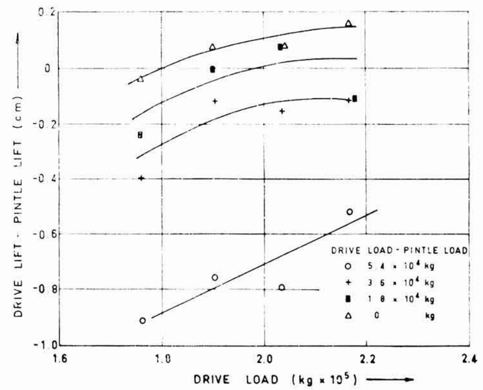


Fig. 6. Effect of drive load and difference between drive load and pintle load on difference between drive lift and pintle lift

The fact that the stresses are less than the theoretical values and depend on the difference between drive load and pintle load is due to the changes in lever arm that occur with changes in values of load difference, accompanying the difference in roll lifts (Fig. 4). When the theoretical values of drive bending stress were calculated using the experimentally determined values of lever arms, they agreed with the observed values to within ± 7%.

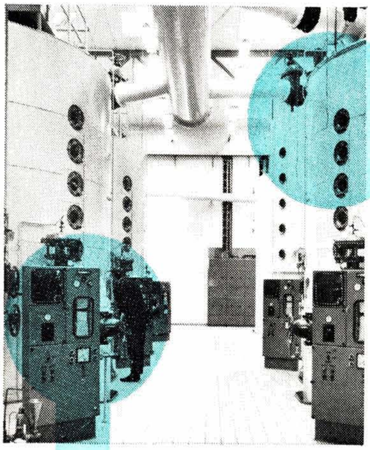
(c) Drive torque

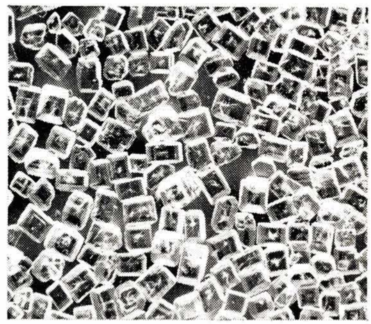
It was found that torque on the top roll for set load conditions showed periodic fluctuations of ± 15% of the mean value. The frequency of these fluctuations was 18 per roll revolution, corresponding to the number of teeth on the pinion. This is evidence of uneven load sharing on gear teeth due principally to imperfections in gear geometry.

The results for average value of top roll torque are shown in Fig. 8. It can be seen that the scatter is appreciable.

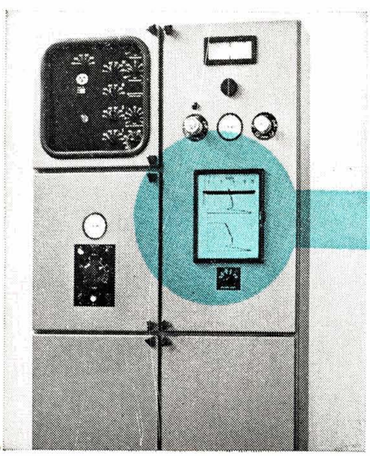
It has been demonstrated that it is possible to employ strain gauges to measure the stresses occurring in a mill shaft in operation and to have these remain operative during several months of crushing.

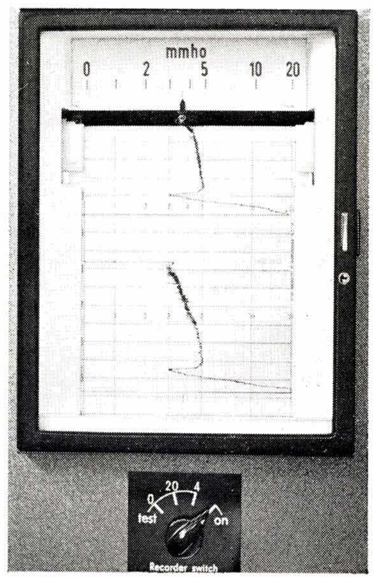
DDS COMPLETE PAN BOILING AUTOMATICS





A low content of conglomerates and a uniform grain size constitute an essential prerequisite for producing the best possible sugar from a given juice. In an existing vacuum pan the best results are achieved by keeping the supersaturation in the mother liquor at an optimum during all stages of the strike. By automizing both graining and final boiling the DDS-Pan-Boiling Automatics meet these demands to their full extent, at the same time considerably reducing the labour costs.





The function of the DDS-Pan-Boiling Automatics is based on a measurement of the conductivity combined with efficient vacuum regulation. The equipment is used for juices with purity up to 97 and works without any use of water. The DDS-Pan-Boiling Automatics have been developed during the last ten years and are of a sturdy and simple construction. They operate successfully in Italy, The Netherlands, South Africa, and Denmark.

A/s DE DANSKE SUKKERFABRIKKER
LANGEBROGADE 5 · COPENHAGEN · DENMARK

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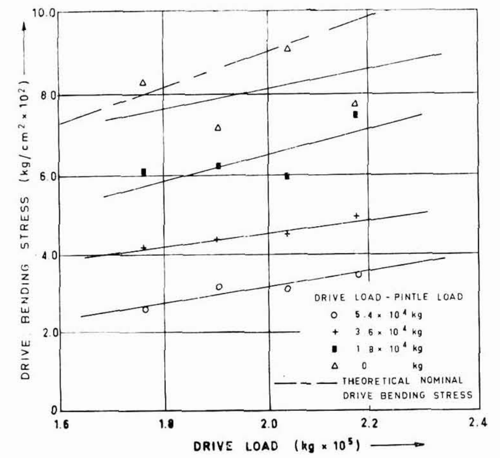


Fig. 7. Effect of drive load and difference between drive load and pintle load on difference between drive lift and pintle lift

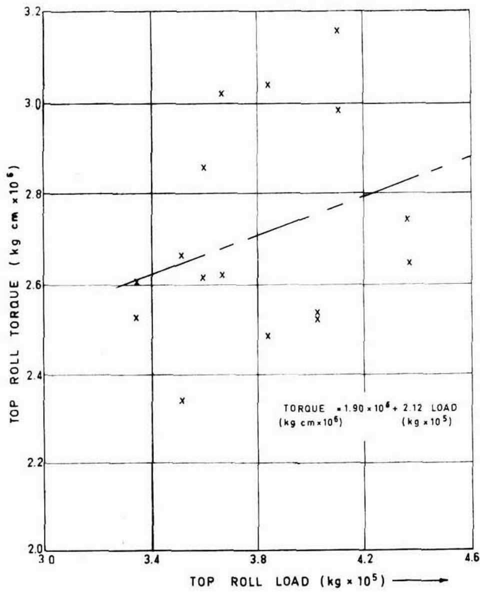


Fig. 8. Effect of top roll load on top roll torque

Conclusions

The value of the pintle lever arm has been shown to be a significant factor affecting the magnitude of the stresses at the pintle journal inside fillet. Because the magnitude of the observed stresses is very close to the endurance limit of the usual shaft material, it is essential that this lever arm at all times be kept to a minimum. This can be done by either limiting the value of difference in lift between drive end and pintle end or alternatively providing a better type of self aligning bearing.

The difference in roll lift has an effect on the lever arm at the drive side opposite to the effect it has on the lever arm at the pintle side. It is fortunate that the large differences in roll lift which give rise to the higher values of drive shear stress also give rise to the lower value of lever arm, thus lowering the values of drive bending stress. If, however the shaft is to operate with minimum difference between drive and pintle lifts for pintle bending stress considerations, it is essential that the extra shear force applied to the shaft by the rigid tailbar coupling to the prime mover be kept to a minimum. This can be done by increasing the flexibility of the tailbar by increasing its length or, where this is not practical, by providing a type of coupling that can accommodate misalignment of the prime mover output shaft and the top roller.

The general level of stress due to bending moment is high and unless design modifications as suggested above are introduced, the conventional shaft should be increased in diameter or a better class of steel used in the shafts.

Ultrasonic testing has proved to be a valuable inspection tool for use during the crushing season, as well as during the non-crushing season, to detect and observe the progress of flaws in a roller shaft. In this way shaft breakages in service can be minimized and a true assessment of the condition of mill shafts and spares can be maintained.

Acknowledgements

The authors wish to thank the Sugar Research Institute for permission to publish this paper and also wish to pay tribute to the members of the engineering staff who contributed so much to the instrumentation, calibration and testing work over a long period.

Summary

The paper outlines the reasons for failures which occur in sugar mill roller shafts and describes how some of the causes of failure, such as corrosion and stress concentrations, can be avoided. An explanation is given to show some of the features of the geometry of shafts and operation of mills which make a purely theoretical approach to an investigation of the conditions of stress in a shaft unpractical.

Details are given of an experimental investigation to determine the levels of stress in a mill roller shaft under operating conditions. A method is described for affixing strain gauges to a shaft so that stress readings can be obtained over several months of crushing. Varying conditions of roll load were employed and measurements were made of the bending and shear stresses at the journal fillets at each end of the roll. In addition measurements were made of the torque at the drive end. Results obtained from the experiments are presented and discussed. It was found that an extremely significant factor affecting the magnitude of the bending stresses was the relative lifts of the drive and pintle side of the roll.

Conclusions are that the shafts are highly stressed and recommendations are made for the design of shafts and modifications to mills.

Hodag "Vap-99" Evaluation

By R. MALONEY, Factory Chemist, Andrews Sugar Factory, Barbados

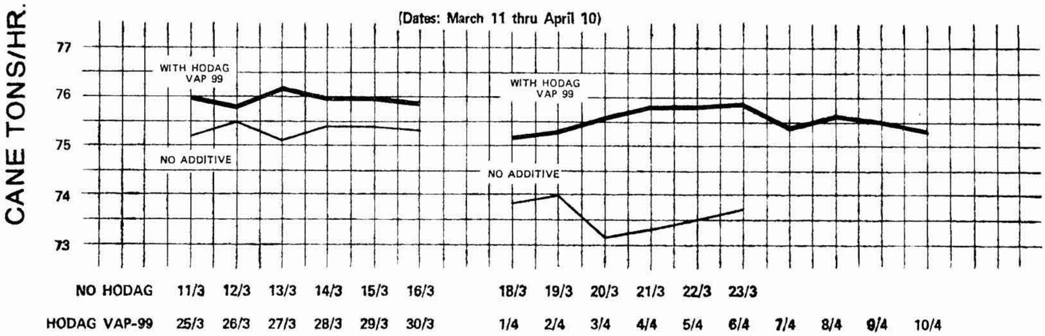
(In cooperation with the Sugar Technology Research Unit, Edgehill, Barbados, West Indies)

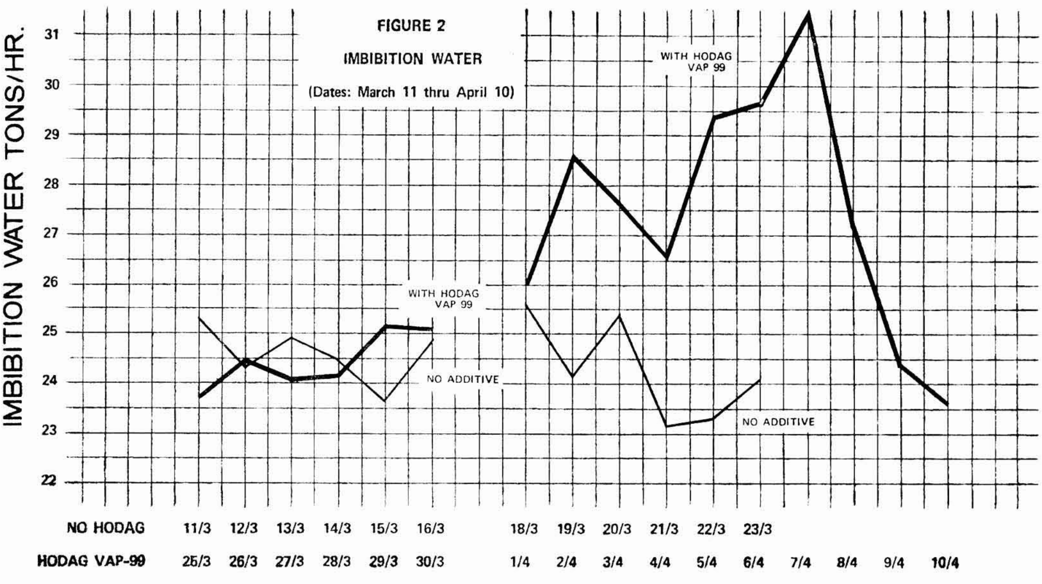
EXPERIMENTS were carried out with Hodag "VAP-99" applied to quadruple evaporators to determine its usefulness as a scale inhibitor or in helping to maintain evaporation rate over longer periods of operation. The concentration used was 10 p.p.m. on weight of mixed juice applied continuously to the evaporator supply tank by a metering pump.

It can be appreciated that to determine the actual deposit of scale with and without Hodag "VAP-99" would be quite difficult, so it was decided to base our findings on the evaporation rate over a period without "VAP-99" and a period with "VAP-99". Four runs were made: two 6-day periods without Hodag "VAP-99" with cleaning on the 7th day; one-6 day period with Hodag "VAP-99" with cleaning on the 7th day

FIGURE 1

GRINDING RATE





one 10-day period without cleaning. During the test runs, an effort was made to maintain a constant grinding rate, and to keep the syrup Brix between 65° and 70° with the imbibition water as the variable.

Observation at the end of two 6-day periods without Hodag "VAP-99" showed that the 3rd and 4th vessels had quite a heavy deposit of hard scale which was not completely removed by mechanical cleaning. (No chemical cleaning is used.) The weight of scale collected from one tube after drying was approximately 18 grams.

After the first 6-day period with Hodag "VAP-99" the scale deposit seemed to be much reduced and was much softer and easier to clean; it was estimated that about 80% of the tubes were thoroughly clean after using mechanical cleaning. The weight of scale collected from one tube after drying was approximately 13 grams.

At the end of the 10-day period with Hodag "VAP-99" the scale deposit again appeared to be much softer and comparatively easy to clean. It was estimated that all the tubes were thoroughly clean

Table I.

ANDREWS SUGAR FACTORY

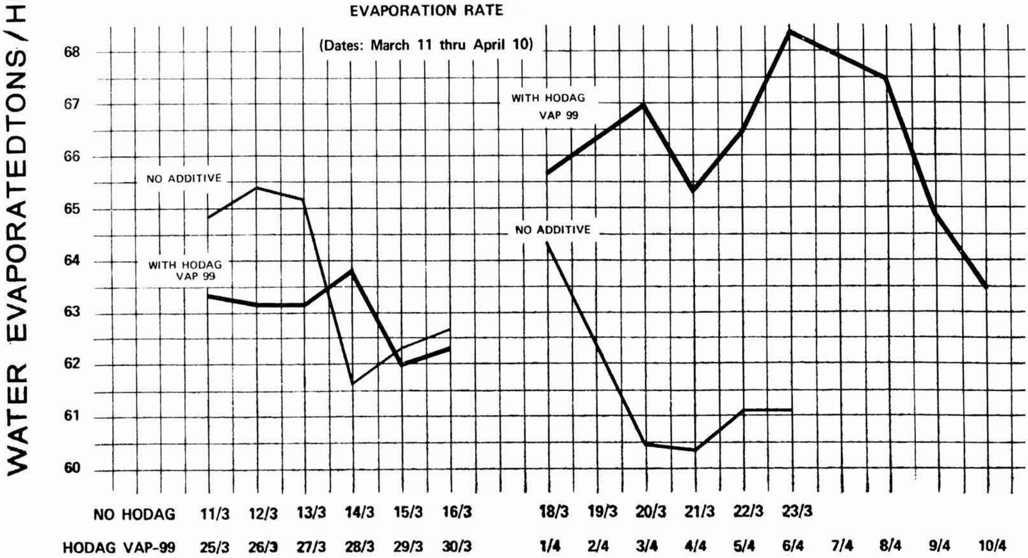
Hourly Averages

	DATE	Tons Cane/hr.	Tons Water/hr.	Tons Water Evap/hr.	Brix Juice	Brix Syrup	% Evap.
WITHOUT VAP. 99	11/3/68	75.23	25.36	64.79	13.56	69.16	80.39
	12/3/68	75.53	24.34	65.36	13.63	68.41	80.08
	13/3/68	75.06	24.93	65.15	13.53	68.08	80.13
	14/3/68	75.35	24.48	61.68	13.52	67.00	79.82
	15/3/68	75.44	23.70	62.28	14.25	67.62	78.93
	16/3/68	75.33	24.87	62.71	14.10	66.70	78.86
	AVERAGE	75.32	24.61	63.66	13.77	67.83	79.70
	18/3/68	73.84	25.64	64.43	13.83	62.75	77.96
	19/3/68	74.00	24.21	62.89	14.24	67.21	78.81
	20/3/68	73.21	25.35	60.51	13.99	63.38	77.93
	21/3/68	73.30	23.16	60.37	14.27	67.79	78.94
	22/3/68	73.50	23.34	61.11	14.27	67.70	78.92
	23/3/68	73.72	24.22	61.13	14.17	67.46	78.99
	AVERAGE	73.60	24.32	61.74	14.13	66.05	78.59
WITH VAP. 99	25/3/68	76.04	23.67	63.36	14.34	70.12	79.55
	26/3/68	75.81	24.35	63.18	14.68	68.75	78.65
	27/3/68	76.20	24.14	63.22	14.59	69.16	78.90
	28/3/68	76.00	24.24	63.79	14.41	68.54	78.98
	29/3/68	75.95	25.19	61.97	14.29	68.07	79.01
	30/3/68	75.90	25.14	62.25	14.15	67.12	78.92
	AVERAGE	75.98	24.46	62.96	14.41	68.63	79.00
	1/4/68	75.21	25.99	65.72	14.58	70.75	79.39
	2/4/68	75.33	28.58	68.27	14.20	68.75	79.35
	3/4/68	75.62	27.70	66.91	13.88	66.38	79.09
	4/4/68	75.81	26.58	64.39	14.38	69.58	79.33
	5/4/68	75.81	29.43	66.51	14.01	65.15	78.50
	6/4/68	75.75	29.65	68.33	13.60	68.20	80.06
	7/4/68	75.42	31.54	67.94	13.48	68.56	80.34
	8/4/68	75.55	27.16	67.37	14.12	69.18	79.59
	9/4/68	75.48	24.43	64.77	14.14	67.79	79.14
	10/4/68	75.31	23.71	63.52	14.94	68.95	78.33
	AVERAGE	75.53	27.48	66.37	14.13	68.33	79.31

FIGURE 3

EVAPORATION RATE

(Dates: March 11 thru April 10)



after the use of mechanical cleaning. The weight of scale from one tube after drying was approximately 15 grams.

It can be seen from Table I and Figs. 1–3 that for the first two 6-day periods without Hodag "VAP-99" the average evaporation rate per hour was 63·66 and 61·74 tons. There was a decline in the evaporation rate from the 1st to the 6th day in the first period of 2·1 tons water per hour and from the 1st to the 6th day in the second period of 3·3 tons water per hour.

In the first six-day period with Hodag "VAP-99" the average evaporation rate was 62·96 tons water per hour with a drop from 63·36 tons water per hour on the first day to 62·25 tons water per hour on the sixth day, a reduction of 1·1 tons water per hour over the period. During the 10-day period with Hodag "VAP-99", the average evaporation rate was 66·37 tons water per hour with a drop from 65·72 tons water per hour on the first day to 63·52 tons water per hour on the tenth day, a reduction of 2·2 tons water per hour. It should be mentioned here that on the fourth day of the 10-day run with Hodag "VAP-99" we encountered some difficulty with vacuum owing to over-heated injection water. On the sixth day, tubes were found leaking in the 3rd vessel of the quadruple effect evaporator and a stop had to be made for repairs; during this period it is felt that there was a certain amount of baking of the tubes which might account for the faster fall-off of evaporation rate during the ninth and tenth days.

It is our opinion that Hodag "VAP-99" does help in maintaining evaporation rate over a longer period of time and also produces a softer scale deposit which makes for much easier mechanical cleaning.

Conclusions

As will be seen from the report, there is no doubt that Hodag "VAP-99" did have a significant effect both in maintaining evaporation rates and in improving the condition of the smaller amount of scale produced during its use. Whether the use of Hodag "VAP-99" can be justified economically in Barbados is not so easily established.

Used at the recommended rate of 10 parts per million on juice at the price to the factory in Barbados of E.C. $1.50 per pound, it would cost about 3·5 cents per long ton of cane or almost 30 cents per ton of sugar (15 cents US currency).

Directions in which savings could possibly be made as a direct result of using Hodag "VAP-99" are discussed below, with comments on the local situation as it seems to affect these savings.

1. *Evaporator efficiency*

In cases where the evaporator capacity is smaller than it should be for the required milling rate the fall-off in evaporation rates during the course of a week's run may make it necessary to reduce imbibition towards the end of the week. If this reduction is severe enough to affect the mill extraction of sugar significantly, anything which would enable the efficiency of evaporation to be maintained would then directly increase the recovery of sugar. It would, of course, be much better to increase the size of the evaporator, but as a temporary measure or if this problem was only occasionally experienced (for example in crops when scaling was particularly severe) then the advantages of using some additive to reduce scaling even marginally might prove to be economically justified.

2. *Cleaning costs*

Since evaporator cleaning is normally paid for on a task basis, a softer scale as such would not show any saving. It would only be if a two-week run without cleaning could be successfully achieved that a reduction in cleaning costs could offset the cost of the chemical.

Cleaning costs naturally vary from one factory to the other, but allowing for labour, wear and tear on cleaning equipment, etc., a weekly clean would not cost a factory more than E.C. $80 at most. Fortnightly instead of weekly cleaning over a 16-week crop would, therefore, only show a saving of about E.C. $650—much less than the cost of chemical for even our smallest factory.

3. *Greater Cane Throughput*

There is no question of weekend stops being forced on the factories by the necessity to clean evaporators. The cane supply is always limited at weekends and a mill stoppage for several hours is inevitable.

However, should particular circumstances arise where Hodag "VAP-99" could be applied at least we are quite happy that it will have some effect on the scaling.

We would like to thank Hodag International who made it possible for these test runs to be made.

* * *

The following material is not part of the original Barbados report but is mainly technical information, supplied by the manufacturers of Hodag "VAP-99", describing the method by which the additive functions.

Hodag "VAP-99" is a surface-active additive used in evaporators to reduce scale formation and improve evaporator efficiency. The viscosity and surface tension characteristics of the juice are reduced, increasing the velocity of the juice across the tube surface, greatly improving circulation and heat transfer. Localized over-heating is prevented and scale deposits are appreciably reduced.

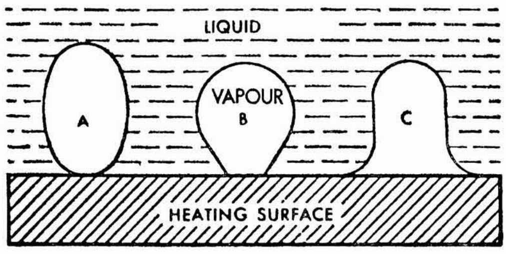


Fig. 4. Effect of interfacial tension on the shape of bubbles of vapour

As McAdams states in his text on "Heat Transmission", if the interfacial tension is low at the boiling liquid surface, or, in other words, if the liquid has a high tendency to wet the surface, the vapour bubbles will be pinched in at the heating surface and readily set free (see Fig. 4).

In contrast, if the liquid has a low tendency to wet the surface, the vapour bubbles will spread out at the surface and be set free only when comparatively large. This gives a lower coefficient of heat transfer since the rate of heat transfer to the vapour is much less than to the liquid. Therefore, more efficient evaporation and boiling in the evaporators can be obtained if the wetting power of the sugar juices can be enhanced.

In addition, calcium salts possess a "reverse" solubility, causing them to be precipitated at the tube surface where the higher temperature reduces the solubility. By improving the rate of heat transfer, this localized overheating is prevented, and the scale deposits are minimized.

Another mechanism for reducing scale is to use a chelating agent to solubilize the calcium salts and prevent their deposition. This is a stoichiometric relationship and requires that the chelating agent be added in direct proportion to the amount of calcium ions present in the juice. In most cases, the cost is prohibitive to effect a material reduction in scale.

Surface activity, on the other hand, is independent of calcium content. Thus trace amounts of surfactants can produce a substantial effect, dependent only on the surface area of the tubes rather than calcium ion content. This gives a means of causing profound effects at a minimum cost.

Brevities

Chile record campaign[1].—Production of sugar in 1968 was the best recorded since the establishment of the industry, fifteen years ago. It was 16% higher than that of 1967 and will cover 57·5% of annual domestic consumption. The area sown to beet was 31,122 hectares, against 28,900 ha in 1967 and 21,042 ha in 1966, and the yield was 38·3 metric tons/hectare compared with 36·3 in 1967. The total slice was 1,193,713 tons as against 1,047,926 tons in 1967, and sugar production was 172,506 tons, compared with 148,922 tons in 1967 and 109,322 in 1966. Molasses production was 39,635 tons as against 35,081 tons in 1967, and dried pulp production 51,460 tons compared with 45,484 tons.

* * *

Swaziland sugar crop, 1968/69[2].—Swaziland produced a record 169,296 short tons of sugar in the 1968/69 season, 4457 tons more than the figure for the previous season. The Swaziland Sugar Association stated that, but for the effects of frost in the southern growing areas, the production figure would certainly have been appreciably higher. During the year, 12,043 tons of sugar were sold locally and exports were 149,487 tons, including 97,725 tons to the UK, 37,794 tons to Canada, 6759 tons to the USA, 6295 tons to Zambia, 720 tons to Malawi and 192 tons to Rwanda. Molasses production for the 1968/69 season totalled 45,673 tons.

* * *

Hawaii 1968 sugar production[3].—The official figure for sugar production in 1968 was 1,232,182 tons of 96° raws, only 1939 tons less than the record crop of 1966 and the second highest in the history of the Island's industry.

[1] *Bol. Remolachero*, February 1969.
[2] *Standard Bank Review*, April 1969, p. 27.
[3] *Sugar y Azúcar*, 1969, **64**, (3), 58.

Sugar cane agriculture

Influence of urea on germination in sugar cane. R. A. Arevalo. *Rev. Agron. Noroeste Argentino*, 1966, **5**, (1–2), 155–164.—Planting setts (3 buds) of cane variety CP 34–120 were subjected, 10 days after cutting, to treatment with 3 different concentrations of urea for 2 hours and then immediately planted. No significant results arose from the treatment.

* * *

Preservation of sugar cane planting material. M. A. Scarsi and D. M. Morin. *Rev. Agron. Noroeste Argentino*, 1966, **5**, (1–2), 165–173.—Results are given of trials with a new pit method of storing sugar cane planting material required at a later period of the year for planting. Three different varieties of cane were used—early, medium and late. It was concluded that this method results in 10% more viable buds than the traditional method of storage. It gave better protection against harmful insects and putrefactive agencies.

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Herbicide application in sugar cane cultivation. E. Cerrizuela, J. A. Mariotti and R. Arevalo. *Rev. Agron. Noroeste Argentino*, 1966, **5**, (1–2), 181–206. Results are given of extensive trials with various herbicides. The effects on different individual weeds, including some that are particularly troublesome (e.g. nut grass, *Cyperus rotundus* and Johnson grass, *Sorghum halepensis*), are recorded.

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Effects of different hot air treatments on germination of sugar cane. E. Cerrizuela and J. A. Mariotti. *Rev. Agron. Noroeste Argentino*, 1966, **5**, (1–2), 207–208.—The variety of sugar cane used in the tests was CP 34-120 and the duration of treatment (58°C) 2, 3, 4, 5, 6 and 7 hours. Results are given in a table. Differences were not significant.

* * *

Future equipment for the sugar industry. W. J. Landry. *Sugar J.*, 1968, **30**, (10), 24–27.—The writer considers that during the next 10 years field implements will become more multi-purpose, there will be less dependence upon high-clearance tractors, harvesters will take on a new look and transport equipment will carry more payload.

* * *

Cytogenetical studies in *Narenga porphyrocoma*. I. Study of karotype and abnormalities in meiosis. D. Jagathesan and T. V. Sreenivasan. *Cytologia*, 1967, **32**, (1), 11–18.—Results of studies on meiosis and pollen mitosis in twenty plants of *Narenga porphyrocoma* are discussed. *N. porphyrocoma* is a species found in Northern India and was formerly included in *Saccharum* as *S. narenga*. Its use as a parent in cane breeding has been advocated by a number of authors.

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Cation exchange capacity of roots and yield potential in sugar cane. K. C. Rao, T. N. Krishnamurthy and J. T. Rao. *Plant and Soil*, 1967, **27**, 314–318. Results are given of tests to determine the cation exchange capacity in sett roots (collected 30 days after planting) and shoot roots (collected 95 days and 135 days after planting) of six high-yielding and five low-yielding hybrid cane varieties.

* * *

Sugar cane variety trials in Tucumán (Argentina). R. F. de Ullivarri and W. Kenning. *IDIA*, 1967, (229), 26–46.—Old and new varieties in Tucumán are discussed and data given in regard to yields from trials carried out at various centres. Differences in yield are continually being studied in order to warrant recommendations for planting.

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Non-sugar constituents in sugar cane juice and varietal selection. (A) J. T. Rao, K. C. Rao and R. Narasimhan. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 29–33. (B) A. C. Chatterjee. *ibid.*, 35–37. (C) J. W. Khanolkar and R. Vaidyanathan. *ibid.*, 39–47.

(A) The chemical composition of cane and juice and juice soluble solids content (%) are tabulated, and the effects of the various constituents on such factors as cane protein synthesis, disease resistance and factory processing are discussed.

(B) The constituents of cane juice and selection of cane varieties are discussed and a list is given of a number of varieties with their yields and average juice pol, purity, reducing sugars content and fibre content, and whether the varieties are smut- or red rot-resistant.

(C) Among the themes discussed are the factors affecting the composition of cane juice, the constituents of cane juice, removal of inorganic non-sugars, varietal selection of cane, and the relationship between processing difficulties and cane variety. Particulars are given of the varieties processed and performance levels at Madurantakam Co-operative Sugar Mills Ltd.

Effect of various levels, method and time of application of phosphatic fertilizers on the quality of sugar cane in v.c. canal tract of Mysore State. S. VENKATARAJ, M. GOPALAREDDY and G. V. HAVANAGI. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 49-58.—Results are given of fertilizer experiments carried out at Mandya Regional Research Station. The optimum rate of application was considered to be 75–100 lb P_2O_5 per acre. Application of phosphate at planting improved the quality of the juice, compared with application at earthing-up, but the latter increased cane yield.

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Influence of soil and plant moistures on juice quality of sugar cane. G. N. RAO, P. H. RAO and P. V. R. RAO. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 59–63.—Experiments on the effect of irrigation, nitrogen and plant moisture on cane juice quality are discussed.

* * *

Problems on cane quality in 1966-67 in Nizam sugar factory. A. S. S. MURTHY and A. SOMASUNDARAM. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 65–86.—A report is presented on cane processing in 1966/67 at Nizam I and II sugar factories, with notes on the effect of disease on juice quality and the deterioration of stale cane.

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Agronomic practices and their relationship to cane quality—Nellikuppam sugar factory area. ANON. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 87–114.—Factors affecting cane quality discussed include month of crushing, climate, and fertilizer application. Results are given of N-P-K experiments.

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Influence of certain agronomic practices on cane quality in Andhra Pradesh. M. LAKSHMIKANTHAM. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 115–121.—An account is given of recent work at the Sugar Cane Research Station, Anakapalle, on cane varieties and recommended schedules of fertilizer application and cultivation methods.

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Agronomic practices in relation to quality in sugar cane. A. C. CHATTERJEE. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 122–124.—The writer highlights India's low average yield of cane per acre compared with other major cane-producing countries, for it is only 14·5 tons/acre (Hawaii 62 and Australia and Mauritius about 20). Recommendations to improve agricultural practices are listed.

* * *

Maturity of sugar cane in relation to time of planting and harvest at Cuddalore. C. EKAMBARAM, V. A. SAKUNTHALA and C. CHOCKALINGAM. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 125–137.—Experiments were conducted on varieties Co 658 and Co 783 during 1963–65 to determine the effect of time of planting and harvest on maturity and juice quality and yield. Results are tabulated.

* * *

Studies in trash mulching as affecting cane and sugar yields. A. SANANDACHARI and K. K. P. RAO. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 138–148.—The literature on this much-discussed subject and experience in other countries are reviewed. Experiments at the Anakapalle Sugar Cane Research Station are recorded. Under prevailing conditions, a trash blanket did much to conserve soil moisture. There was marked reduction in weed growth and in the incidence of early shoot borer. No marked beneficial effect on cane yield was noted, considered to be because of the adverse effect of the trash on stalk population. This might have been reduced by using less trash.

* * *

Agronomic practices in relation to quality in sugar cane. R. VADYANATHAN. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 149–152. The author discusses the subject in relation to the Madurantakam sugar factory area, and covers climatic effects, soil type and irrigation, summer preparatory work, cane planting, varietal situation, effects of fertilizer application and irrigation on cane quality, the more important factors affecting cane quality, and harvesting.

* * *

Diseases of sugar cane prevalent in India in relation to quality. K. V. SRINIVASAN. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 168–170. Cane diseases prevalent in South India are discussed, and particularly those found in the Nizamabad district of Andhra Pradesh.

* * *

Insect pests of sugar cane. R. A. AGARWAL. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 171–175.—The losses caused by specific insect pests are discussed and methods for control of top and shoot borers and scale insects described. Insect pests of cane in South India are mentioned, particularly the internode borer *Proceras indicus* Kapur and the scale insect *Melanaspis glomerata.*

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Inproved sugar cane varieties for the southern states (of India). J. T. RAO. *Proc. Seminar S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1967, 183–185.—The chief characteristics of new cane varieties adopted commercially in South India are listed. These varieties are slowly replacing Co 419.

* * *

Co 6611—a substitute for Co 312 in western Uttar Pradesh. R. L. BHOJ and P. C. JAPOOR. *Indian Sugar*, 1968, **17**, 805–808.—The popular variety Co 312 is condemned on account of high susceptibility to red rot. Reasons are given why Co 6611 should prove a good substitute for it in Uttar Pradesh.

Rôle of cultural methods in the cultivation of the ratoon crop under deficient irrigation. B. K. MATHUR and A. SINGH. *Indian Sugar*, 1968, **17**, 815–822.—Experiments in the utilization of trash to conserve moisture under conditions prevailing in the eastern tract of Uttar Pradesh are described. Mulching with trash without dismantling the ridges is recommended for general cultivation.

* * *

Phosphatic fertilizers for sugar cane. R. WYATT. *S. African Sugar J.*, 1968, **52**, 417–429.—The more important phosphatic fertilizer materials used in the South African sugar industry are described and discussed, such as superphosphate, double and treble superphosphates, ammoniated superphosphate, rock phosphates, basic slag and basic superphosphate. Investigations on phosphatic fertilizers in other important cane-growing countries such as Hawaii, Mauritius and Australia are also discussed and suggestions made for future research.

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Over forty years with cane pests. R. W. MUNGOMERY. *Australian Sugar J.*, 1968, **60**, 51–55.—The author, Assistant Director of the Queensland Bureau of Sugar Experiment Stations and a well known entomologist, who is retiring, gives an interesting survey of cane pests in Queensland during his long period of service.

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Fertilizing of sugar cane: regional experiments in Tucumán, Argentina. G. KENNING V. and R. F. DE ULLIVARRI. *IDIA*, 1967, (239), 1–23.—Results are given of fertilizer trials (N-P-K) on various sugar cane estates in Tucumán, the location of the estates being indicated in a sketch map.

* * *

Clean seed—the key to higher yields. ANON. *The Link* (Natal), 1968, (4), 1–6.—The menace of ratoon stunting disease to South African cane growers is discussed and the point stressed that the disease is more damaging under drought conditions and with cane on poor or ill-managed soils. The need for seed-cane nurseries and heat treatment of seed-cane is explained and details given of the correct treatment of setts or "seed".

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Mixed cropping of wheat with sugar cane. S. D. FASIHI and M. HUSSAIN. *W. Pakistan J. Agric. Res.*, 1965, **3**, (4), 10–15.—Intercropping experiments showed that best yields and incomes were obtained when cane was planted in September and an intercrop of wheat was sown in November. Planting both in mid-October was easier but gave lower yields of both crops. September planting of cane gave a 38% higher cane yield than March planting.

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The search for suitable sugar cane varieties in the Peshawar valley. O. J. MIAN. *West Pakistan J. Agric. Res.*, 1965, **3**, (4), 79–84.—The exacting climatic conditions for cane in the Peshawar valley are described, notably winter cold and a short growing season. As a result of trials the three most promising varieties were: CP 48/103, N:Co 310 and CoS 321.

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The rôle of RSD in determination of sugar cane varieties. R. J. STEIB and S. J. P. CHILTON. *Sugar J.*, 1968, **30**, (12), 10–12.—Data are given for reduction in yield due to ratoon stunting disease (RSD) in tons per acre in present commercial varieties in Louisiana. Both RSD and sugar cane mosaic are responsible for severe losses. However it is felt that, if they are kept under control, the highly productive varieties now available, plus those in the pipeline, should not "run out" as fast as varieties grown prior to control of RSD by heat treatment.

* * *

A comparison of two methods of checking field populations of the sugar cane borer. R. MATHES. *Sugar Bull.*, 1968, **46**, (16), 7–13.—A brief description of the two methods is given and their respective advantages and disadvantages discussed. Details are supplied of replicated field tests in which the two methods were directly compared.

* * *

Cane train braking investigations. R. A. JAMES and C. R. MURRAY. *Producers' Rev.*, 1968, **58**, (5), 17. This paper indicates how the average speed, reliability and safety of mainline cane transport systems in Queensland can be improved.

* * *

Investigations into chemical control of arrowing. A. C. ARVIER. *Producers' Rev.*, 1968, **58**, (5), 21.—Some of the results obtained in other countries are briefly reviewed and an account given of preliminary trials in Queensland using "Diquat", "Paraquat" and "Monuron", the cane variety being N:Co 310, which is prone to flower freely in some areas of Queensland. Results were promising and further trials are contemplated.

* * *

The Dalton BHC box. ANON. *Australian Sugar J.*, 1968, **60**, 125.—This new BHC distributor, designed by a Mr. C. DALTON of Ingham, is the result of increasing interest in frenchi grub control with BHC. It is described and illustrated. The box is attached directly behind the fertilizer box of the planter. An extended shaft operates through both boxes and drives the fertilizer agitator and the BHC agitator. It delivers a uniform band of BHC dust across the width of the planted row.

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The diseases of sugar cane (in Mexico). ANON. *Bol. Azuc. Mex.*, 1968, (219), 22–23.—A brief account is given of ratoon stunting disease and mosaic in Mexico with precautionary measures that may be taken.

Sugar beet agriculture

Sugar beet in the North. P. WARD. *British Sugar Beet Rev.*, 1968, **36,** 129–131.—An account is given of the methods adopted by some sugar beet growers in Scotland engaged in mixed farming, special emphasis being given to mechanization practised and economy in labour.

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The sugar beet nematode. J. ALTMAN. *Sugar J.*, 1968, **31,** (2), 29–33.—A general account is given of this pest, one of the major problems of the sugar beet industry. Losses in yield due to it in Colorado are estimated to average 10–20% in all areas studied by the author. On many farms losses may reach 50–75%. Results are given of extensive soil fumigation tests with "Telone".

* * *

Weed control in sugar beets. W. F. MEGGITT. *Sugar Beet J.*, 1968, **31,** (3), 14–15.—In the use of herbicides with sugar beet, soil properties such as clay and organic matter content may have an important bearing. "Pyramin" plus TCA has proved to be an effective combination for pre-emergence control of annual broad-leaved and grass weeds. In 1968 a new combination, "Pyramin" plus "Ramrod", became available for trial. This is discussed.

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Influence of aneuploid plants on the yield of polyploid sugar beet varieties. K. H. BAROKA, H. GEIDEL and W. HAUFE. *Zucker*, 1968, **21,** 282–286.—The commercially available varieties of polyploid sugar beet are usually mixtures composed of anisoploid plants. Using a model of competition, in this investigation the influence of aneuploid plants that are found in polyploid varieties and which cause reduced yields, was examined with regard to its effect on the average yield of the varieties. On the basis of results as well as by a critical consideration of the problem concerning the occurrence of aneuploid plants it could be shown that yield reductions caused by these plants generally are overrated: thus the aneuploid plants will not exert any crucial influence on the importance of polyploid varieties.

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Weight losses and rotting of sugar beet stored in fields, and ways of reducing these. I. I. DYKHNENKO, D. L. FRADKINA and S. V. IL'EVICH. *Sakhar. Prom.*, 1968, **42,** (5), 43–47.—In parallel tests, weight losses and the degree of rotting were lowest in soil-covered beet clamps and highest in uncovered clamps. Covering with rush matting gave the next best results to covering with soil but the differences in the results were still very great.

* * *

Search for best beet growing routine. L. AMEY. *Times*, 27th May, 1968.—The writer reviews the latest developments and labour saving techniques adopted in the growing of sugar beet in recent years and describes demonstrations on a 2000-acre estate where the normal beet area is 300 acres. Attention is drawn to a new development described as follows. "An ingenious idea is the drilling of double rows, eight inches apart—one of monogerm at wide spacing, the other of commercial multigerm seed at two-inch spacing. If the monogerm seed behaves as it should, the other row is simply hoed out, but it is a relatively cheap insurance against failure."

* * *

Influence of weed competition on sugar beets. R. L. ZIMDAHL and S. N. FERTIG. *Weeds*, 1967, **15,** (4), 336–339; through *Field Crop Abs.*, 1968, **21,** 262. In field trials during 2 years the yield of sugar beet roots in uncultivated plots was significantly reduced by broad-leaved weeds, annual grass weeds, or an equal combination of both at all 4 densities tested (2, 5, 10 and 20 weeds/ft). In cultivated plots, root yields were reduced only at the highest weed density when weeds were limited to a 10-inch band along the row. Weed density had similar effects on the yield of tops, average root diameter and total yield.

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Aphids and the sugar beet crop. G. D. HEATHCOTE. *British Sugar Beet Rev.*, 1968, **36,** 171–173.—There are about 500 species of aphid in Britain, most of them green in colour. Some are so similar that it takes an expert to distinguish them. Those aphids that attack sugar beet are discussed. Information is also given on virus transmission, forecasting virus yellows and systemic insecticides.

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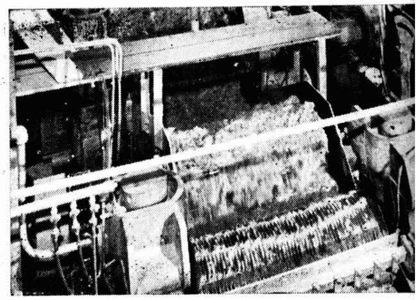
Mechanization trials with multigerm seed, low seed rates and mechanical thinning. L. HANBURY. *British Sugar Beet Rev.*, 1968, **36,** 174–178.—The purpose of the trials here reported and carried out between 1964 and 1966 was to obtain the maximum potential yield with the minimum of manual labour and where possible without any hand labour at all. Results from the crop grown this way were compared for labour economy and yield with crops grown and hand-singled by traditional and current methods.

Cane sugar manufacture



Cane payment in relation to its sucrose content. O. VALSECHI. *Brasil Açuc.*, 1968, **71**, 493–502.—The importance of proper control of sugar production under modern sugar marketing conditions is discussed. The use of a system of cane payment where sugar content is a factor to be considered is desirable since this provides greater precision in the control of sugar output per unit area than where maximum cane tonnage, irrespective of sugar content, is sought by the grower. The history of the movement for adoption of such a system in Brazil is described up to a law of 1965 which, however, was not ratified. Details of the resolution, on which this law was based, are given as regards classification of high, average and low-sucrose varieties, criteria for payment, etc.

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The selection and sizing of control valves. F. LE GUEN. *Rev. Agric. Sucr.* (Mauritius), 1968, **47**, 33–36.—A review is presented of the types of globe valves and other valves used for control purposes, together with information on selection of the proper size of valve and the factors involved in calculating the valve coefficient. In addition to the latter, other important considerations in choosing the valve type are listed; these include reliable mechanical construction, ease of maintenance, etc.

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The performance of (Mauritius) sugar factories in 1967. J. DUPONT DE R. DE ST. ANTOINE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1967, 117–121. A survey is made of the 1967 season with an account of experience in regard to cane quality, milling results, clarification and filtration, boiling house work and sugar quality. In spite of bad weather and low sucrose in cane, the average milling rate was a record and reduced extraction the same as 1966. Juice purity was good and no major clarification problems were encountered. Loss records indicate improvements in milling and filtration, but molasses loss was high, and it is re-emphasized that in Mauritius efforts to reduce losses should be made in the boiling house. Sugar quality was improved further in 1967 against previous years.

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Heating of massecuite by the Jeff Rogers resistance heater. E. PIAT. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1967, 128–135.—The resistance heater, supplied by Jeff Rogers Pty. Ltd. to the design of the Sugar Research Institute, Mackay, Queensland, was tested at The Mount Sugar Estate. Control of temperature is self-stabilizing for the same massecuite once the voltage has been adjusted to give the required exit temperature, but a change in massecuite quality requires a further adjustment. Results of a series of tests on reheating of cold (about 30°C) massecuite showed that sucrose re-solution was kept to a low level provided the final temperature did not exceed 45°C. However, owing to the low conductivity of local massecuites, it cannot be expected to reheat more than 45 cu.ft. of massecuite per hour from 28° to 45°C.

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The effects of burnt cane and trash on factory operations. N. AGUILA. *Sugarland*, 1968, **5**, (3), 13–17. This paper presents the viewpoint of the millers on the demerits of milling burnt cane or trashy cane and on how it adversely affects factory operations in sugar recovery.

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Quantitative measurement of entrainment in vacuum pans. S. MARIE-JEANNE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1967, 138–140.—By measuring condenser water flow using a rectangular weir, and determining the sucrose content of a sample by the citric acid method[1], it was possible to calculate the total loss during a strike. The method can be used to find out whether individual pans entrain more sugar and to check the efficiency of entrainment separators.

* * *

Pump operation and NPSH. L. H. SENCE. *Sugar J.*, 1968, **31**, (2), 15–16.—The net positive suction head (NPSH) of a pump is given by a formula involving atmospheric pressure, vapour pressure and specific gravity of the liquid, the elevation head and the friction head. Below a minimum level, which depends on its design, the pump will not work and cavitation occurs. When insufficient NPSH is available there may be ways of preventing cavitation, e.g. cooling the liquid, minimizing friction head, etc., while other methods may be employed where efficiency is not of paramount importance and operation under cavitation conditions can be permitted.

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New method of bagasse disposal at Mhlume factory. ANON. *S. African Sugar J.*, 1968, **52**, 619.—Disposal of the surplus bagasse at Mhlume Sugar Co., Swaziland, had become almost impossible and extremely

[1] ANDO & KIUCHI: *Proc. Research Soc. Japan Sugar Refinerie's Tech.*, 1965, **15**, 91–97; *I.S.J.*, 1965, **67**, 282.

expensive, and a Rees burner was adapted by the suppliers for incineration of bagasse. It has operated in the 1968 crop, burning 8–10 tons an hour, the only costs being for two unskilled workers and the power for two 25-h.p. fan motors. The bagasse is burned completely and there are no smoke or fly-ash problems.

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Ingenio Aztra of Ecuador. ANON. *La Ind. Azuc.*, 1968, **73**, 93–96.—See *I.S.J.*, 1969, **71**, 180.

* * *

Evaluating cane diffusion systems and mill tandems. P. FREUND. *Sugar y Azúcar*, 1968, **63**, (8), 30.—Milling extraction depends on so many factors that it is not, by itself, a good criterion for comparison of mill performance. Better criteria are the lost absolute juice % fibre and pol in bagasse; the latter is influenced by the bagasse moisture, however, and a reduced value, corresponding to 48% moisture content, is proposed as a means for evaluating the performance of extraction plants, whether milling tandems or diffusers.

* * *

Millions of pesos are lost in milling trash. ANON. *Sugarland* (Philippines), 1968, **5**, (3), 24–26.—The milling of trash along with cane not only requires power for the mills but also increases losses because it becomes part of the bagasse and takes up sugar not originally present, while further trash constituents enter the juice and increase the non-sugars, thus causing an increase in molasses loss. Photographs of cane supplies containing up to 22% of trash are indicative of the problem facing the factories, and it is pointed out that both the farmer and the miller share the loss involved.

* * *

Water in cooling systems. R. MALDONADO C. *Bol. Azuc. Mex.*, 1968, (221), 32–41.—Problems arising with cooling water systems, especially involving re-use of water, are discussed under four headings and an account is given of treatments devised to eliminate or minimize them. The headings are: scale formation, corrosion, biological control, and deterioration of wood in cooling towers.

* * *

Electronic weighing system at Florida sugar factory. ANON. *Sugar J.*, 1968, **31**, (3), 34–35.—A new system at Bryant Sugar House, which operates with an accuracy of 99·85% over the season, employs load cells for weighing of the gross and tare weights of the rail cars which are unloaded at a tippler. The weights are printed automatically in the remote control room. The system is provided with interlocks so that the tippler cannot operate if the car has not been secured or the gross weight recorded, and the method is rapid, so that it is now possible to receive cane at the rate of 10,000 tons per 24 hr. It also eliminates the errors due to variation in the tare-weight marked on the car as a result of dirt and cane accumulated during the season, and errors due to inexperienced weighmasters.

* * *

Boiler feed water treatment. G. RAMACHANDRAN. *Proc. 1st Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1968, (1), 25–27.—Condensates (and raw water used when starting-up) were treated in 1967/68 with "Alfloc 35" for maintaining the phosphate level and "Alfloc 21"* for maintaining caustic alkalinity appropriate to use as boiler feed. This internal treatment, plus periodical blowdowns, resulted in no trouble or carryover from the boilers, and very little scaling in the boiler tubes, by contrast with the previous year.

* * *

Further studies on cane preparatory devices. Performance of shredders. G. RAMACHANDRAN. *Proc. 1st Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1968, (1), 29–31.—Benefits obtained as a result of the installation of a shredder at Jeypore Sugar Co. Ltd. are discussed; these include improved reduced mill extraction at a lower imbibition rate (and consequently lower fuel consumption), and an increase of 15% in milling capacity.

* * *

Use of phosphates and phosphoric acid in reducing losses in waste molasses. T. T. OOMMEN and B. S. GURUMURTHY. *Proc. 1st Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1968, (1), 39–44.—Addition of phosphate to clarified juice inhibits reducing sugar destruction in the evaporator and was shown in factory experience at Shimoga sugar factory to permit better molasses exhaustion. Comparison of pure orthophosphoric acid solution with impure single superphosphate indicated the former to be more economical and effective.

* * *

Further studies on the use of phosphate in clear juice. A. C. CHATTERJEE, K. T. PILLAI and S. SRINIVASAN. *Proc. 1st Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1968, (1), 45–50.—Addition of superphosphate solution to clear juice (see previous abstract) was found to reduce evaporator scale, decrease reducing sugars destruction, improve sugar quality, reduce final molasses purity, improve molasses exhaustion, improve massecuite quality by reducing its viscosity, and reduce inversion losses.

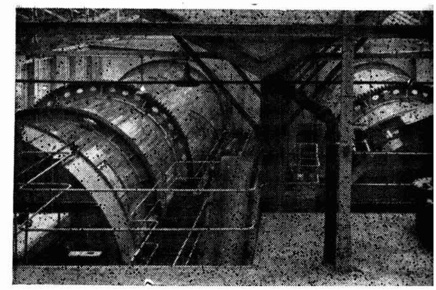
* * *

White sugar without sulphur and hydros. A. C. CHATTERJEE. *Proc. 1st Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1968, (1), 57–65.—The DMC white sugar process[1] has been used with success for two seasons at Aruna Sugars Ltd., and details are presented of equipment used, factory performance data, and the benefits of the process.

* Imperial Chemical Industries Ltd.

[1] GUPTA *et al.*: *I.S.J.*, 1966, **68**, 340.

Beet sugar manufacture



Production of electrical energy by a back-pressure turbine. J. DELCOURT and A. BOZET. *Sucr. Belge*, 1968, **87**, 631–642.—After reviewing the principle of operation of the back-pressure turbine, the authors examine its application in the sugar factory. Advantages of such equipment are presented both in respect of production of electrical energy for the factory's requirements only and also regarding surplus electricity production for supply to the grid. A description is given of the installation at Notre-Dame refinery at Oreye, Belgium, where electricity is supplied to the 15 kV grid.

* * *

Development of a modified RT process for beet juice purification. R. VANDEWIJER and R. PIECK. *Sucr. Belge*, 1968, **87**, 651–656.—The original RT juice purification process involved preliming and flocculation of colloids which were removed by settling before the main liming. As a consequence, the juice alkalinity did not reach the levels found in the classical system without preliming. The advantages of not subjecting the juice to sudden high alkalinities indicated that benefit might be obtained from similar action in the preliming stage, and pilot plant trials confirmed that it was better to raise the pH gradually rather than instantaneously, when a more compact flocculate was obtained, especially in the presence of returned first carbonatation mud. Pre-carbonatation was changed to defeco-saturation with gassing as well as liming, so that local high pH values are avoided. The resulting thin juice was of better quality in respect of purity, lime salts and colour, and factory trials in 1967/68 have confirmed the results of the pilot plant trials.

* * *

Fundamentals of automatic control. J. PULACZEWSKI and S. MICHALOWICZ. *Gaz. Cukr.*, 1968, **76**, 148–152. The principles of automatic regulation (as opposed to automatic control, which may involve merely warning systems) are discussed, with a device for automatic temperature regulation in a DDS diffuser cited as example. This is compared with a manual device for the same task. Types of regulators used are considered and also grouped according to their task.

* * *

Filter aids. M. FRIML and E. OUTRATOVÁ. *Listy Cukr.*, 1968, **84**, 150–157.—Known methods for analysing filter aid properties have been tested and new methods introduced. Evaluation of 15 filter aids showed "Dicalite 408" to give the highest filtration rate for distilled water (2·02 litres/sq.m./sec), although it is only slightly better than "Dicalite 478". "Dicalite 4108", "Celite J4" and "Celite J6" were the next best, followed by "Hyflo Super-Cel", then "Hannover 80_2" and "Clarcel CB". "Hannover 80_1", "Hannover 70_3" and "Clarcel DIC" had the same filtration properties, after which came four brands of perlite, the lowest rate being obtained with "Košice P2" perlite (0·04 litre/sq.m./sec.).

* * *

Automation in the sugar industry. V. VALTER. *Listy Cukr.*, 1968, **84**, 157–162.—The prerequisites for successful application of automation in the Czechoslovakian sugar industry and the efficiency of automatic control in sugar factories in other countries are discussed and future tasks are briefly outlined.

* * *

Factory tests on scale formation inhibition in thin juice evaporation using Czechoslovak apparatus for magnetic treatment of solutions. J. WRETZEL and Z. MATĚJKA. *Listy Cukr.*, 1967, **84**, 162–163.—Passing thin juice through a magnetic field before evaporation considerably reduced the amount of scale in the 2nd and 3rd effects of a triple-effect evaporator, while no scale formed in the juice heater preceding the evaporator or in the 1st effect, so that boiling-out was not necessary for a whole campaign. The temperature of the juice should not exceed 70°C when passing through the magnetic field.

* * *

Aspects of the 1967 campaign (in West Germany). F. SCHNEIDER. *Zucker*, 1968, **21**, 437–445.—Various aspects of the 1967/68 beet campaign are discussed, including the processing of beet lifted by Volvo harvesters which remove the crowns, press water sterilization by brief exposure to high-temperature heating, the use of filter-thickeners, pol changes in carbonatation, and the formation and fate of potassium imidodisulphonate in factory products.

* * *

Hydro-erosion of metals in diffusion juice. A. I. NEKOZ and N. A. SOLOGUB. *Sakhar. Prom.*, 1968, **42**, (7), 17–18.—Tests in which metal samples were blasted with a jet of raw juice showed that erosion was governed by the anti-corrosion properties of the samples and not by their mechanical properties.

* * *

White sugar cooling in apparatus with positive displacement of a fluidized bed. A. I. CHERNYAVSKII and

V. D. KARMAZIN. *Sakhar. Prom.*, 1968, **42,** (7), 28–33. A rather complex formula is presented for calculating the white sugar temperature in a horizontal fluidized bed cooler in terms of the basic factors affecting heat exchange between the sugar and the cooling gas. At specific sugar loads corresponding to bed heights of 200 and 300 mm, calculated and experimental values obtained in a test unit were in satisfactory agreement. With a lower sugar load the experimental results were somewhat higher than the theoretical values.

* * *

Use of hydrocyclones in a juice purification scheme. Z. D. ZHURAVLEVA and F. N. DOBRONRAVOV. *Sakhar. Prom.*, 1968, **42,** (7), 33–36.—Rapid removal of predefecation mud in hydrocyclones or centrifugal separators caused a 4–9°St rise in the colour of 2nd carbonatation juice. To avoid this, the predefecation juice should be stood for 30 min before hydrocyclone treatment. Treatment of 1st carbonatation juice with live steam (the quantity and parameters to be decided for each case) improves mud separation in subsequent hydrocyclone treatment and gives a clearer juice. The juice should be fed into the hydrocyclone at a pressure not exceeding 3·5 atm, since above this pressure there is a rise in the colour content. Hydrocyclone treatment of both 1st and 2nd carbonatation juice permits up to 99·5% mud removal, the mud in 2nd carbonatation juice being basically crystalline $CaCO_3$.

* * *

Automation of defecation with "Start" system instruments. Z. S. VOLOSHIN and V. G. BELIK. *Sakhar. Prom.*, 1968, **42,** (7), 36–40.—Details are given of an automatic control scheme which regulates the juice: lime ratio in defecation to within ± 0·1% CaO with variation in raw juice feed between 50 and 130 cu.m./hr and a milk-of-lime density range of 1·09–1·17 g/c.c. It has been used in one Soviet sugar factory and is being introduced into others, with some modifications.

* * *

Concentration of the sugar solution being evaporated and the heat transfer coefficient. V. V. MAIOROV. *Izv. Vuzov, Pishch. Tekhnol.*, 1968, (3), 141–142. Results at a steam pressure of 1 atm showed that the concentration of a sugar solution affects heat exchange in evaporation through changes in the thermo-physical properties of the solution, the effect being substantial when forced circulation is used, and falling somewhat with increase in the circulation rate.

* * *

Calculation of (the parameters) of the multiple-effect evaporators. E. E. GLUBERZON. *Izv. Vuzov, Pishch. Tekhnol.*, 1968, (3), 143–148.—Equations are derived for calculating technological and economic factors with the aim of computer programming to establish optimum evaporator design based on a static model of a forced-flow multiple-effect evaporator as used in a beet sugar factory.

Change in Kuban' beet non-sugars during storage. I. F. ZELIKMAN and N. L. TROYANOVA. *Sakhar. Prom.*, 1968, **42,** (8), 14–16.—For a study of the changes in the contents of the various non-sugars group in stored beet, the beet were split into three fractions according to the extent of deterioration. After 90 days' storage the beets and juice were processed in a laboratory unit to thick syrup. Details are given of the non-sugar changes and of the effects in the various processing stages.

* * *

Hydro-erosion stability of metals in milk-of-lime. A. I. NEKOZ and N. A. SOLOGUB. *Sakhar. Prom.*, 1968, **42,** (8), 16–18.—Examination of the resistance of metal samples to erosion in milk-of-lime showed that their stability was governed chiefly by their hardness and not by their anti-corrosion properties[1].

* * *

Automation of white sugar vacuum pans. –. WELLENHOFER. *Zeitsch. Zuckerind.*, 1968, **93,** 487–488.—A suggested automatic control scheme is described in which the supersaturation is used as command variable and is determined, by means of an analogue computer, from the differences between the vapour temperature corresponding to the measured pan vacuum and the measured temperature of the syrup. The selected supersaturation (and thus the "target" solution temperature) is maintained by injecting water into the pan. Why water is used instead of thick juice or wash syrup is explained, and the advantages of the scheme are listed.

* * *

Modernization of beet elevators. V. N. SHCHEGOLEV and N. R. FREPON. *Sakhar. Prom.*, 1968, **42,** (8), 18–22.—The modifications proposed refer to two types of Soviet manufacture which have proved defective in operation.

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Application of (waste water) purification plant. B. S. ZHALOV. *Sakhar. Prom.*, 1968, **42,** (8), 22–26.—Guidance is given on efficient preparation and use of settlement tanks, land filtration, distribution channels, pipes, sluices, etc., for beet sugar factory effluent.

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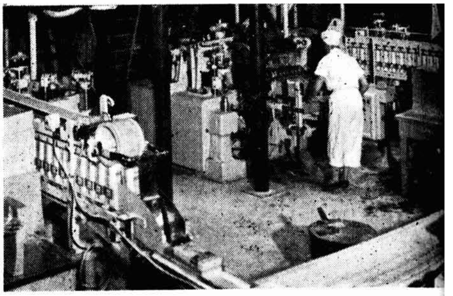
A graphical method for determining the heat of combustion of solid fuel. A. I. KHOMENKO. *Sakhar. Prom.*, 1968, **42,** (8), 27–28.—Formulae and nomograms are presented for calculation of solid fuel parameters, including the heat of combustion and calorific value.

* * *

Removal of light impurities in a beet washer. A. V. KISELEV. *Sakhar. Prom.*, 1968, **42,** (8), 34–36.—Details are given of a modified Demchenko trash catcher which was used in conjunction with a beet washer to remove foreign bodies (large and small) from the beet flow.

[1] *Cf.* NEKOZ & SOLOGUB: *I.S.J.*, 1969, **71,** 212.

Sugar refining



Dynamics of vacuum flotation. R. M. MORRIS. *S. African Sugar J.*, 1967, **51**, 789–791.—Equations are derived for calculating the conditions necessary for bubble detachment in vacuum flotation expressed in terms of the forces involved. It is shown that particle diameter is of greatest significance and that the probability of flotation is greatest in the region of small floc particles.

* * *

Stages and processes in refining. A. BOBADILLA G. *Bol. Azuc. Mex.*, 1967, (220), 27–37.—The extent to which sugar is refined in Mexico is noted, and recent advances in refinery techniques and raw sugar requirements for economical refining are listed. The various stages of refining, from affination to drying and packing, are briefly reviewed.

* * *

Causes of a fall in pH of sugar solutions treated with granular active carbons and ways of avoiding it. A. N. KISELEV and V. N. GOLUBEV. *Sakhar. Prom.*, 1967, **41**, (12), 11–15.—A fall in the pH of sugar solutions during treatment with granular active carbon is attributed to catalysis of hexose conversion to organic acids by oxygen compounds on the surface of the carbon. Subsequent dissociation of the organic acids causes an increase in the activity of H^+ ions in the sugar solution and hence sucrose inversion. Although effective in reducing the fall in pH, heating granular carbon under vacuum (e.g. at 900°C and 28 mm Hg) after each regeneration necessitates extra equipment in the refinery, and a simpler and cheaper method of stabilizing pH is considered to be addition of metal oxides such as magnesite powder[1,2].

* * *

Ways of increasing white sugar yield from cane raw sugar. B. G. NERUBAL'SHCHUK. *Sakhar. Prom.*, 1967, **41**, (12), 19–22.—The processes used at Odessa and Krasnoyaruzhskii refineries are compared to show why Odessa can obtain a white sugar yield of 93·6% when refining cane raws while the other refinery has a yield of only 90%. Advice is offered on the basis of experience at Odessa refinery.

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Investigation of the physico-chemical properties of perlite. V. A. KOLESNIKOV and D. M. LEIBOVICH. *Sakhar. Prom.*, 1967, **41**, (12), 23–25.—The physico-chemical properties of perlite were examined and compared with those of kieselguhr in the form of "Hyflo-Super Cel". Graphs show almost identical filtering and turbidity-reducing properties, although the perlite is shown to give a higher filtration rate and the quantity of "Hyflo-Super Cel" to give identical turbidity reduction was greater (3 g compared with 1·9 g per 38 sq.cm. filter surface).

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Warehouse for bulk storage of white sugar at refineries. E. KH. BERKOVICH. *Sakhar. Prom.*, 1967, **41**, (12), 37–39.—Details are given of a warehouse of parabolic section erected at Mantulin refinery, Moscow, to house 25,000 metric tons of white sugar. Sugar enters the warehouse from rail trucks at the rate of 80–100 tons/hr and is distributed via an elevator and an overhead conveyor system. It is reclaimed via an underground conveyor at the rate of 40 tons/hr.

* * *

Reports on the application of (the) Funda filter to double pressing. N. SHIMIZU and M. IWASE. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1967, **19**, 29–33.—The performance of two Funda filters, each of 25 sq.m. filtering surface, installed at the authors' factory is discussed. Automatic operation of the filters for carbonatation mud treatment by double pressing involved no difficulties. Cake pol was 0·4–0·5 and its moisture content about 40%. The cake was discharged easily, no back-washing being required. Clogging of the residual water discharge pipe by mud was eliminated by attaching a pipe at a slope of 60°. Build-up of cake between filter leaves was prevented provided a cake thickness was used which was obtained from a graph of cake thickness *vs.* the difference in Brix between muddy juice and filtrate. Maximum capacity of the filters was 0·53 tons of dry cake/sq.m./day at a filtration cycle of 1·5 hours and a cake thickness of 40 mm. Some details are also given of carbonatation liquor filtration by the Funda filters.

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Study on (a) resonance conveyor cooler. S. SUZUKI, H. TAKAHASHI and H. HIGASHINO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1967, **19**, 34–36. Tests are described in which granulated sugar was cooled as it passed over a series of louvres placed in a horizontal row. The cooling air was fed below the louvres and passed up through them and through the sugar layer. The cooler's performance was compared with that of a fluidized bed cooler.

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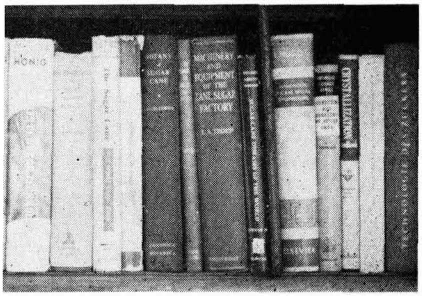
[1] USSR Patent 182,605.
[2] ZDANOVICH & ALEKSEENKO: *I.S.J.*, 1965, **67**, 341.



New books

Sugar year book 1967. 371 pp.; $3\frac{1}{2} \times 5\frac{1}{2}$ in. (The International Sugar Council, 28 Haymarket, London S.W.1, England.) 1968. Price: £2 0s 0d.

Statistics for 126 countries are tabulated in the 21st edition of the ISC sugar year book, figures being given for West Malaysia, Sabah and Sarawak as well as for Malaysia. In most cases the tables cover the period 1961–67, the 1967 figures sometimes being estimated. The data are submitted by the International Sugar Agreement member countries under the rules of the Agreement, while those of non-member countries are either supplied by the governments concerned or are extracted from statistical publications. The data cover world centrifugal sugar production in calendar years, expressed, where possible, as 96° pol raw sugar and tabulated by countries in alphabetical order. A warning is given in the introduction to the book that figures for individual countries, particularly those for the more recent years, are constantly being revised and that the true figure may differ from the tabulated value. Other tables towards the end of the book give general information, including world sugar production, imports, exports and consumption (absolute and per caput), sugar stocks in selected countries, world sugar prices 1953–67, export quotas for 1966–68 under the British Commonwealth Sugar Agreement, US sugar quotas for 1966 and 1967, white refined sugar retail prices in selected countries in 1966–68, and equivalent weights and measures. There is probably no more convenient source book for quick and easy reference to world sugar data.

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Tate & Lyle Ltd. Research Centre Annual Report, 1968. 65 pp.; $8\frac{1}{4} \times 11\frac{3}{4}$ in. (Tate & Lyle Ltd. Research Centre, Keston, Kent, England.) 1969.

As the Director of Research of Tate & Lyle Ltd. explains in the introduction to this report, detail and length have been sacrificed for the sake of clarity and brevity, although the objective remains the same as in previous reports, i.e. to show what research has been done, why, how and by whom, and the results of such research and whether the results are applicable now or later. It is also pointed out that all of the programmes are designed to yield results which are applicable, even where it is necessary to enter into an unexplored area of science, e.g. a long-term study which has been under way for some years on natural sugar cane hormones; this study is beneficial to and complements the shorter-termed and more empirical screening of chemicals which might be applied to cane fields to improve cane ripening. The studies in this report are grouped under four main headings: physical chemistry, biology-agriculture, organic chemistry and biophysics-bioanalysis. Each experimental programme is reported in clear, concise terms, usually with the aid of graphs and/or illustrations. The print is easily legible and well spaced out. Details are given of courses and conferences attended and other visits made by Research Centre staff and appear at the start of the appropriate section. The report is a valuable record of the year's work.

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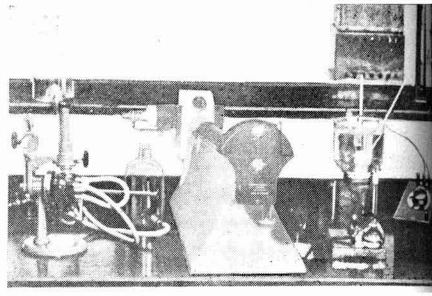
Food engineering operations. J. G. BRENNAN, J. R. BUTTERS, N. D. COWELL and A. E. V. LILLY. 443 pp.; $5\frac{1}{2} \times 9$ in. (Elsevier Publishing Co. Ltd., 22 Rippleside Commercial Estate, Barking, Essex, England.) 1969. Price: 110s 0d.

This book is largely based on the lecture course in Food Engineering given at the National College of Food Technology (University of Reading) to undergraduate students reading Food Technology, so that its basic purpose is to provide a textbook for such students, presenting a survey of the equipment and major operations used in food industry engineering and including the necessary basic theory relevant to each general process. As might be expected, therefore, specific mention of sugar is limited, and what is mentioned gives the impression that the authors have no recent practical experience of the sugar industry. This is because of both inaccuracies in the text and inadequacy of treatment. For example, it is stated that "sugar is crystallized in single effect vacuum evaporator pans, a typical example of which is shown . . .". The illustration shows a low-head calandria pan fitted with a forced-circulation stirrer; pans of this type are not sufficiently widely adopted in the industry to be described as "typical", and there is no mention of any other type of heating element. Similarly, the only type of continuous sugar centrifugal quoted is the Escher Wyss horizontal push-type machine, whereas the bulk of continuous machines used in the industry are either vertical or horizontal conical centrifugals. Thus, while the information on other food industries may be sufficiently accurate and adequate for use in a food engineering course, we would not consider it suitable for a student of sugar engineering alone.

Laboratory methods & Chemical reports



A comparison between laboratory filtrability tests on affined raws and the filtrability of factory carbonatated liquors. R. P. Jennings and J. B. Alexander. *Proc.* 1966 *Tech. Session Cane Sugar Refining Research*, 62–71.—Tests showed that none of the three laboratory filtrability tests used in South Africa—the Johns-Manville method[1], the C.S.R. method[2], and the modified C.S.R. method involving filtration at 80°C instead of 20°C[3]—was of any real benefit to the refinery for predicting the behaviour of a sugar in practice. Laboratory filtrability can, however, be used as a measure of factory performance for assessing the effects of changes in carbonatation technique on raw sugar filtration. Correlation between filter station throughput and laboratory filtrability of factory carbonatated liquor was highly significant and this seems to indicate that factory performance of a sugar would best be predicted by means of a laboratory filtrability test which would duplicate as nearly as possible the conditions in the particular refinery. For conditions at Hulett's refinery, determination of the starch content of an affined sugar offers a quick and good indication of how liquor from that particular sugar will perform in the filter station.

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Measurement of the colour of sugar solutions. K. J. Parker. *Proc.* 1966 *Tech. Session Cane Sugar Refining Research*, 72–84.—The evaluation of the colour properties of sugar solutions is based on the measurement of the absorbance of the optically clear solution at 455, 520 and 595 nm in the visible spectrum. The colour properties can then be expressed in terms of a scale of measurement appropriate to the particular colour specification required. Three properties of the colorant are recognised: concentration, quality or hue and visual intensity, each being given an arbitrary scale of magnitude. The application to different situations is illustrated with examples.

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Moisture of granulated sugar using the Karl Fischer reagent. R. D. Moroz, Y. Yankelevits and N. P. Anastasakos. *Proc.* 1966 *Tech. Session Cane Sugar Refining Research*, 102–112.—A modification of the Karl Fischer method for determination of surface and total moisture in refined sugar has been tested and found satisfactory. It involves the use of formamide as the solvent for the sugar, and slow dissolution is brought about by using a magnetic stirrer, the Karl Fischer reagent being added during the process. Sodium tartrate dihydrate, of known water content, is used for standardization of the reagent, and the endpoint is determined electrometrically. A limit is imposed in that a water content of more than 0·6 mg/ml cannot be tolerated in the formamide.

* * *

Applications of gas-liquid chromatography in the sugar industry. J. F. Dowling and J. P. Libert. *Proc.* 1966 *Tech. Session Cane Sugar Refining Research*, 113–125.—Gas-liquid chromatography involves the injection of the sample into a gas stream at a point which is heated for complete vaporization of volatile components. The stream carries these components to a liquid column where the components are dissolved and re-vaporized at differential rates so that the effluent gas stream carries separated components which may be detected with e.g. a flame ionization detector, giving characteristic recorder traces from which the components may be identified. The method has been investigated and found applicable to analysis, within 1 hour, of mono- and disaccharides using the trimethylsilyl derivatives of the sugars, with accuracy at least equal to standard methods for low-purity samples. A further field is the highly-volatile odour substances in sugar liquors, and initial work has traced two compounds or mixtures of b.p. < 50°C through the refining process. It is thought that the technique will eventually permit analysis of all organic non-sugars and amino acids.

* * *

Precipitation of calcium phosphate. M. S. Bhangoo and F. G. Carpenter. *Proc.* 1966 *Tech. Session Cane Sugar Refining Research*, 125–136.—The nature of the calcium phosphate precipitate obtained in sugar refining was examined by measurement of refractive index range and crystal habit. The initial precipitate, regardless of temperature and pH, was found to be very fine. At pH $< 4·0$ it redissolves and reprecipitates as dicalcium phosphate dihydrate (DCPD) at room temperature and as anhydrous dicalcium phosphate (ADP) at >40°C. Of raw sugar constituents, only SO_4^{--} and aconitic acid affect the crystal habit of DCPD. Above pH 5·0 the fine precipitate is stable for at least 16 hours. At low levels of calcium and phosphoric acid, such that precipitation barely occurred, the fine precipitate had the properties of octacalcium phosphate pentahydrate (OCP); at high levels the properties were different from OCP

[1] Browne & Zerban: "Sugar Analysis", 3rd Edn. (Wiley, New York), 1955, p. 150.
[2] Nicholson & Horsley: *Proc. 9th Congr. ISSCT*, 1956, 271.
[3] Jennings: *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 199.

or hydroxyapatite (HOP) or intracrystalline mixtures of the two. This amorphous calcium phosphate (ACP) was more poorly crystalline, more stable, of lower refractive index, and more easily precipitated than OCP and HAP mixtures. It is probably colloidal and is non-stoichiometric. In the phosphate clarification process OCP is formed at low dosage and ACP at high acid dosage.

* * *

A yellow component in sugar colorant. E. J. MACDONALD and J. P. MADACSI. *Proc.* 1966 *Tech. Session Cane Sugar Refining Research*, 136–141.—An account is given of the separation, by electrophoresis and chromatography on a cellulose diethylaminoethyl ether (DEAE cellulose) column, of two yellow colour components from cane juice, and preliminary results in the attempted characterization of one of these[1].

* * *

Physical chemistry problems in sugar processing. F. G. CARPENTER. *Proc.* 1966 *Tech. Session Cane Sugar Refining Research*, 141–148.—Sucrose in solution is usually considered as an inert diluent, except in such cases of solubility of $Ca(OH)_2$ with which it combines chemically, in the study of reactions taking place in sugar processing, etc. It is pointed out that sucrose solutions are solvent systems which are different from water alone, and that physical characteristics should be considered. Such characteristics are discussed; they include activity, dielectric constant, ionic strength, ionic activity, ionizations and pH, pH scales and measurement, and solubility.

* * *

TSC quality control. C. C. CHEN. *Taiwan Sugar*, 1968, **15**, (1), 19–20.—Because most Taiwan sugar is exported, effective control of quality is important and is achieved by careful attention to control of raw material, operation, process standards and the final product characteristics. Training courses and co-operative action have been adopted among the sugar factory staffs to this end.

* * *

Refractive index of sugar solutions. V. VALTER. *Listy Cukr.*, 1968, **84**, 103–104.—Tabulated values of the refractive index of sucrose solutions at 0–70°Bx and 20–90°C are presented and an equation is derived for calculation of the thermal gradient.

* * *

Determining the size of sugar dust particles. K. ČÍŽ and V. ČEJKOVÁ. *Listy Cukr.*, 1968, **84**, 104–107. The size of particles of sugar dust, powdered sugar, etc. can be determined by measuring the sedimentation rate at 20°C of the particles in a cyclohexanol-cyclohexanone mixture in an Andreasen column. Samples of the suspension are withdrawn with a special pipette, dried, and weighed. The liquid mixture viscosity and density are measured as is the sugar density, and the particle size calculated from the expression $d = \sqrt{\frac{18\eta \cdot u}{(\rho-\rho')\,g}}$, where d = particle size, η and ρ' are liquid viscosity and density, respectively, ρ = particle density, g = acceleration due to gravity, and u = settling rate. From calibration curves the mean particle size, coefficient of uniformity and fractional distribution are obtainable.

* * *

Effect of the number of sugar crystals in solution on the crystallization rate. S. ZAGRODZKI. *Gaz. Cukr.*, 1968, **76**, 77–81.—See *I.S.J.*, 1968, **70**, 120.

* * *

Determination of molasses saturation coefficient. J. PALACI and J. STAMBUL. *Gaz. Cukr.*, 1968, **76**, 81–86. The method used in the laboratories of Groupement Technique de Sucreries for molasses saturation coefficient determination is similar to that of WAGNEROWSKI *et al.*[2] and involves preparation of four molasses solutions, of different non-sugar:water ratios, in which sugar crystals are dissolved to give a Brix of 28 ± 1° at 20°C. Purity is measured conductimetrically and, for one of the solutions, with a polarimeter and refractometer in order to calibrate the conductimeter. Details are given of the apparatus and method used for solution saturation and of the analysis method. Nomograms which can be used are also presented.

* * *

Comparison of three methods of evaluating the technological quality of sugar beet. J. TRZEBIŃSKI and Z. RUEBENBAUER. *Gaz. Cukr.*, 1968, **76**, 121–122.—Of the methods tested for beet sugar yield prediction, the most suitable for beet breeders was found to be determination of the conductimetric ash content. This gave about the same results as did determination of the potassium and sodium contents. Determining juice purity after clarification is considered to be too involved.

* * *

Study on foaming sugars. P. DEVILLERS, M. LOILIER and J. C. CHARTIER. *Sucr. Franç.*, 1968, (6/7), 193. Sugars which had a tendency to foam formation as well as control samples having little or no such tendency were examined, foam height in a standard apparatus after passage of air through a 40°Bx solution as well as saponin content and pH being measured. There was a striking parallel between foaming, saponin content and low pH, and it seems likely that boiling at low pH results in precipitation of saponins which are incorporated in the crystals; to avoid foaming of sugars, the saponin content of the syrups should be reduced by treatment with a carbon adsorbent, white sugar quality should be improved, and boiling should be carried out at pH >8·5.

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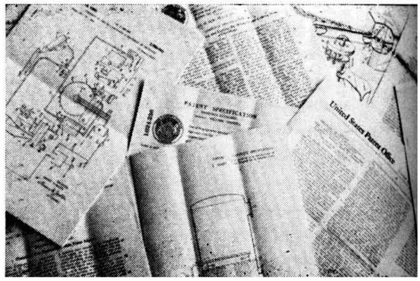
[1] *See also I.S.J.*, 1965, **67**, 307.
[2] *I.S.J.*, 1962, **64**, 115.

Patents



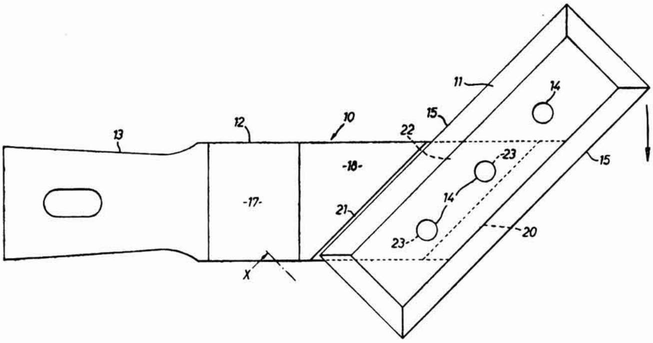
UNITED KINGDOM

Producing sugars by fermentation. KYOWA HAKKO KOGYO CO. LTD., of Tokyo, Japan. **1,141,107.** 18th January 1967; 29th January 1969.—Sugars, including e.g. glucose, fructose, sucrose, etc., may be produced from a hydrocarbon source [a *n*-paraffin having 6–25 C atoms (kerosene, benzene)] by culturing a suitable micro-organism, (e.g. *Arthrobacter paraffinus* ATCC 15594, *A. roseoparaffinus* ATCC 15584, *Brevibacterium ketoglutamicum* ATCC 15587, *Corynebacterium hydrocarboclastus* ATCC 15592, *Micrococcus paraffinolytieus* ATCC 15582, *Pseudomonas aeruginosa* ATCC 7700) in an aqueous nutrient medium containing the hydrocarbon, at 25–40°C and pH 4–10, thereafter recovering the sugars (by the use of ion exchange).

* * *

Mill knives. FAIRYMEAD SUGAR CO. LTD., of Bundaberg, Queensland, Australia. **1,141,833.** 2nd February 1966; 5th February 1969.

The rotating knives used for cane preparation are commonly of one-piece construction, having a relatively short life and requiring frequent maintenance.



The knife illustrated comprises a blade 11 and a holder 12, the mounting end 13 of the latter being of the conventional type. The blade, however, is rectangular and may measure e.g. 4 in wide and 12 in long. It is flat but has a sharpened tapered edge all the way round and is provided with apertures 23 so that it may be bolted through two of them to the holder, and by turning the blades, four separate cutting edges are available.

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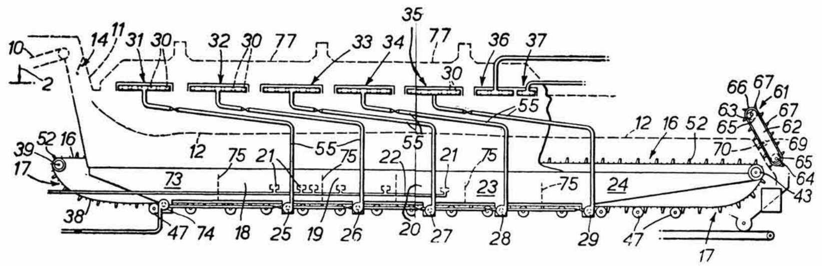


Cane diffuser. FAIRYMEAD SUGAR CO. LTD., of Bundaberg, Queensland, Australia. **1,142,463.** 25th April 1966; 5th February 1969.

Prepared bagasse is brought by conveyor 10 to feed chute 11 which delivers it under the control of level-sensing motor-control 14 so as to provide a bed of the desired height as indicated at 12. The bed is carried at e.g. 4 f.p.m. on the upper horizontal run 16 of conveyor 17 and is discharged by means of a continuous rake or scraper assembly 61 onto a conveyor which carries it away.

During its passage the bed is exhausted of its sugar content by treatment with hot water supplied through distributor 37, and hot sweet-water, e.g. extracted by means of a press from the discharged bagasse, supplied through distributor 36, as well as juices of increasing strength delivered as continuous transverse curtains through distributors 35, 34, 33, 32 and 31 in order of increasing concentration, the water and juices percolating through the bed and through the perforated slats of the conveyor 17 to collect in

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

tanks 18, 29, 20, 23 and 24 where, after heating by steam injected to controlled temperatures, they are sent by pumps 25, 26, 27, 28 and 29 to the distributors nearer the head end of the diffuser. The most concentrated juice collects in tank 73 from which it is withdrawn by pump 74 to process.

* * *

UNITED STATES

Cane harvester topper mechanism. R. C. ASH, of Ingham, Queensland, Australia, *assr.* INTERNATIONAL HARVESTER CO. **3,398,515.** 27th December 1965; 27th August 1968.

* * *

Cane harvester base cutter height indicator. D. J. QUICK, of Manifold Heights, Geelong, Victoria, Australia, *assr.* INTERNATIONAL HARVESTER CO. **3,398,516.** 27th December 1965; 27th August 1968.

* * *

L-Glutamic acid production using bacteria. T. OHSAWA, M. SHIBUKAWA and H. TAKAHASHI, *assrs.* ASAHI KASEI KOGYO K.K., of Osaka, Japan. **3,399,114.** 16th August 1965; 27th August 1968.—A biotin-requiring glutamic acid-producing bacterium [*Microbacterium flavum* var. *glutamicum*, *Brevibacterium* spp. (*B. dibalicutum*), *Micrococcus* spp. (*M. glutamicus*) or *Corynebacterium* spp.] is inoculated into a culture medium containing either beet molasses plus (>30 γ/litre of) synthetic biotin in excess of the amount required for maximum growth, or cane molasses. Aerobic fermentation under submerged and agitation conditions is carried out (at pH 6–9 and at 25–35°C), adding (0·05–0·2 g/dl of) a polyoxyethylene fatty acid ester type surface-active agent (polyoxyethylene monostearate and/or monopalmitate and/or monomyristate) at the start of the logarithmic growth phase of the bacterium, and (0·005–0·05 g/dl of) an alkylamine salt-type surface-active agent (salts of decylamine and/or laurylamine and/or myristylamine and/or palmitylamine) between the middle and end-stages.

* * *

Beet cleaner and conveyor. E. C. ROLLINS, of Ogden, Utah, USA, *assr.* HESSTON MANUFACTURING CO. INC. **3,399,766.** 10th February 1966; 3rd September 1968.

* * *

Cane planter. D. A. THIBODEAUX, of Napoleonville, La., USA. **3,401,841.** 8th February 1966; 17th September 1968.

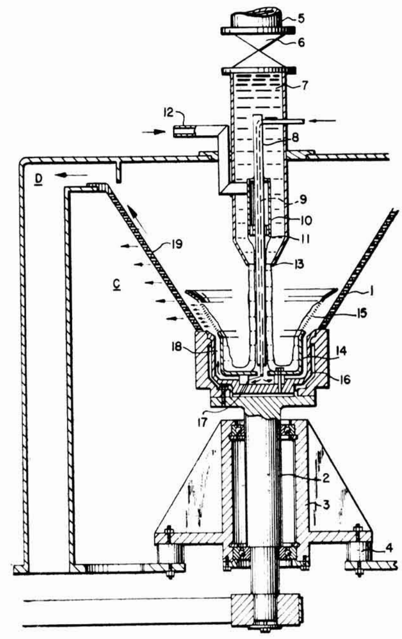
* * *

Continuous fermentation of glutamic acid. J. H. GORE, H. B. REISMAN and C. H. GARDNER, *assrs.* MERCK & CO. INC., of Rahway, N.J., USA. **3,402,104.** 29th November 1965; 17th September 1968.—A continuous process involves (i) a growth stage, (ii) a transition state, and (iii) a production stage in each of which constant volume equilibria are established by controlling the rate of addition of nutrients (including cane molasses) to each and the rate of addition of a growth-limiting factor to (ii) and (iii) as well as the rate of transfer from one stage to the next. The residence times, pH and temperature in each stage are chosen to give high yields of L-glutamic acid by fermentation of the micro-organism (*Micrococcus glutamicus*).

* * *

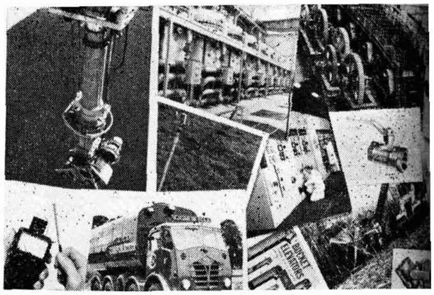
Continuous centrifugal A. MERCIER, of La Madeleine, Nord, France, *assr.* SOC. FIVES LILLE-CAIL. **3,403,785.** 19th October 1967; 1st October 1968.

Massecuite is fed to the centrifugal via valve 6 in pipe 5, 7. The latter tapers to an outlet 13 through the centre of which is a co-axial guide 8 which ends just above the centre of the bowl 14. A small quantity of water is admitted through pipe 12 and enters a chamber 10 coaxial with and surrounding the guide 8, and leaves as a thin film surrounding the guide, between it and the massecuite, so aiding smooth flow of the latter. The guide 8 is hollow and contains



a central tube 9 fed with steam which passes downwards through the hole in the centre of bowl 14 into chamber 17 and thence to the annular passage between the bowl 14 and the base 16 of the centrifugal basket 19. The massecuite and water film are rapidly mixed in bowl 14, diluting the molasses phase, and pass upwards to the frustroconical perforated section 15 through which the mixture passes in fine streams towards the basket 19. These streams are heated by the steam rising from the annular passage, the heating being accompanied by condensation of the steam and further dilution of the molasses, thus giving rapid dilution and heating of the massecuite between its entry into bowl 14 and deposition on the basket 19, so aiding molasses and crystal separation.

Trade notices



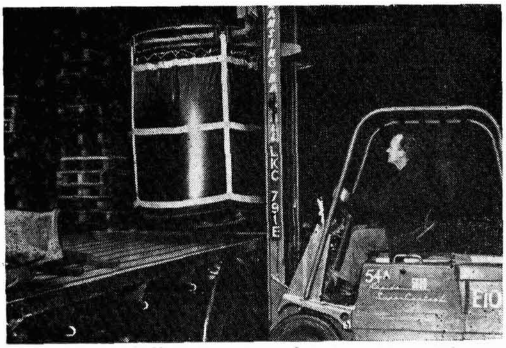
Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Bulk handling systems. The Tills Engineering Co. Ltd., Arbour Lane, Kirkby Industrial Estate, Liverpool, Lancs., England.

Three systems for pneumatic handling of bulk granular materials, especially sugar, in one-ton loads, have been devised by The Tills Engineering Co. Ltd., a subsidiary of Tate & Lyle Ltd. The "Pneumaflex" system involves the use of flexible containers mounted on pallets which also carries the entraining unit below. At the reception point a pipe with a quick-release coupling is connected to the entraining unit and an air suction unit draws air into the pipe which carries the entrained sugar into a reception hopper. The flexible containers are made of woven nylon cloth, covered on both sides with non-toxic polyvinyl chloride, and are water-proof, washable and completely hygienic.

The "Transiflex" system is for delivery to premises where no air suction unit and pneumatic hopper feeding system exists. Here the suction/blower unit and entrainment piping are mounted on the truck together with the containers. Each is connected to the suction unit in turn and the entrained sugar delivered by positive pressure to the customer's container.

The flexible containers are in both cases supported by rigid frames and consequently occupy the same space when returning empty as when full for delivery. The "Stacaflex" system employs a different kind of flexible container which, while made of the same materials, has a shallow rigid top frame from which the container is supported while the frame is lifted and moved using a fork-lift truck. The bottom of the container has a flap covering a slide valve by which the sugar in the container is delivered to the entraining pipe. When full the containers can be stacked two high for road transport or three high in a warehouse; when empty, however, they collapse to only 8 inches deep and can be stacked for return, leaving space available for return loads on the truck or trailer.



* * *

Flow control valves. Midland Industrial Designers Ltd., Common Lane, Main Road, Watnall, Nottingham, England.

The "Dyris" flow control valve has a circular central aperture in its aluminium alloy main body and is provided with an iris-type diaphragm in the form of metal leaves, controlled by an external lever. Movement of the lever through an arc of less than 85° converts the iris opening from fully open to fully shut, giving accurate control of flow rate through the aperture from e.g. a silo. The lever may be air-operated and the diaphragm leaves are protected by a metal sleeve.

A similar function is performed by the MID double slide valve where two $\frac{1}{4}$-in mild steel plates slide from each side to close or open a rectangular aperture in the aluminium alloy body. The plates are linked by a lever system and actuated by air cylinders giving infinitely variable flow with practically no maintenance.

The MID rotary air lock feeder has a side entry for products including free flowing powders, granulated solids, cubes, pellets, etc., and has an overall depth of only $15\frac{1}{2}$ inches. It is fitted with "Nylatron" spring-loaded self-adjusting seals and with high-pressure jets for ejection of material from the rotating pockets.

* * *

"Starweigh" load cell weighing system. Thorn Automation Ltd., Rugeley, Staffs., England.

"Starweigh" is a new and flexible system capable of meeting many types of industrial weighing applications. One form, for on-the-spot weight recording at the site of operation, embodies four load cells supporting a platform and connected to any of the "Starweigh" range of indicators or recorders which give a visual or printed-out record of the weight on the platform. The latter is mobile and is positioned by a lifting attachment. On being lowered into position on any suitable firm and reasonably level base, its trailer can be pulled clear by the towing vehicle. The load cells are robust and reliable, giving a repeatable accuracy of better than ½%, are of small size and require no maintenance.

* * *

"Cyberprobe" moisture meter and controls. M2 Systems and Controls Ltd., 16 Swaisland Drive, Crayford, Kent, England.

The "Cyperprobe" moisture meter is a low-cost unit featuring solid-state circuitry and provides direct moisture indication, unaffected by resistance change, temperature-compensated and with a high-speed response. Probe electrodes are designed to suit each application and the moisture content of the substance examined may be shown by remote transmission and with large-scale indication if required. Mains or battery versions of the meter are available and the unit may be incorporated in a control system.

* * *

"Econ-O-Lift" elevator/conveyor. Gough Econ Ltd., Clough St., Hanley, Stoke-on-Trent, Staffs., England.

The "Econ-O-Lift" is a bucket-type elevator/conveyor in which the buckets are filled while in normal horizontal position and the material discharged by gentle rotation of the bucket through 360° by means of a sprocket fitted to the side of each bucket, which engages with either a fixed or a pivoted rack held in position manually, pneumatically or electrically. Discharge can be accomplished on any horizontal section, and in some cases on an inclined section. The buckets range from 6 to 36 inches in length and are available made of plastic, mild or stainless steel. Feeding without any spillage is brought about by a special collapsing chain action, whereby the buckets close up together at the feed point, after which the chain carrying the buckets returns to its normal straight line form.

* * *

"Turbo Finex" sieve. Russell Constructions Ltd., Russell House, Adam St., London W.C.2, England.

The "Turbo Finex" is a totally-enclosed, high-capacity sieve which is driven by a 3-h.p. motor through pulleys and belt drive. The product enters the inlet port and is fed by a helical worm into the sieving chamber where it is picked up by impeller blades specially designed to produce just sufficient turbulence and centrifugal force to project the powder through the mesh. All moving parts coming in contact with the material being sieved are easily removable for cleaning.

* * *

Level indication and control. Goring Kerr Ltd., Hanover Way, Windsor, Berks., England.

The Goring Kerr capacitance level indicators work on the principle of having a rod or wire element fixed perpendicularly or diagonally in a container and measuring the change in electrical capacitance that occurs as the material rises or falls. A D.C. voltage is supplied to the measuring instrument proportional to the amount by which the element is covered, and, although with packing of the material in the container the level will change, the density change causes a compensating change in capacitance so that the indication is a measure of weight rather than level. By setting the instrument at empty, half-full and full the contents of the container can be indicated on a percentage scale.

An alternative type of control utilizes detectors which may be of the capacitance or resistance-operated type and which are in the form of low and high-level probes or multi level probes mounted on the wall of a container and connected to a display panel to show the surface level position.

* * *

"Thermech" corrosion proofing. The Ceilcote Co., Berea, Ohio, USA.

The "Thermech" system overcomes curing problems associated with manual methods of applying liquid epoxy resins to floors and walls. The thermo-mechanical equipment provides continuous heating, mixing and spraying, so that the anti-corrosion properties of the epoxy resins are not impaired. Application is quicker, the coat is more uniform in depth and formulation, and the initial and maintenance costs are lower.

* * *

Helical worm "Radicons". David Brown Gear Industries Ltd., Park Gear Works, Huddersfield HD4 5DD, England.

The new helical worm totally-enclosed "Radicon" gear drives cover power transmission requirements up to 87 h.p. capacity and consist of case-hardened and profile-ground helical primary gears and low-ratio secondary wormgears to give higher efficiencies and torque capacities than do conventional wormgear units. They have taper roller bearings throughout and are lubricated for life. Their external dimensions are metric and the units are designed as past of a modular system to give a range of combined units with unlimited ratios. The maximum ratio of a single HW "Radicon" is 125:1.

* * *

"Selfrac 23" fire brick. General Refractories Ltd., Genefax House, Tapton Park Rd., Sheffield S10 3FJ, England.

Added to General Refractories range of over 100 refractory products is a new insulting fire brick, the "Selfrac 23", which conforms to ASTM C155 and BS 2973 classifications for 1350°C. It has low heat storage capacity and high thermal resistance and has yielded excellent results in tests.

PUBLICATIONS RECEIVED

DERION ROTARY VALVES. Derion Ltd., Foundry Lane, Chippenham, Wilts., England.

A new leaflet illustrates and describes the Derion rotary valves, airlocks and blowing seals for use in transferring solids from a container, which may be under pressure or vacuum, to pneumatic or other systems while reducing air leakage to a minimum. The Derion range includes components of various materials for different duties, and can handle powdered, granular, heavy, lumpy, sticky or abrasive substances.

* * *

HOLMES. W. C. Holmes & Co. Ltd., P.O. Box B7, Turnbridge, Huddersfield, Yorkshire, England.

Publication No. 8, under this title, surveys the range of products of the Holmes company which include vacuum pumps, gas meters, valves, the "Holoflite" processor[1], dust filters and collectors, etc., as well as the air blowers which are fitted to bulk delivery road tankers for sugar.

* * *

GRINDING MILLS. Kek Ltd., Hulley Road, Hurdsfield Industrial Estate, Macclesfield, Cheshire, England.

Leaflets describe the 4B2 and 3H grinding mills which operate on the pin-disc principle and are suitable for various throughputs. Such mills have been used for many years in the production of icing sugar from granulated.

* * *

SUGAR FACTORY PROCESS CHEMICALS. Fabcon Inc., 33 Public Square, Cleveland, Ohio, 44113 USA.

Process chemicals and their application and testing techniques which have been employed successfully by sugar factories in the Caribbean area, Central America and the Philippines are described in a new booklet, which is available in English and Spanish.

* * *

STEEL VALVES. Wakai Valve Mfg. Co. Ltd., P.O. Box 48, Higashisumiyoshi, Osaka, Japan.

Details are given in a brochure of Wakai cast steel gate, globe and angle and check valves.

* * *

STAINLESS STEEL VALVES. Nakamura Kinzoku Co. Ltd., Osaka, Japan.

Nakamura "Red-Handle" stainless steel globe and gate valves are described in a brochure which also features stainless steel screw fittings.

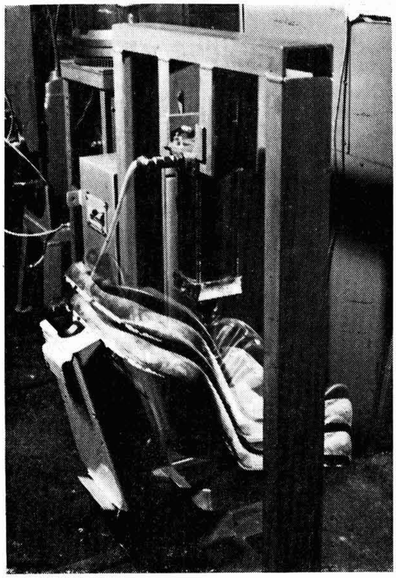
* * *

"MANLOVES IN THE SUGAR INDUSTRY—CENTRIFUGALS AND ROTARY DRYERS". Manlove Alliott & Co. Ltd., P.O. Box 81, Bloomsgrove Works, Nottingham NG7 3HQ, England.

A new brochure, No. SP1, gives details of Manlove Alliott rotary dryers and coolers which are available for sugar in a number of diameters between 4 and 10 ft and in lengths up to 50 ft. The brochure also features automatic and semi-automatic sugar centrifugals now being manufactured by the company to the latest designs of the former Glasgow firm of Watson Laidlaw & Co. Ltd. A brief history of Manlove Alliott & Co. Ltd. is also given, pointing out that the firm was formed in 1837 under the name of "Centrifugal Company" and held the first British patent for centrifugals or hydro-extractors. It was also responsible for complete sugar factories up to the early 20th Century, when the world economic situation forced it to make drastic cuts in the range of sugar equipment manufactured.

* * *

Farmers' "Open Days" at Massey-Ferguson.—Massey-Ferguson Ltd., the world's largest manufacturers of tractors, combine harvesters, diggers and loaders, and diesel engines, held a series of "Open Days" at their Training Centre near Coventry during the 14th–24th April 1969. Demonstrations were made of farm machinery and there were displays covering service, parts supply and component testing operations. The latter included test rigs for farm machinery components where the strains and stresses of a lifetime of normal work were packed into a few weeks; the illustration shows a rig for testing the suspension mechanism of a tractor seat which simulates a 210-lb driver being bounced about over rougher ground than he is ever likely to encounter, at the rate of 30 times every minute for half a million cycles.



In addition, the display included the electronic techniques for non-destructive testing of production components using e.g. ultrasonic probes. Leading items from the Massey-Ferguson range of farm machinery on show included five new all-steel trailers of 3–7 tons capacity, a new swinging drawbar and "Auto-Hitch" for tractors, and new fixed and reversible ploughs.

* * *

Thin juice ion exchange treatment.—"Imacti" Industrieele Mij. Activit N.V., of Amsterdam, Holland, are providing plant for deliming of 660 cu.m. of thin juice per hr (2420 gal/min) at the new beet sugar factory being built for Società Italiana per l'Industria degli Zuccheri at Argelato, near Bologna, Italy. The great part of the juice will also be demineralized, and provisions have been made for remelt decolorization by absorption resin. "Imacti" are supplying the "Imac" ion exchangers and "Asmit" absorption resins.

* * *

Philippines cane mill order.—Lopez Sugar Central Mill Co., of Negros Occidental in the Philippines, has ordered a 5-mill tandem from the Farrel Co., a division of USM Corp., of Ansonia, Conn., USA. Each mill will have three 38 × 78-inch rollers, and the order also covers high- and low-speed reducers and auxiliary equipment. The tandem is tentatively scheduled for shipment early in 1970 and will be the first US-built cane mill to be sold to the Philippines since 1959 when a Farrel tandem was supplied to Victorias Milling Co.

* * *

Process water treatment seminars.—Fabcon Inc., manufacturers of process chemicals for the sugar industry, held its first seminar in 1968 in Jamaica on the chemical treatment of process water. Management and engineering personnel from all industries in Jamaica were invited. In view of the seminar's success, it was decided to hold further seminars in 1969 in Central and South America and in those Far Eastern and African countries where the company has sales representation. Fabcon Inc. has recently received the Presidential "E" Award, given by the US Government in recognition of the company's contribution to the promotion of international trade.

[1] *I.S.J.*, 1958, **60**, 181.

French sugar imports and exports[1]

	1968		1967	
	(Metric tons, tel quel)			
	Not exceeding	Exceeding	Not exceeding	Exceeding
Imports	99·8°	99·8°	99·8°	99·8°
Australia	—	—	25,239	—
Belgium/Luxembourg	155	875	671	751
Brazil	55,801	—	36,101	—
Colombia	—	—	13,868	—
Congo (Brazzaville)	21,635	—	24,453	—
Cuba	9,630	—	—	—
Czechoslovakia	—	1,500	—	50
FWI	87,483	—	107,769	—
India	—	—	10,351	—
Malagasy	10,046	—	19,319	—
Mexico	—	—	10,160	—
Poland	25,265	160	31,260	—
Réunion	171,882	—	186,337	—
South Africa	—	—	20,981	—
Switzerland	—	936	2	695
Other Countries	96	44	513	—
	381,993	3,515	487,024	1,496
Exports				
Algeria	65	25,360	70,638	18,457
Andorra	153	1,229	1	1,139
Belgium/Luxembourg	5,015	2,022	1,174	338
Cameroons	—	2,577	165	3,650
Dahomey	—	8,567	10	6,015
Finland	7,875	—	—	—
Germany, West	94,380	18,677	122,956	7,862
Ghana	—	15,710	—	15,346
Greece	4,341	10,986	410	7,841
Hong Kong	—	1,050	—	—
India	—	1,026	4	—
Indonesia	5,250	4,515	—	—
Israel	4,200	—	—	32
Italy	8,780	7,039	7,333	5,276
Ivory Coast	7	15,536	1,035	11,905
Jordan	60	5,000	—	—
Liberia	—	1,667	—	1,375
Malaysia	3,045	2,500	—	—
Mali	—	5,176	1,302	3,780
Mauritania	—	12,318	—	9,472
Morocco	—	510	3,993	—
Netherlands	75,382	31,072	29,642	13,511
Niger	—	3,714	50	6,083
Nigeria	—	10,836	—	13.775
Senegal	1	16,615	136	28,106
Sierra Leone	1	1,290	—	2,201
Spain/Sp. Africa	15,306	77,032	—	4,592
Sweden	21,695	—	6,700	1
Switzerland	13,237	66,714	1,441	28,940
Togo	—	9,181	40	4,331
UK	33,081	3,710	—	963
USA	3,150	3,501	831	—
Upper Volta	—	3,855	—	7,033
Vietnam, South	—	17,340	—	15
Other Countries	1,114	2,226	999	2,690
	296,138	388,551	248,860	204,729

Polish sugar rationalization[2].—Production costs for sugar have risen in Poland by 1914 zloty per ton, compared with 1961/62. On the other hand, the domestic price of sugar has been reduced, from 15 zloty/kilo in 1953 to 10·50 at present. In the face of a satisfied domestic market and limited export possibilities a further extension of Polish sugar production cannot be justified, and the beet area must be reduced; in the past an area of 402,000 hectares has been officially contracted but beets have actually been grown on at least 414,000 ha. The extra "wild contracting" area is to be abolished and beet area adapted to processing capacity, in order to avoid over-long campaigns.

Brevities

Hungarian sugar prospects[3].—Circumstances in the Hungarian industry lead to the supposition that Hungary will cease to be a sugar exporter in a few years. Production within the country has fallen from 445,000 tons in 1964 to 406,000 tons in 1968, while domestic consumption has risen steadily to 370,000 tons per year and should reach 400,000 tons in 1971.

* * *

Florida sugar crop, 1968/69[4].—Production of cane sugar in Florida in the 1968/69 season, which ended in the middle of March, was considerably less than that of 1967/68, reaching 545,577 short tons, raw value, compared with 717,112 tons in the previous season. Bad climatic conditions, added to the 5% cut in acreage imposed by the Dept. of Agriculture, were the cause of this fall in production.

* * *

Beet sugar extension in India[5].—According to press reports, Daurala sugar factory, Daurala, and Kisan Cooperative Sugar Factory, Bazpur, Naini-tal, are to install diffusion plants for the manufacture of sugar from beet after the cane sugar season has ended.

* * *

Chile sugar developments[6].—Industria Azucarera Nacional S.A. is to build a large sugar factory and subsidiary processing plants at Curicó, and also plans to produce 84 tons of liquefied carbon dioxide a day at its plant in Los Angeles.

* * *

Norway-Czechoslovakia trade agreement[7].—Under the terms of a new long-term trade agreement, to cover 1969–1973, Czechoslovakia is to supply Norway with a number of products including sugar.

* * *

Sugar cane research in East Africa[8].—Approval for K£118,374 to be used in the establishment of an East African Sugar Cane Breeding Institute with a research wing at Kwanda, Uganda, and a breeding wing at Kibaha, Tanzania, has been given by the Research and Social Council of the East African Community.

* * *

FAO documentary services.—As a result of its world-wide activities, the Food and Agriculture Organization of the United Nations has accumulated, since its creation in 1945, a wealth of technical, economic and social information, contained in some 25,000 publications and documents. This information is to be made available through the FAO Documentation Centre, free of charge or at minimum cost. The Centre has published a monthly *Current Index* since January 1967 and retrospective *Special Indexes* for 1945–66, the former being supplied free of charge on request, and these permit the selection of documents of interest by means of subject matter, author and title references in each of the fields of agriculture, fisheries, forestry, nutrition, rural economy, etc. The centre can also provide *ad hoc* bibliographies on specific subjects on request. The address is: FAO Documentation Centre, FAO Headquarters, Via Terme di Caracalla, 00100 Rome, Italy.

1 C. Czarnikow Ltd., *Sugar Review*, 1969, (910), 51.
2 *Trybuna Ludu*; through F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (8), 7.
3 *Agence France-Presse*, 29th March 1969.
4 *Zeitsch. Zuckerind.*, 1969, **94**, 160.
5 *Indian Sugar*, 1969, **18**, 734.
6 *Bank of London & S. America Review*, 1969, **3**, 329.
7 *Czechoslovak Heavy Industry*, 1969, (4), 27.
8 *Barclays Overseas Review*, April 1969, p. 30.

Brevities

New distillery for Holland[1].—N.V. Zuid-Nederlandsche Spiritusfabriek, of Bergen-op-Zoom, has inaugurated at Delfzijl in northern Holland a new automatic plan tfor the manufacture of alcohol. Raw material used will be molasses from two sugar factories also in northern Holland. The Zuid-Nederlandsche company will thus become the largest producer of fermentation alcohol in Europe.

* * *

New sugar factory for Japan[2].—The Nippon Beet Sugar Manufacturing Co. Ltd. applied to the Ministry of Agriculture and Forestry on the 22nd February for permission to construct a new sugar factory in Hokkaido. According to the plan, daily slicing capacity is around 3600 metric tons.

* * *

Greek sugar factories capacity increase[3].—The Agricultural Bank of Greece, the main shareholder in the Hellenic Sugar Industry, has granted a loan of 100 million drachmas for expansion of the Platy and Larissa sugar factories in order to increase sugar production from their current levels of 28,000 tons/year to 35,000 tons and later 40,000 tons/year.

* * *

French sugar factory closure[4].—One of the oldest sugar factories in France, Sucrerie et Distillerie de Francières S.A., which was founded in 1822, closed on the 20th March. Its daily slice was less than 1000 tons of beet.

* * *

US sugar factory closure[5].—Little Texas sugar factory, a 1400 t.c.d. plant located new Napoleonville, Louisiana, has been sold and will be dismantled and the machinery disposed of. Cane from the Little Texas and St. Emma plantations, sold with the factory, will probably go to the Leighton sugar factory of Lafourche Sugar Co. at Thibodaux.

* * *

New USSR sugar factory[6].—A new sugar factory supplied by Poland has been opened at Mogilev in the Ukraine. This is the seventh Polish sugar factory supplied to the Ukraine and the 15th in the USSR. These sugar factories have had a daily processing capacity between 2500 and 3500 tons of beet.

* * *

Mauritius Sugar Industry Research Institute[7].—Dr. P. O. WIEHE, former Director of the M.S.I.R.I., was appointed Vice-Chancellor of the University of Mauritius last November, and on his departure, Mr. ROBERT ANTOINE, Head of the Plant Pathology and Plant Breeding Divisions of the Institute, was appointed Director in his place. Mr. J. DUPONT DE RIVALTZ DE ST. ANTOINE, Chief Sugar Technologist of the Institute, has been appointed Assistant Director. The Mauritius College of Agriculture has been absorbed in the University and will form the core of the School of Agriculture, and degrees in Agriculture and Sugar Technology will be offered.

* * *

Togo sugar imports[8].—Imports of sugar into Togo totalled 11,239 metric tons, tel quel, in 1968 compared with 8274 tons in 1967. In both years the principal suppliers were France (6833 tons in 1968 and 4480 tons in 1967) and Belgium/Luxembourg (2278 and 2272 tons).

* * *

Iran sugar factories expansion[9].—The sugar factories of Fassa and Turbat-i-Haiderieh in Iran are to be expanded and their daily slicing capacities—at present 330 and 700 tons/day, respectively—are to be doubled. The beet area is also to be extended.

Finland sugar imports and exports[10]

	1968	1967
	(metric tons, tel quel)	
Imports		
Brazil	—	10,440
Colombia	—	20,926
Cuba	108,472	80,281
Dominican Republic	—	14,133
France	28,443	—
Germany, East	14,681	3,241
Hungary	2,489	—
Poland	12,943	13,198
USSR	48,113	59,090
Other Countries	—	55
	215,141	201,364
Exports		
Algeria	1,990	—
Iceland	762	—
Netherlands	1,025	4,341
Norway	22,085	6,723
Sweden	25,165	14,539
Switzerland	—	6,050
Other Countries	38	563
	51,065	32,216

Cane drought in Queensland[11].—Drought is stiiking hard in Queensland and even cane growers are being forced to seek work away from their farms to earn money. Queensland cane growers will lose between $A20,000,000 and $A30,000,000 at least this season because of drought. Parts of the Bundaberg, Childers and Maryborough districts have been described as disaster areas. Some cane crops not under irrigation are being ploughed-in.

* * *

Rwanda cane sugar project[12].—Taiwan is providing development services in Rwanda for development of sugar cane growing and manufacture of sugar. A new factory is being installed in the Nyabarongo River Valley, outside Kigali, with a capacity of 100 tons of cane per day, and costing $500,000, about a third of the total cost of the project. The 30 tons/day of sugar which the factory will produce will satisfy the local demand.

* * *

Brazil sugar plan, 1969/70[13].—The Brazilian sugar plan for 1969/70 provides for a total production of 75,060,000 60-kg bags (4,504,000 metric tons), of which 35 million bags (2,100,000 tons) are to be produced in the State of São Paulo. Of the total production, 57,060,000 bags (3,424,000 tons) are to be as white sugar and 18,000,000 bags (1,080,000 tons) will be export raw sugar. The majority of this export sugar (15,000,000 bags or 900,000 tons) will be produced in the states of the North-East and the remaining 3,000,000 bags (180,000 tons) will be produced in São Paulo.

1 *Sucr. Belge*, 1969, **88**, 329.
2 *Willett & Gray*, 1969, **93**, 164.
3 F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (7), 5.
4 *B. W. Dyer & Co.*, 28th March 1969.
5 *Sugar y Azúcar*, 1969, **64**, (1), 42.
6 F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (9), 5.
7 *Rev. Agric. Sucr.* (Mauritius), 1968, **47**, 243-245.
8 C. Czarnikow Ltd., *Sugar Review*, 1969, (920), 94.
9 F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (14), 4.
10 C. Czarnikow Ltd., *Sugar Review*, 1969, (908), 43.
11 *The Australian News*, 8th May 1969.
12 *Sugar y Azúcar*, 1969, **64**, (4), 37.
13 F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (14), 4.

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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.
Edwards Engineering Corp.
Soc. Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.

Accumulators, Steam.
see Steam Accumulators.

Activated carbon.
Atlas Chemical Industries Inc.
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
Farnell Carbons.
Honeywill-Atlas Ltd.
Lurgi Gesellschaft fur Wärme- und Chemotechnik m.b.H.
Norit Sales Corporation Ltd.

Air clutches.
Farrel Company.
Renold Ltd.

Air compressors.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Peter Brotherhood Ltd.
George Cohen Machinery Ltd.
Cotton Bros. (Longton) Ltd.
Soc. Fives Lille-Cail.
Krupp Stahlexport G.m.b.H.
Nash International Company.

Air compressors, Oil-free.
Peter Brotherhood Ltd.

Air conditioning equipment.
A.B. Svenska Fläktfabriken.

Air coolers.
E. Green & Son Ltd.
A.B. Svenska Fläktfabriken.

Air filters.
N.V. "Ama" Niagara Filters.
Buhler Brothers Ltd.
Norit Sales Corporation Ltd.
Simon-Barron Ltd.
A.B. Svenska Fläktfabriken.

Air heaters.
Fluostatic Ltd.
E. Green & Son Ltd.
A.B. Svenska Fläktfabriken.
Yarrow & Co. Ltd.

Air-operated portable stitchers.
Thames Packaging Equipment Co.

Alcohol plant.
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Soc. Fives Lille-Cail.
T. Giusti & Son Ltd.
S.P.E.I. Chim.
Technoexport Czechoslovakia.

Ammonia removal from condensates.
Imacti N.V.

Anti-foam agents.
Hodag Chemical Corporation.
Schill & Seilacher Chemische Fabrik.

Asbestos products.
Cape Insulation Ltd.

Automatic beet laboratories.
Instrumentenfabriek Venema.

Automatic saccharimeters and polarimeters.
Schmidt + Haensch.
Carl Zeiss.

Automatic tare rooms.
Instrumentenfabriek Venema.

Bag, *see* Sack.

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

Bagasse baling presses.
Buckau-Wolf Maschinenfabrik A.G.
Honiron.
Shirtliff Bros. Ltd.
Thibodaux Boiler Works Inc.

Bagasse depithing equipment.
Gruendler Crusher & Pulverizer Company.

Bagasse furnaces.
Babcock & Wilcox (Operations) Ltd.
Honiron.
S.E.U.M.
John G. Stein & Co. Ltd.

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

Bagasse presses.
C F & I Engineers Inc.

Bagasse utilization plant for manufacture of cellulose, paper pulp, particle board, etc.
Buckau-Wolf Maschinenfabrik A.G.
Cellulose Development Corporation Ltd.
Defibrator A.B.
Dorr-Oliver Inc.
Simon Handling Engineers Ltd.

Beet diffusers, Continuous.
Babcock Atlantique.
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.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Etbts. A. Olier.
Technoexport Czchoslovakia.

Beet flume equipment.
Dreibholz & Floering Ltd.

Beet mechanical discharging and storage equipment.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Soc. Fives Lille-Cail.

Beet molasses sugar recovery.
Imacti N.V. (*Quentin process*).
Stork-Werkspoor Sugar N.V.

Beet pulp presses.
BMA Braunschweigische Maschinenbauanstalt.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Fletcher and Stewart Ltd.
Hein, Lehmann & Co. A.G.
AB. Kockum-Landsverk.
Etablissements F. Moret.
Etbts. A. Olier.
Rose, Downs & Thompson Ltd.
Stord Bartz Industri A/S.

Beet seed.
A/S De Danske Sukkerfabrikker.

Beet slicers.
Dreibholz & Floering Ltd.
Soc. Fives Lille—Cail.
H. Putsch & Comp.

Beet tail utilization plant.
Buckau-Wolf Maschinenfabrik A.G.
H. Putsch & Comp.

Beet tare house equipment.
Dreibholz & Floering Ltd.
Ingeniörsfirman Nils Weibull AB.

Beet washing plant.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Salzgitter Maschinen A.G.

Beet water-jet unloading equipment.
Dreibholz & Floering Ltd.
Technoexport Czechoslovakia.

Belting, Conveyor & elevator.
see Conveyor belting.

Blending machines.
Arenco-Alite Ltd.

Boiler mountings.
Dewrance & Co. Ltd.

Boiler water treatment.
N.V. "Ama" Niagara Filters.
William Boby & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Eimco (Great Britain) Ltd.
Fabcon Inc.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.

Boilers, Shell.
Marshall, Sons & Co. Ltd.

Boilers, Water tube.
Babcock & Wilcox (Operations) Ltd.
Buckau-Wolf Maschinenfabrik A.G.
George Cohen Machinery Ltd.
Soc. Fives Lille-Cail.
Foster Wheeler John Brown Boilers Ltd.
Marshall, Sons & Co. Ltd.
Murray Iron Works Company.
S.E.U.M.
Simon-Carves Ltd.
Stork-Werkspoor Sugar N.V.
Yarrow & Co. Ltd.

Bone Char.
British Charcoals & Macdonalds Ltd.

Brushes.
Flexotube (Liverpool) Ltd.
The Kleen-e-ze Brush Co. Ltd.

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

Bulk storage hoppers.
Babcock Atlantique.
Fletcher & Stewart Ltd.
T. Giusti & Son Ltd.
Spencer (Melksham) Ltd.
The Taylor Rustless Fittings Co. Ltd.
The Tills Engineering Co. Ltd.

Bulk sugar containers, Transportable.
Robert Hudson (Raletrux) Ltd.
The Tills Engineering Co. Ltd.

Bunker discharge equipment.
Buhler Brothers Ltd.
Henry Simon Ltd.
The Triton Engineering Co. (Sales) Ltd.

Burners, Sulphur.
see Sulphur furnaces, Continuous.

Calciners, Fluidized bed.
Fluostatic Ltd.

Cane car tippers.
Fletcher and Stewart Ltd.
Honiron.
The Mirrlees Watson Co. Ltd.

Cane cars and trailers.
Honiron.
Robert Hudson (Raletrux) Ltd.
Kingston Industrial Works Ltd.
Krupp Stahlexport G.m.b.H.
The Thomson Machinery Co. Inc.
Weeks & Co. (Engineers) Ltd.

Cane carts.
Honiron.
Kingston Industrial Works Ltd.
The Thomson Machinery Co. Inc.
Weeks & Co. (Engineers) Ltd.

Cane conveyor drives.
Edwards Engineering Corp.

Cane cultivation equipment.
Massey-Ferguson (Export) Ltd.
The Thomson Machinery Co. Inc.
Wyper Brothers Ltd.

Cane diffusers, Continuous.
Soc. Sucrière de l'Atlantique (Engineering).
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
C F & I Engineers Inc.

Cane diffusers, Continuous—*continued*
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc.
Extraction De Smet S.A.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Technoexport Czechoslovakia.

Cane grapples.
Honiron.
Joseph Westwood & Co. Ltd.

Cane harvesters.
Honiron.
Massey-Ferguson (Export) Ltd.
The Thomson Machinery Co. Inc.
Wyper Brothers Ltd.

Cane loaders.
Honiron.
Massey-Ferguson (Export) Ltd.
The Thomson Machinery Co. Inc.

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

Cane planters.
Massey-Ferguson (Export) Ltd.

Cane preparation equipment for diffusion.
C F & I Engineers Inc.
Dorr-Oliver Inc.
Fletcher and Stewart Ltd.
Gruendler Crusher & Pulverizer Co.
Stork-Werkspoor Sugar N.V.

Cane shredders.
see Shredders.

Cane trash shredders.
Dorr-Oliver Inc.
Gruendler Crusher & Pulverizer Co.

Cane washing plants.
Soc. Sucrière de l'Atlantique (Engineering).

Cane washing tables.
Honiron.
The Thomson Machinery Co. Inc.

Carbon, Decolorizing.
Atlas Chemical Industries Inc.
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
C.E.C.A.
Farnell Carbons.
Honeywill-Atlas Ltd.
Lurgi Gesellschaft für Wärme- und Chemotechnik m.b.H.
Norit Sales Corporation Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Carbon decolorizing equipment.
Norit Sales Corporation Ltd.

Carbon decolorizing systems.
Norit Sales Corporation Ltd.

Carbon reactivation.
Norit Sales Corporation Ltd.

Carbonatation equipment.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.

Carbonatation equipment—*continued*
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Neyrpic.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Technoexport Czechoslovakia.

Castings.
Babcock & Wilcox (Operations) Ltd.
E. Green & Son Ltd.
Stork-Werkspoor Sugar N.V.

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

Cement, Sugar resistant.
Lafarge Aluminous Cement Co. Ltd.

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

Centrifugal clarifiers.
Alfa-Laval AB.
Dorr-Oliver Inc., Cane Sugar Division.

Centrifugal motors.
ASEA.
The Western States Machine Co.

Centrifugal screens.
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 & Co. A.G.
Krieg & Zivy Industries.
Charles Mundt & Sons.
The Sugar Manufacturers' Supply Co. Ltd.
The Western States Machine Co.

Centrifugals and accessories.
Alfa-Laval AB.
ASEA.
BMA Braunschweigische Maschinenbauanstalt.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co. A.G.
Honiron.
AB. Kockum-Landsverk.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
The Sugar Manufacturers' Supply Co. Ltd.
The Western States Machine Co.

Screw conveyors.
Aldersley Engineers Ltd.
Ewart Chainbelt Co. Ltd.
The Mirrlees Watson Co. Ltd.
Etablissements F. Moret.
Simon-Barron Ltd.
The Triton Engineering Co. (Sales) Ltd.

Vibratory conveyors.
Ewart Chainbelt Co. Ltd.
Henry Simon Ltd.
Simon-Barron Ltd.
The Triton Engineering Co. (Sales) Ltd.

Conveyors and elevators, Mobile.
Aldersley Engineers Ltd.
Buhler Brothers Ltd.
Crone & Taylor (Engineering) Ltd.
Mavor & Coulson Ltd.
Salzgitter Maschinen A.G.
Simon Handling Engineers Ltd.

Coolers, Fluidized bed.
Fluostatic Ltd.

Coolers, Sugar.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
Fletcher and Stewart Ltd.
Manlove Alliott & Co. Ltd.
Etablissements F. Moret.
Newell Dunford Engineering Ltd.
Salzgitter Maschinen A.G.
Standard Steel Corporation.
Stork-Werkspoor Sugar N.V.

Coolers, Water.
Film Cooling Towers (1925) Ltd.
Metal Propellers Ltd.

Cranes.
Babcock & Wilcox (Operations) Ltd.
Butters Cranes Ltd.
Soc. Fives Lille-Cail.
John M. Henderson & Co. Ltd.
Robert Hudson (Raletrux) Ltd.
Jones Cranes Ltd.
O. & K. Export- und Handelsgesellschaft m.b.H.
Stork-Werkspoor Sugar N.V.
Stothert & Pitt Ltd.
Wheway-Watson Ltd.

Crystallization aids.
Fabcon Inc.
Hodag Chemical Corporation.

Crystallizers.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Standard Steel Corporation.
Stork-Werkspoor Sugar N.V.

Cube-making machinery.
Buckau-Wolf Maschinenfabrik A.G.
Chambon Ltd.
Goka N.V. Machine Works.
Standard Steel Corporation.

Cube sugar moulding, ranging and packeting plant.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.
Standard Steel Corporation.

Cube wrapping machines.
Fr. Hesser Maschinenfabrik A.G.
SAPAL.

Deaerators.
William Boby & Co. Ltd.
The Permutit Co. Ltd.
Stork-Werkspoor Sugar N.V.

Decolorizing plants.
Atlas Chemical Industries Inc.
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
BMA Braunschweigische Maschinenbauanstalt.
Honeywill-Atlas Ltd.
IMACTI.
Norit Sales Corporation Ltd.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.

Decolorizing resins.
Diamond Shamrock Chemical Co., Resinous Products Division.
IMACTI.
Montecatini Edison S.p.A.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Resindion S.p.A.
Rohm and Haas Company.

Deliming plants.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Division.
IMACTI.
Robert Reichling & Co. K.G.

Demineralization plants.
BMA Braunschweigische Maschinenbauanstalt.
William Boby & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
The Eimco Corporation.
IMACTI.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.

Demisters.
Begg, Cousland & Co. Ltd.

Diatomaceous earth, *see* Filter-aids.

Diesel alternator sets.
W. H. Allen, Sons & Co. Ltd.
ASEA.
Stork-Werkspoor Sugar N.V.

Distillery plant, *see* Alcohol plant.

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

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

Dryers.
BMA Braunschweigische Maschinenbauanstalt.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Manlove Alliott & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Etablissements F. Moret.
Newell Dunford Engineering Ltd.
Salzgitter Maschinen A.G.
S.E.U.M.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
Spencer (Melksham) Ltd.
Standard Steel Corporation.
Stork-Werkspoor Sugar N.V.
A.B. Svenska Fläktfabriken.

Dryers, Fluidized bed.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fluostatic Ltd.
Stork-Werkspoor Sugar N.V.
A.B. Svenska Fläktfabriken.

Dust control equipment.
Buell Ltd.
Buhler Brothers Ltd.
Collectron (Sales) Ltd.
Dust Control Equipment Ltd.
Newell Dunford Engineering Ltd.
Phoenix Precision Instrument Co.
Henry Simon Ltd.
Standard Steel Corporation.
A.B. Svenska Fläktfabriken.
Thermix Industries Ltd.
The Tills Engineering Co. Ltd.

Dust sleeves and bags.
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
Samuel Hill Ltd.
S.A. Lainière de Sclessin.
P. & S. Textiles Ltd.
Henry Simon Ltd.

Economizers.
E. Green & Son Ltd.

Effluent screens.
F. W. Brackett & Co. Ltd.

Effluent treatment.
William Boby & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Eimco (Great Britain) Ltd.
Film Cooling Towers (1925) Ltd.
Jones & Attwood Ltd.
The Permutit Co. Ltd.
Simon-Hartley Ltd.

Electric motors.
ASEA.
George Cohen Machinery Ltd.
Soc. Fives Lille-Cail.
The Harland Engineering Co. Ltd.

Electric power generators.
ASEA.
George Cohen Machinery Ltd.
Soc. Fives Lille-Cail.
General Electric Company of U.S.A.
Krupp Stahlexport G.m.b.H.
Murray Iron Works Company.
Stork-Werkspoor Sugar N.V.

Electric surface heaters.
Isopad Ltd.
Stabilag Engineering Ltd.

Electrical meters and relays.
Hartmann & Braun A.G.

Electronic equipment.
ASEA.
Hartmann & Braun A.G.
Honeywell Ltd.
Henry Simon Ltd.
Thorn Automation Ltd.

Engineering design and contracting services.
Soc. Sucrière de l'Atlantique (Engineering).
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Dorr-Oliver Inc.
Fletcher and Stewart Ltd.
Lucks + Co. G.m.b.H.
The Mirrlees Watson Co. Ltd.

Engines, Diesel.
W. H. Allen, Sons & Co. Ltd.
George Cohen Machinery Ltd.
Stork-Werkspoor Sugar N.V.

Engines, Steam.
George Cohen Machinery Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Entrainment separators.
Begg, Cousland & Co. Ltd.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
Lancaster & Tonge Ltd.
Newell Dunford Engineering Ltd.
St. Mary Iron Works Inc.

Evaporator additives.
Fabcon Inc.
Hodag Chemical Corporation.

Evaporators and condensing plant.
Alfa-Laval AB.
A.P.V. Co. Ltd.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.

Evaporators and condensing plant *continued.*
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
Stork-Werkspoor Sugar N.V.
Technoexport Czechoslovakia.

Evaporator tube cleaners.
see Tube cleaners.

Fans, Induced and forced draft.
Stork-Werkspoor Sugar N.V.
A.B. Svenska Fläktfabriken.

Filling machines.
Arenco-Alite Ltd.

Filters.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
I. V. Pressure Controllers Ltd.
Lancaster & Tonge Ltd.
Sankey Green Wire Weaving Co. Ltd.
Henry Simon Ltd.
S.P.E.I. Chim.
Wire Weaving Co. Ltd.

Automatically controlled filters.
N.V. "Ama" Niagara Filters.
F. W. Brackett & Co. Ltd.
Chemap A.G.
Schumacher'sche Fabrik.
Sparkler Manufacturing Company.
Stella-Meta Filters Ltd.

Bag pressure filters.
N.V. "Ama" Niagara Filters.
A. F. Craig & Co. Ltd.

Candle filters.
N.V. "Ama" Niagara Filters.
BMA Braunschweigische Maschinenbauanstalt.
Etbts. A. Olier.
H. Putsch & Comp.
Schumacher'sche Fabrik.
Stella-Meta Filters Ltd.

Diatomite filters.
N.V. "Ama" Niagara Filters.
Chemap A.G.
Enzinger Division, The Duriron Co. Inc.
The Mirrlees Watson Co. Ltd.
Schumacher'sche Fabrik.
Sparkler Manufacturing Company.
Stella-Meta Filters Ltd.

Filter presses.
BMA Braunschweigische Maschinenbauanstalt.
Manlove Alliott & Co. Ltd.

Filter thickeners.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
H. Putsch & Comp.
Schumacher'sche Fabrik.

Gravity and pressure filters.
N.V. "Ama" Niagara Filters.
William Boby & Co. Ltd.
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.

Iron removal filters.
N.V. "Ama" Niagara Filters.
William Boby & Co. Ltd.
Brimag Ltd.
Electromagnets Ltd.
The Permutit Co. Ltd.
Rapid Magnetic Ltd.

Leaf filters.
N.V. "Ama" Niagara Filters.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Enzinger Division, The Duriron Co. Inc.
Ferguson Perforating & Wire Co.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Sparkler Manufacturing Company.
Stella-Meta Filters Ltd.
Stork-Werkspoor Sugar N.V.

Plate and frame filters.
N.V. "Ama" Niagara Filters.
Manlove Alliott & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Pressure filters.
N.V. "Ama" Niagara Filters.
BMA Braunschweigische Maschinenbauanstalt.
William Boby & Co. Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Chemap A.G.
George Cohen Machinery Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Enzinger Division, The Duriron Co. Inc.
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.
Schumacher'sche Fabrik.
A. & W. Smith & Co. Ltd.
Sparkler Manufacturing Company.
Stella-Meta Filters Ltd.
The Taylor Rustless Fittings Co. Ltd.

Rotary vacuum filters.
Soc. Sucrière de l'Atlantique (Engineering).
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
The Eimco Corporation.
Eimco (Great Britain) Ltd.
Eimco Industriale S.p.A.
Etbts. A. Olier.
H. Putsch & Comp.

Filter aids.
C.E.C.A.
Dicalite/GREFCO Inc.
Kenite Corporation.
The Sugar Manufacturers' Supply Co. Ltd.

Filter cloths.
Associated Perforators & Weavers Ltd.
Begg, Cousland & Co. Ltd.
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
N. Greening (Warrington) Ltd.
Samuel Hill Ltd.
S.A. Lainière de Sclessin.
Nordiska Maskinfilt AB.
P. & S. Textiles Ltd.
Sankey Green Wire Weaving Co. Ltd.
Henry Simon Ltd.

Filter leaves.
N.V. "Ama" Niagara Filters.
Dorr-Oliver Inc., Cane Sugar Division.
Enzinger Division, The Duriron Co. Inc.
Ferguson Perforating & Wire Co.
Charles Mundt & Sons.
Sankey Green Wire Weaving Co. Ltd.
Sparkler Manufacturing Company.

Filter papers.
J. Barcham Green Ltd.
A. H. Korthof N.V.
The Sugar Manufacturers' Supply Co. Ltd.

Filter pulp.
J. Barcham Green Ltd.

Filter screens.
Associated Perforators & Weavers Ltd.
Begg, Cousland & Co. Ltd.
F. W. Brackett & Co. Ltd.
Cotton Bros. (Longton) Ltd.
Endecotts (Test Sieves) Ltd.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Haver & Boecker.
Krieg & Zivy Industries.
Charles Mundt & Sons.
J. & F. Pool Ltd.
Sankey Green Wire Weaving Co. Ltd.
Henry Simon Ltd.

Flanges, Non-Ferrous.
Blundell & Crompton Ltd.

Flexible drives.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.

Flexible shaft couplings.
David Brown Gear Industries Ltd.
The Falk Corporation.
Renold Limited.
Henry Simon Ltd.

Flexible shafting.
Flexible Drives (Gilmans) Ltd.
Henry Simon Ltd.

Flowmeters.
Aldersley Engineers Ltd.
Alfa-Laval AB.
Fischer & Porter Ltd.
Hartmann & Braun A.G.
Honeywell Ltd.
K.D.G. Instruments Ltd.
Negretti & Zambra Ltd.
Siemens A.G., Wernerwerk für Messtechnik.
The Sugar Manufacturers' Supply Co. Ltd.

Gas purifying equipment.
Maschinenfabrik H. Eberhardt.
Lodge-Cottrell Ltd.
Stork-Werkspoor Sugar N.V.

Gear couplings.
David Brown Gear Industries Ltd.
The Falk Corporation.
Renold Ltd.
Henry Simon Ltd.

Gearing, *see* Reduction gears.

Gearmotors.
ASEA.
David Brown Gear Industries Ltd.
The Falk Corporation.
Renold Ltd.

Grabs, Cane, Beet and Raw sugar.
Honiron.
Joseph Westwood & Co. Ltd.

Granulators, *see* Dryers.

Harvesters, *see* Beet harvesters *and* Cane harvesters

Heat exchangers, Air-cooled.
E. Green & Son Ltd.
J. & L. Engineering Company Inc.

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

Heat exchangers, Plate type.
Alfa-Laval AB.
A.P.V. Co. Ltd.
Buckau-Wolf Maschinenfabrik A.G.

Heat exchangers, Spiral-type.
Alfa-Laval AB.
E. Green & Son Ltd.

Heat exchangers, Tubular.
Alfa-Laval AB.
A.P.V. Co. Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
John Dore & Co. Ltd.
Enzinger Division, The Duriron Co. Inc.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
E. Green & Son Ltd.
Honiron.
Kingston Industrial Works Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
S.P.E.I. Chim.
The Taylor Rustless Fittings Co. Ltd.
Technoexport Czechoslovakia.

Heat sealers.
The Thames Packaging Equipment Co.

Heating mantles and tapes, Electric.
Isopad Ltd.
Stabilag Engineering Ltd.

Hydraulic controls for valves, etc.
Edwards Engineering Corp.
The Lunkenheimer Company.

Insect control equipment.
Henry Simon Ltd.

Instruments, Process control.
Anacon Inc.
ASEA.
Bellingham & Stanley Ltd.
Chemap A.G.
Fischer & Porter Ltd.
Hartmann & Braun A.G.
Honeywell Ltd.
K.D.G. Instruments Ltd.
Negretti & Zambra Ltd.
Phoenix Precision Instrument Co.
Scientific Furnishings Ltd.
Siemens A.G., Wernerwerk für Messtechnik.
The Sugar Manufacturers' Supply Co. Ltd.
Thorn Automation Ltd.
G. H. Zeal Ltd.

Insulation, Thermal (heat and cold).
Cape Insulation Ltd.
Lafarge Aluminous Cement Co. Ltd.

Ion exchange plants.
BMA Braunschweigische Maschinenbauanstalt.
William Boby & Co. Ltd.
IMACTI.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.

Ion exchange resins.
Diamond Shamrock Chemical Co., Resinous Products Division.
IMACTI.
Montecatini Edison S.p.A.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Resindion S.p.A.
Rohm and Haas Company.

Irrigation equipment.
Farrow & Sons Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Juice heaters.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Technoexport Czechoslovakia.

Juice scales.
Ashworth Ross & Co. Ltd.
Fletcher and Stewart Ltd.
Carl Schenck Maschinenfabrik G.m.b.H.
N.V. Servo-Balans.
see also Weighing Machines

Juice strainers and screens.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
The Deister Concentrator Co. Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Endecotts (Test Sieves) Ltd.
Farrel Company.
Ferguson Perforating & Wire Co.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Haver & Boecker.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.

Juice and syrup mixers.
Anacon Inc.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.

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

Knives, Milling.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
A. F. Craig & Co. Ltd.
Farrel Company.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Knives, Milling—Drives.
Farrel Company.
Fletcher and Stewart Ltd.
General Electric Company of U.S.A
Stork-Werkspoor Sugar N.V.

Laboratory apparatus and equipment.
Chemap A.G.
Endecotts (Test Sieves) Ltd.
C. A. Hendley & Co.
A. H. Korthof N.V.
The Permutit Co. Ltd.
Phoenix Precision Instrument Co
The Sugar Manufacturers' Supply Co. Ltd.
The Taylor Rustless Fittings Co. Ltd.
see also Laboratory instruments, *etc.*

Laboratory glassware.
C. A. Hendley & Co.

Laboratory instruments.
Anacon Inc.
Honeywell Ltd.
K.D.G. Instruments Ltd.
A. H. Korthof N.V.
Phoenix Precision Instrument Co.
The Sugar Manufacturers' Supply Co. Ltd.
G. H. Zeal Ltd.
Carl Zeiss.
see also Automatic saccharimeters and polarimeters, Laboratory apparatus and equipment, Refractometers, Saccharimeters and polarimeters, *etc.*

Laboratory reagents.
A. H. Korthof N.V.
The Sugar Manufacturers' Supply Co. Ltd.

Lens cleaning tissues.
J. Barcham Green Ltd.

Level indicators and controllers.
Goring Kerr Ltd.
Hartmann & Braun A.G.
Haver & Boecker.
Honeywell Ltd.
K.D.G. Instruments Ltd.
Negretti & Zambra Ltd.
Siemens A.G., Wernerwerk für Messtechnik.
Thorn Automation Ltd.

Lime slaking equipment.
Dorr-Oliver Inc., Cane Sugar Division.
Maschinenfabrik H. Eberhardt.
The Eimco Corporation.
Fluostatic Ltd.
Etablissements F. Moret.
Stork-Werkspoor Sugar N.V.

Limestone pulverizers for agricultural stone.
Gruendler Crusher & Pulverizer Co.

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

Loading machinery.
Buhler Brothers Ltd.
The Eimco Corporation.
O. & K. Export- und Handelsgesellschaft m.b.H.

Locomotives, Diesel.
General Electric Company of U.S.A
Robert Hudson (Raletrux) Ltd.
Krupp Stahlexport G.m.b.H.
O. & K. Export- und Handelsgesellschaft m.b.H.

Magnetic lifting equipment.
Brimag Ltd.
Electromagnets Ltd.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.

Magnetic separators.
Brimag Ltd.
Electromagnets Ltd.
Fletcher and Stewart Ltd.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.

Massecuite heat treating equipment.
Babcock Atlantique.
C F & I Engineers Inc.
Dorr-Oliver Inc.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Western States Machine Co.

Metal detectors.
ASEA.
Goring Kerr Ltd.
Newell Dunford Engineering Ltd.

Meters, Integrating, for liquids.
Hartmann & Braun A.G.

Meters for liquid fuels.
Hartmann & Braun A.G.

Mill hydraulics.
Edwards Engineering Corp.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Mill rolls.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
A. F. Craig & Co. Ltd.
Farrel Company.
Soc. Fives Lille-Cail.

Mill rolls—*continued*
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Mill roll movement indicators and recorders.
Edwards Engineering Corp.

Milling plant.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
A. F. Craig & Co. Ltd.
Farrel Company.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Technoexport Czechoslovakia.

Milling plant—complete electrical equipment.
ASEA.
General Electric Company of U.S.A.

Mist eliminators.
Begg, Cousland & Co. Ltd.

Mixing machines.
Arenco-Alite Ltd.

Moisture expellers.
Richard Simon & Sons Ltd.

Molasses addition plants for beet pulp.
Buckau-Wolf Maschinenfabrik A.G.
Amandus Kahl Nachf.

Molasses tanks.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Honiron.
Kingston Industrial Works Ltd.
Krupp Stahlexport G.m.b.H.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.
The Taylor Rustless Fittings Co. Ltd.

Packeting machinery.
Brecknell, Dolman & Rogers Ltd.
Fr. Hesser Maschinenfabrik A.G.
SIG Swiss Industrial Company.

Packeting machinery for individual sachets.
SIG Swiss Industrial Company.

Palletizers.
Carl Drohmann G.m.b.H.

Pan boiling aids.
Fabcon Inc.
Hodag Chemical Corporation.

Pans, Vacuum.
A.P.V. Co. Ltd.
Babcock Atlantique.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
John Dore & Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Taylor Rustless Fittings Co. Ltd.

Parcelling machines.
Carl Drohmann G.m.b.H.
Fr. Hesser Maschinenfabrik A.G.
SIG Swiss Industrial Company.

Pelleting presses for bagasse and pith.
Amandus Kahl Nachf.
Simon-Barron Ltd.

Pelleting presses for dried pulp.
Buhler Brothers Ltd.
Amandus Kahl Nachf.
Simon-Barron Ltd.
Richard Sizer Ltd.

Perforated metals.
Associated Perforators & Weavers Ltd.
Ferguson Perforating & Wire Co.
N. Greening (Warrington) Ltd.
Krieg & Zivy Industries.
Charles Mundt & Sons.
J. & F. Pool Ltd.

Pipe fittings.
see Tube fittings

Pipes, Non-ferrous.
Birmingham Battery Tube Company.
Yorkshire Imperial Metals Ltd.

Pipework installation.
Blundell & Crompton Ltd.

Polythene bag sealers.
The Thames Packaging Equipment Co.

Power actuators.
The Lunkenheimer Company.

Power plants.
W. H. Allen, Sons & Co. Ltd.
ASEA.
General Electric Company of U.S.A.
Stork-Werkspoor Sugar N.V.

Power transmission equipment.
W. H. Allen, Sons & Co. Ltd.
ASEA.
Thomas Broadbent & Sons Ltd.
David Brown Gear Industries Ltd.
Ewart Chainbelt Co. Ltd.
The Falk Corporation.
Farrel Company.
Renold Limited.
Henry Simon Ltd.

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

Pressure gauges.
The British Rototherm Co. Ltd.
Hartmann & Braun A.G.
Honeywell Ltd.
K.D.G. Instruments Ltd.
Negretti & Zambra Ltd.
G. H. Zeal Ltd.

Pressure vessels.
N.V. "Ama" Niagara Filters.
A.P.V. Co. Ltd.
Babcock Atlantique.
Babcock & Wilcox (Operations) Ltd.
W. P. Butterfield (Engineers) Ltd.
John Dore & Co. Ltd.
T. Giusti & Son Ltd.
Metal Propellers Ltd.
St. Mary Iron Works Inc.
S.E.U.M.
Stork-Werkspoor Sugar N.V.
The Taylor Rustless Fittings Co. Ltd.
Thibodaux Boiler Works Inc.

Printing machinery—Rotary multicolour for sugar cartons and bags, etc.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.

Process computers.
General Electric Company of U.S.A.
Siemens A.G., Wernerwerk für Messtechnik.

Pulley blocks.
Wheway-Watson Ltd.

Pulp screens.
Associated Perforators & Weavers Ltd.

Pulverizers, Sugar.
Gruendler Crusher & Pulverizer Co.
Henry Simon Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Pumps.
Dorr-Oliver Inc., Cane Sugar Division.
Fletcher and Stewart Ltd.
The Harland Engineering Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.

Centrifugal pumps.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
A.P.V. Co. Ltd.
A.P.V.-Kestner Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Peter Brotherhood Ltd.
Etablissements F. Moret.
Saunders Valve Co. Ltd.
Schabaver.
Simonacco Ltd.
Stothert & Pitt Ltd.

Corrosion-proof pumps.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
A.P.V. Co. Ltd.
A.P.V.-Kestner Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Mono Pumps Ltd.
Simonacco Ltd.
Stothert & Pitt Ltd.

Dosing pumps.
BMA Braunschweigische Maschinenbauanstalt.
Fabcon Inc.
The Permutit Co. Ltd.

Filtrate pumps.
A.P.V.-Kestner Ltd.
BMA Braunschweigische Maschinenbauanstalt.
The Eimco Corporation.
Mono Pumps Ltd.
Etablissements F. Moret
Simonacco Ltd.
Stothert & Pitt Ltd.

Irrigation pumps.
Allen Gwynnes Pumps Ltd.
Farrow & Sons Ltd.
Saunders Valve Co. Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Massecuite pumps.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buckau Wolf New India Engineering Works Ltd.
Soc. Fives-Lille-Cail.
A. & W. Smith & Co. Ltd.
Stothert & Pitt Ltd.

Membrane pumps.
The Eimco Corporation.
Saunders Valve Co. Ltd.

Molasses pumps.
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau Wolf New India Engineering Works Ltd.
Amandus Kahl Nachf.
Mono Pumps Ltd.
Etablissements F. Moret.
Stothert & Pitt Ltd.

Positive-action pumps.
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Mono Pumps Ltd.
Stothert & Pitt Ltd.

Process pumps.
Enzinger Division, The Duriron Co. Inc.

Rotary pumps.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
BMA Braunschweigische Maschinenbauanstalt.
The Eimco Corporation.
Mono Pumps Ltd.
Etablissements F. Moret.
Stothert & Pitt Ltd.

Self-priming pumps.
The Albany Engineering Co. Ltd.
The Eimco Corporation.
Flexible Drives (Gilmans) Ltd.
Mono Pumps Ltd.
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I. V. Pressure Controllers Ltd.
Saunders Valve Co. Ltd.
Serck Jamesbury Ltd.
Triangle Valve Co. Ltd.
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Butterfly valves, Resilient seated.
I.V. Pressure Controllers Ltd.
Saunders Valve Co. Ltd.

Corrosion-resistant valves.
Enzinger Division, The Duriron Co. Inc.

Diaphragm valves.
Negretti & Zambra Ltd.
Saunders Valve Co. Ltd.

Diverter valves.
The Tills Engineering Co. Ltd.

Relief valves.
Blundell & Crompton Ltd.
I.V. Pressure Controllers Ltd.

Rotary valves.
The Tills Engineering Co. Ltd.

Stainless steel valves.
I.V. Pressure Controllers Ltd.
Saunders Valve Co Ltd.

Steam reducing valves.
I. V. Pressure Controllers Ltd.

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Dewrance & Co. Ltd.

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ASEA.
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Haver & Boecker.
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Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
see also Juice scales.

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Begg, Cousland & Co. Ltd.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
N. Greening (Warrington) Ltd.
The Kleen-e-ze Brush Co. Ltd.

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N.V. "Ama" Niagara Filters.
Associated Perforators & Weavers Ltd.
Begg, Cousland & Co. Ltd.
Endecotts (Test Sieves) Ltd.
Ferguson Perforating & Wire Company.
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Sankey Green Wire Weaving Co. Ltd.
Wire Weaving Co. Ltd.

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Associated Perforators & Weavers Ltd.

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Thames Packaging Equipment Co.

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Begg, Cousland & Co. Ltd.
Endecotts (Test Sieves) Ltd.
N. Greening (Warrington) Ltd.
Sankey Green Wire Weaving Co. Ltd.

Wrapping machines.
Fr. Hesser Maschinenfabrik A.G.
SAPAL.
SIG Swiss Industrial Company.

Yeast plants.
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
S.P.E.I. Chim.

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Adequate Weighers Ltd.,
Bridge Road, Sutton, Surrey, England.
Tel.: 01-642 6666/8. *Cable:* Adegrate, London.

The Albany Engineering Co. Ltd.,
Church Road, Lydney, Glos., England.
Tel.: Lydney 2275/2276/2277. *Cable:* Bolthead, Lydney.

Aldersley Engineers Ltd.,
Albion Road, West Bromwich, Staffs., England.
Tel.: 021-553 3091. *Cable:* Ubique, West Bromwich.

Alfa-Laval AB.,
Tumba, Sweden.
Tel.: 0753/31100. *Cable:* Alfalaval, Tumba.
Telex: 10260, 10261.

Allen Gwynnes Pumps Ltd.,
Queens Engineering Works, Bedford, England
Tel.: Bedford 67400. *Cable:* Pump, Bedford, Telex.
Telex: 82100.

W. H. Allen, Sons & Co. Ltd.,
Queens Engineering Works, Bedford, England.
Tel.: Bedford 67400. *Cable:* Pump, Bedford, Telex.
Telex: 82100.

N.V. "Ama" Niagara Filters,
Kwakelkade 28, Alkmaar, Holland.
Tel.: 02200-18923. *Cable:* Niagara, Alkmaar.
Telex: 31791.

Anacon Inc.,
62 Union St., Ashland, Mass., 01721 U.S.A.
Tel.: (617) 881-3000.

The A.P.V. Co. Ltd.,
Manor Royal, Crawley, Sussex, 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: Kestner, Grnhe 896356.

Arenco-Alite Ltd.,
Pixmore Avenue, Letchworth, Herts., England.
Tel.: Letchworth 3965-9. *Cable:* Aral, Letchworth.
Telex: 82368.

von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke,
605 Offenbach/Main, Germany.
Tel.: 832054. *Cable:* Kondenstopf, Offenbachmain.
Telex: 4152899 shof.

ASEA,
Västeras, Sweden.
Tel.: 021/110000. *Cable:* Asea, Vasteras.
Telex: 4720.

Ashworth Ross & Co. Ltd.,
Scout Hill, Dewsbury, Yorkshire, England.
Tel.: 0924-2-5642. *Cable:* Duros, Dewsbury.

Associated Perforators & Weavers Ltd.,
Perforating Division, Woolwich Road, London S.E.7., England.
Tel.: 01-858 6401.
Telex: 896648.

Soc. Sucrière de l'Atlantique (Engineering),
18 Avenue Matignon, Paris 8ème, France.
Tel.: 225-60-51/359-22-94. *Cable:* Sucatlan, Paris.
Telex: 20.602 Jilion.

Atlas Chemical Industries Inc.,
Wilmington, Delaware, 19899 U.S.A.
Tel.: (302) OL8-9311. *Cable:* Atchem, Wilmington.
TWX: 762-2355.

Atlas Chemical Industries S.A.,
15 Rue Blanche, Brussels 5, Belgium.

Atlas Chemical Industries, Canada, Ltd.,
P.O. Box 1085, Brantford, Ontario, Canada.

Atlas Chemical Interamerica Inc.,
420 South Dixie Highway, Coral Gables, Florida, 33133 U.S.A.

Babcock Atlantique,
48 Rue la Boétie, Paris 8e (75), France.
Tel.: 256.68.00. *Cable:* Babcock, Paris.
Telex: 29 027.

Babcock & Wilcox (Operations) Ltd.,
Babcock House, 209 Euston Road, London N.W.1., England.
Tel.: 01-387 4321. *Cable:* Babcock, London N.W.1.
Telex: 23256, 23257.

Bagshawe & Co. Ltd.,
Church Street, Dunstable, Beds., England.
Tel.: Dunstable 64302-5.
Telex: 81287.

William Bain & Co. Ltd.,
80 Ebury St., Westminster, London S.W.1., England
Tel.: 01-730 2219. *Cable:* Lochrin, London.

Balco-Filtertechnik G.m.b.H.,
Elektro-Chemische Fabrik, 33 Braunschweig, Am Alten Bahnhof 5, Germany.
Tel.: 26518. *Cable:* Balco, Braunschweig.
Telex: 0952509.

Begg, Cousland & Co. Ltd.,
Springfield Wire Works, 636 Springfield Rd., Glasgow S.E., Scotland.
Tel.: 041-554 1017.
Telex: 77445.

Bellingham & Stanley Ltd.,
61 Markfield Rd., London N.15., England.
Tel.: 01-808 2675. *Cable:* Polyfract, London, N.15.
Telex: 23784.

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, E.14, England.
Tel.: 01-987 6001/3838. *Cable:* Blundell, London, E.14.

BMA Braunschweigische Maschinenbauanstalt,
(33) Braunschweig, Bahnhofstrasse 5, Germany.
Tel.: Braunschweig 20111 and 23691.
Cable: Bema, Braunschweig.
Telex: Bema Bswg. 0952840.

William Boby & Co. Ltd.,
23 High Street, Rickmansworth, Hertfordshire, England.
Tel.: Rickmansworth 76363. *Cable:* Boby, Ricmanswth.
Telex: 24193.

Bosco S.p.A. Officine Meccaniche e Fonderie,
Piazzale Antonio Bosco N.3, Terni, Italy.
Tel.: 55341. *Cable:* Bosco, Terni.
Telex: 66032 Boscoter.

F. W. Brackett & Co. Ltd.,
Hythe, Colchester, Essex, England.
Tel.: Colchester 73958. *Cable:* Brackett, Colchester.

Brecknell, Dolman & Rogers Ltd.,
Pennywell Road, Bristol BS5 0TL, England.
Tel.: Bristol 558222. *Cable:* Bremaners, Bristol.
Telex: 44871 Answer Back Code Bremanners Bstl.

Brimag Ltd.,
Palladium House, Sansome Road, Shirley, Solihull, Warwickshire, England.
Tel.: 021-744 4504.

British Charcoals & Macdonalds Ltd.,
21 Dellingburn St., Greenock, Scotland.
Tel.: 20273. *Cable:* Brimac, Greenock.

The British Rototherm Co. Ltd.,
Merton Abbey, London S.W.19, England.
Tel.: 01-542 7661. *Cable:* Rototherm, London S.W.19.
Telex: 262355.

Thomas Broadbent & Sons Ltd.,
Central Ironworks, Huddersfield, Yorkshire, England.
Tel.: Huddersfield 22111. *Cable:* Broadbent, Huddersfield.
Telex: 51515.

Peter Brotherhood Ltd.,
Peterborough, Northants., England.
Tel.: 71321. *Cable:* Brotherhood, Peterborough.
Telex: 32154 Brotherhd Pboro.

David Brown Gear Industries Ltd.,
Park Gear Works, Huddersfield HD4 5DD, Yorks., England.
Tel.: Huddersfield 22180. *Cable:* Gearing, Huddersfield.
Telex: 51562 and 51563.

Buckau-Wolf Maschinenfabrik A.G.,
D4048 Grevenbroich, Postfach 69, Germany.
Tel.: 02181/421. *Cable:* Buckauwolf, Grevenbroich.
Telex: 08 517 111.

Buckau Wolf New India Engineering Works Ltd.,
see Protos Engineering Co. Private Ltd.

Buell Ltd.,
George Street Parade, Birmingham 3, England.
Tel.: 021-236 5391. *Cable:* Buellon, Birmingham.
Telex: 338458.

Buhler Brothers Ltd.,
Engineering Works, 9240 Uzwil, Switzerland.
Tel.: (073) 5 01 11. *Cable:* Buhler, Uzwil.
Telex: 7 75 41.

W. P. Butterfield (Engineers) Ltd.,
P.O. Box 38, Shipley, Yorkshire, England.
Tel.: Shipley 52244. *Cable:* Tanks, Shipley.
Telex: 51583.

Butters Cranes Ltd.,
The Crane Works, Station Approach, Long Lane, Hillingdon, Middlesex, England.
Tel.: Uxbridge 37271.
Telex: 24301.

Cape Insulation Ltd.,
Kerse Road, Stirling, Scotland.
Tel.: 0786 2063. *Cable:* Incorrupt, Stirling.
Telex: 77228.

John R. Carmichael Ltd.,
Kenmore Works, Broad Lane, Liverpool, L11 1AE, England.
Tel.: 051-226 1336/7. *Cable:* Filclo, Liverpool.

C.E.C.A.,
24 Rue Murillo, Paris 8e, France.
Tel.: Carnot 82-00. *Cable:* Ceca, Paris.

Cellulose Development Corporation Ltd.,
Villiers House, 41-47 Strand, London W.C.2, England.
Tel.: 01-839 5805. *Cable:* Celdecor, London, Telex.
Telex: 28444.

C F & I Engineers Inc., (*formerly Silver Engineering Works Inc.*)
3309 Blake Street, Denver, Colo., 80205 U.S.A.
Tel.: (303) 623-0211. *Cable:* Silver, Denvercolo.
Telex: 045-567 Silverengr Dvr.

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.: (051) 73 91 01. *Cable:* Servochemie, Männedorf.
Telex: 75 508.

George Cohen Machinery Ltd.,
600 Wood Lane, London W.12, England.
Tel.: 01-743 2070. *Cable:* Omniplant, London W.12.
Telex: 21288/9.

Collectron (Sales) Ltd.,
5 Greenhills Road, Charlton Kings, Cheltenham, Gloucestershire, GL53 9ED, England.
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Cooper, Pegler & Co. Ltd.,
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Crown Works, Portland Rd., Longton, Stoke-on-Trent, Staffs., England.
Tel.: 0782-33021. *Cable:* Cotbro, Stoke-on-Trent.

A. F. Craig & Co. Ltd.,
Caledonia Engineering Works, Paisley, Scotland.
Tel.: Paisley 2191. *Cable:* Craig, Paisley.
Telex: 778051.

Crone & Taylor (Engineering) Ltd.,
Sutton Oak, St. Helens, Lancs., England.
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Telex: 627110 Chamcom Liverpool.

A/S De Danske Sukkerfabrikker,
(The Danish Sugar Corporation),
Langebrogade 5, Copenhagen K, Denmark.
Tel.: ASTA 6130. *Cable:* Sukkerfabrikker, Copenhagen.
Telex: 5530 Sukker KH.

Defibrator AB.,
Box 270 73, S-102 51 Stockholm 27, Sweden.
Tel.: 08/23 04 40. *Cable:* Defibrator, Stockholm.
Telex: 19026 Defiber.

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901–935 Glasgow Avenue, Fort Wayne, Ind., 46801 U.S.A.
Tel.: 742-7213. *Cable:* Retsied, Fort Wayne.

Dewrance & Co. Ltd.,
Trevithick Works, P.O. Box 108, Skelmersdale, Lancs., England.
Tel.: Tawd Vale 3511.
Telex: 627039.

Diamond Shamrock Chemical Company, Resinous Products Division,
P.O. Box 829, 1901 Spring Street, Redwood City. Calif., 94064 U.S.A.
Tel.: (415) 369–0071. *Cable:* Daco-West, Redwood City.

Dicalite/GREFCO Inc., International Division,
630 Shatto Place, Los Angeles, California. 90005 U.S.A.
Tel.: (213) DUnkirk 1-5081. *Cable:* Dicalite, Losa.
Telex: 67-4224.

John Dore & Co. Ltd.,
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Dorr-Oliver Inc., Cane Sugar Division,
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Telex: 965912.

Dreibholz & Floering Ltd.,
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Telex: 97357.

Carl Drohmann G.m.b.H.,
Remscheider Str. 3–5, Postfach 360, 7 Stuttgart-Bad Canstatt. Germany.
Tel.: 54 11 06. *Cable:* Drohmannpacker, Stuttgart-Bad Canstatt.
Telex: 072 2886.

Dust Control Equipment Ltd.,
Thurmaston, Leicester LE4 8HP, England.
Tel.: Syston 3333. *Cable:* Dust, Leicester.
Telex: 34500.

Maschinenfabrik H. Eberhardt,
3340 Wolfenbüttel, Frankfurterstr. 14/17, P.O. Box 266, Germany.
Tel.: 22002 and 3263. *Cable:* Eberhardt, Wolfenbüttel.
Telex: 09 52620 ebhdt d.

Edwards Engineering Corp.,
1170 Constance Street, New Orleans, La., 70130 U.S.A.
Tel.: 524–0175. *Cable:* Joedco, New Orleans.
Telex: 058-342.

The Eimco Corporation,
P.O. Box 300, Salt Lake City 10, Utah, U.S.A.,
Tel.: (801) 328-8831. *Cable:* Eimco, Salt Lake City.
Telex: 2066-0388446.

Eimco (Great Britain) Ltd.,
Process Machinery Division, Station Rd., St. Neots, Hunts., England.
Tel.: St. Neots 3461. *Cable:* Eimfilt, St. Neots. *Telex:* 32111.

Eimco Industriale S.p.A.,
Strada Cerca, 20067 Tribiano (Milano), Italy.
Tel.: 9064. 234/5/6/7. *Cable:* Eimcoit, Milano. *Telex:* 2023-32606.

Electromagnets Ltd.,
Boxmag Works, Bond Street, Hockley, Birmingham 19, England.
Tel.: 021-236 9071. *Cable:* Boxmag, Birmingham. *Telex:* Chamcom, Birmingham 338024, Electromags.

Endecotts (Test Sieves) Ltd.,
Lombard Road, London S.W.19, England.
Tel.: Liberty 8121/2/3. *Cable:* Endtesiv, London S.W.19.

Enzinger Division, The Duriron Co. Inc.,
P.O. Box 71, 9542 Hardpan Rd., Angola, N.Y., 14006 U.S.A.
Tel.: (716) 549-2500. *Cable:* 091 301. *Telex:* 091 301.

Escher Wyss Ltd.,
Case Postale–Gare Centrale, 8023 Zurich, Switzerland.
Tel.: 444451. *Cable:* Escherwyss, Zurich. *Telex:* 53906/7/8.

Ewart Chainbelt Co. Ltd.,
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Extraction De Smet S.A.,
265 Ave. Prince Baudouin, Edegem-Antwerp, Belgium.
Tel.: (03) 49.42.40. *Cable:* Extraxsmet, Antwerp. *Telex:* 31824.

Fabcon Inc.,
314 Public Square Building, Cleveland, Ohio, 44113 U.S.A.
Tel.: (216) 621-2344. *Cable:* Fabcon, Cleveland.

The Falk Corporation,
P.O. Box 492, Milwaukee, Wis., 53201 U.S.A.
Tel.: 342-3131. *Cable:* Falk, Milwaukee. *Telex:* 026-722.

Farnell Carbons,
Division of Forestal Industries (U.K.) Ltd.,
The Adelphi, John Adam St., London W.C.2, England.
Tel.: 01–930 6777. *Cable:* Scofar, London W.C.2. *Telex:* 22817/22818.

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Division of USM Corporation,
Ansonia, Conn., U.S.A.
Tel.: 734–3331. *Cable:* Farrelmach, Ansonia.

Farrow & Sons Ltd.,
Welland Road, Off London Road, Spalding, Lincs., England.
Tel.: Spalding 3764. *Cable:* Farrow, Spalding.

Ferguson Perforating & Wire Co.,
134–140 Ernest Street, Providence, R.I., U.S.A.
Tel.: Williams 1–8876. *Cable:* Ferguson, Providence.

Film Cooling Towers (1925) Ltd.,
Chancery House, Parkshot, Richmond, Surrey, England.
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Fischer & Porter Ltd.,
Eagle Star House, Elmgrove Rd., Harrow, Middx., England.
Tel.: Harrow 6466. *Cable:* Flowrator, Harrow. *Telex:* 262478.

Société Fives Lille–Cail,
7 Rue Montalivet, 75 Paris 8e, France.
Tel.: 265.22.01. *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, England.
Tel.: Warwick 44331/5. *Cable:* Skatoskalo, Warwick. *Telex:* 31451.

Flexotube (Liverpool) Ltd.,
25 Hope Street, Liverpool 1, Lancs., England.
Tel.: 051–ROY 3345. *Cable:* Flexotube, Liverpool.

Fluostatic Ltd.,
Borough Green, Kent, England.
Tel.: Borough Green 2806. *Cable:* Fluostatic, Sevenoaks. *Telex:* 95251.

Fontaine & Co. G.m.b.H.,
51 Aachen, Grüner Weg 31, Germany.
Tel.: 31340. *Cable:* Fontaineco, Aachen. *Telex:* 832558 fonte d.

Foster Wheeler John Brown Boilers Ltd.,
3 Ixworth Place, London S.W.3, England.
Tel.: 01–589 6363. *Cable:* Rewopsteam, London. *Telex:* 23945.

John Fowler & Co. (Leeds) Ltd.,
Leathley Road, Leeds 10, Yorkshire, England.
Tel.: Leeds 30731. *Telex:* 55461.

General Electric Company of U.S.A.,
159 Madison Ave., New York, N.Y., 10016 U.S.A.
Tel.: PL1-1311. *Cable:* Ingeco, New York. *Telex:* 62845 Western Union.

Girling Ltd.,
Industrial Products Group, Grange Rd., Cwmbran, Mon. NP4 3XU, South Wales.
Tel.: Cwmbran 2022. *Cable:* Wonder, Cwmbran. *Telex:* 49205.

T. Giusti & Son Ltd.,
202–224 York Way, Kings Cross, London N.7, England.
Tel.: 01-607 5021–5. *Cable:* Giustison, London N.7.

Goka N.V. Machine Works,
Postbus 3530, Koestraat 2a, Amsterdam C, Holland.
Tel.: Amsterdam 222255/6. *Cable:* Kagodam, Amsterdam. *Telex:* 14173.

Goring Kerr Ltd.,
Hanover Way, Windsor, Berks., England.
Tel.: Windsor 63211. *Cable:* Metlokate, Windsor.

E. Green & Son Ltd.,
Calder Vale Road, Wakefield, Yorkshire, England.
Tel.: Wakefield 71171. *Cable:* Economiser, Wakefield. *Telex:* 55452.

J. Barcham Green Ltd.,
Hayle Mill, Tovil, Maidstone, Kent, England.
Tel.: 0622-52040/56852. *Cable:* Green, Tovil, Maidstone.

N. Greening (Warrington) Ltd.,
Britannia Works, Warrington, Lancs., England.
Tel.: Warrington 32401. *Cable:* Greenings, Warrington, Telex. *Telex:* 62195.

Gruendler Crusher & Pulverizer Co.,
2915 North Market Street, St. Louis, Mo., 63106 U.S.A.
Tel.: Jefferson 1–1220. *Cable:* Grupulco, St. Louis. *Telex:* 44–7415.

The Harland Engineering Co. Ltd.,
Harland House, 20 Park Street, London W1Y 4BD, England.
Tel.: 01-499 1221/3. *Cable:* Rheometric, London, Telex. *Telex:* 22881.

Hartmann & Braun A.G., Mess- und Regeltechnik,
6000 Frankfurt 90, Postfach 900507, Germany.
Tel.: 7991. *Cable:* Hartmannbraun, Frankfurtmain.
Telex: 4-14071 hbfm d.

Haver & Boecker,
4740 Oelde/Westfalen, Postfach 163, Germany.
Tel.: (02522) 301. *Cable:* Haboe, Oelde.
Telex: 8921571.

Hein, Lehmann & Co. A.G.,
P.O. Box 4109, Fichtenstr. 75, 4000 Düsseldorf, Germany.
Tel.: 780201. *Cable:* Eisenbau, Dusseldorf.
Telex: 8582740.

John M. Henderson & Co. Ltd.,
P.O. Box 26, King's Works, Aberdeen AB9 8BU, Scotland.
Tel.: Aberdeen 24262. *Cable:* Cranes, Aberdeen.
Telex: 73109.

C. A. Hendley & Co.,
Victoria Road, Buckhurst Hill, Essex, England.
Tel.: 01–504 6899.

Fr. Hesser Maschinenfabrik A.G.
7 Stuttgart-Bad Cannstatt, Nauheimerstr. 99, Germany.
Tel.: Stuttgart 566 141. *Cable:* Hesser, Stuttgart-Bad Cannstatt.
Telex: 072-2362.

Samuel Hill Ltd.,
Balderstone Mill, Oldham Rd., Rochdale, Lancashire, England.
Tel.: Rochdale 46748/9. *Cable:* Filtering, Rochdale.

Hodag Chemical Corporation,
7247 North Central Park Avenue, Skokie, Ill., 60076 U.S.A.
Tel.: Orchard 5–3950. *Cable:* Hodag, Skokieill.

Honeywell Ltd.,
Great West Rd., Brentford, Middlesex, England.
Tel.: 01-568 9191. *Cable:* Honeywell, Hounslow, Telex.
Telex: 22765.

Honeywill-Atlas Ltd.,
Mill Lane, Carshalton, Surrey, England.
Tel.: Franklin 2261/2/3/4.

Honiron,
Division of Ward Foods Inc.,
475 Fifth Avenue, New York, N.Y., 10017 U.S.A.
Cable: Honiron, New York.

Robert Hudson (Raletrux) Ltd.,
Raletrux Works, P.O. Box 4, Morley, Leeds, England.
Tel.: Morley 4931. *Cable:* Raletrux, Leeds.
Telex: 55133 Leeds.

IMACTI Industrieele Maatschappij Activit N.V.,
Postbus 240c, Amsterdam, Holland.
Tel.: 60153, 60821. *Cable:* Activit, Amsterdam.
Telex: 11652 Ion exchange.

Industrial Magnets Ltd.,
Station Road, Acocks Green, Birmingham 27, England.
Tel.: 021–706 0706. *Cable:* Indmag, Birmingham.

Ingeniörsfirman Nils Weibull A.B.,
see Weibull.

Instrumentenfabriek Venema,
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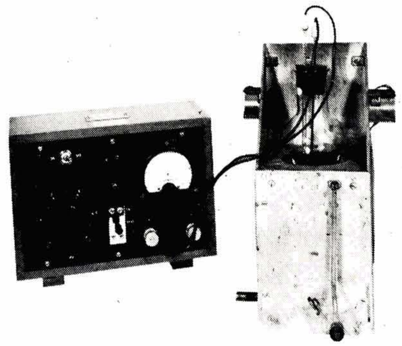

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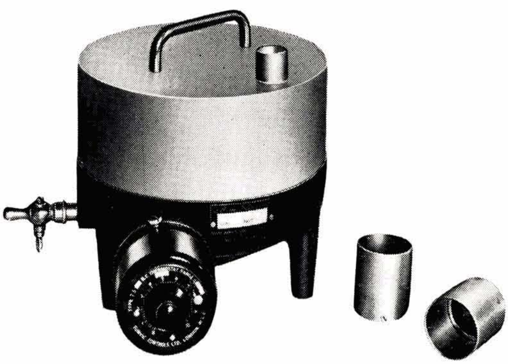

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PRINTED IN GREAT BRITAIN