THE INTERNATIONAL SUGAR JOURNAL

A TECHNICAL AND COMMERCIAL PERIODICAL
DEVOTED ENTIRELY TO THE SUGAR INDUSTRY

EDITED BY:
D. LEIGHTON, B.Sc., F.R.I.C.
M. G. COPE, A.I.L.(*Rus.*)

JANUARY TO DECEMBER

1964

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PANEL OF REFEREES

ERRATA AND CORRIGENDA

Page 20. Line 2 of column 1. After "153–161" insert ", 191–197".
Page 56. Line 21 of column 2. Read "evaporator" for "exaporator".
Page 101. Line 16 of column 2. Read "Southern Rhodesia" for "Swaziland".
Page 121. Line 8 from bottom of column 2. Read "22–29" for "1–6".
Page 128. Line 17 from bottom of column 2. Read "BARANY" for "BARAN".
Page 216. Line 15 of column 1. Read "KALRA" for "KABRA".
Page 240. Line 15 from bottom of column 2. Read "TROJNA" for "TRONJA".
Page 297. Line 3 of column 1. Read "P. MOJZIS" for "A. MOJZIS".

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VOL. 66 *January 1964* No. 781

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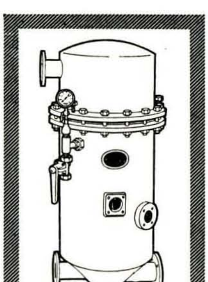

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Sugar Drying in Belgium

After supplying a Turbo Tray Dryer/Cooler with Predryer for White Sugar to the Raffinerie Tirlemontoise, we received the following letter from this well-known Company:—

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with and without Predryers for all Sugar Qualities

Screens and Bins

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Conveyors for Defecation Slurr,

Beet Top Preparation Plants

Induced Draft Fans and

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Mechanical Dust Collectors
of van Tongeren design

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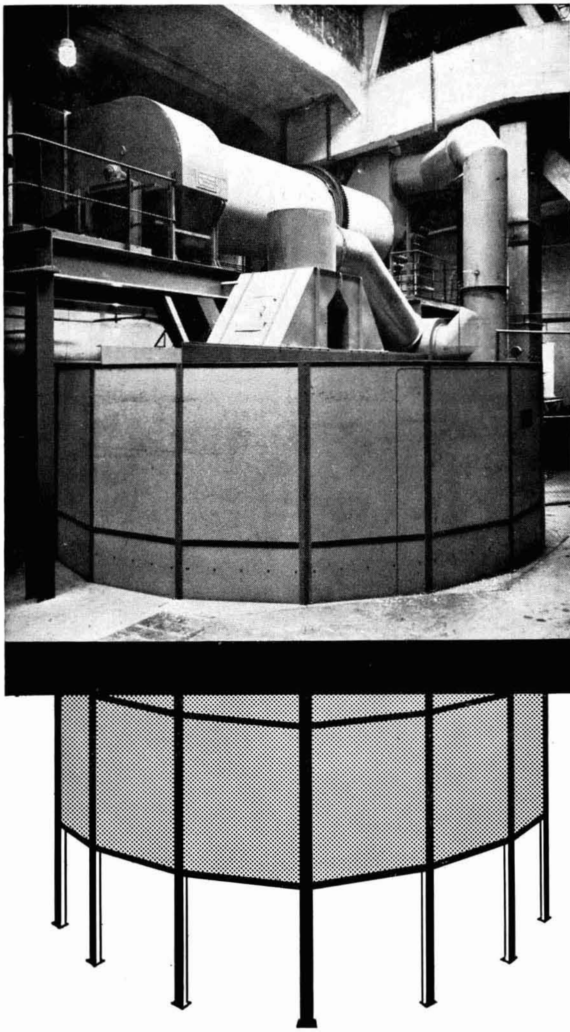

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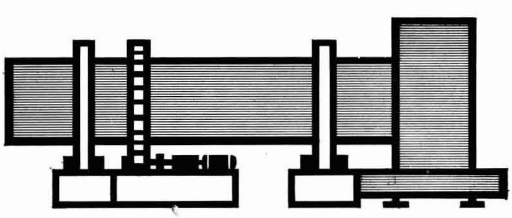
Fans, design Dr. Eck

Dust Collecting Plants, design van Tongeren



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NOTES AND COMMENTS

U.K. sugar beet acreage.

In a written reply to a question in Parliament, the Minister of Agriculture, Fisheries and Food announced that, in the light of recent developments in the world sugar situation, the acreage for which the British Sugar Corporation Ltd. might contract in 1964 would be increased by 20,000 acres in England and Wales and 750 acres in Scotland, which increase can be handled by existing factories. Whether the increased acreage can be continued in subsequent years will depend on developments in the world sugar situation.

About 85% of U.K. sugar supplies are assured either under the Commonwealth Sugar Agreement (at the "negotiated price") or by the production of beet sugar at home. The effect of the increase in the domestic acreage of sugar beet in 1964 is to substitute home-produced sugar for an equivalent tonnage of imported sugar at the current world price which is higher than the cost of domestic production and may remain high for some time.

The Corporation advised its beet suppliers to apply for their requirements of increased acreage and these applications were quickly made. Demand was heavier in England than in Scotland and the Minister has told the Corporation that if their best endeavours do not result in the absorption of the allocation of 750 acres to Scotland, any balance may be transferred to England and Wales.

* * *

Commonwealth Sugar Agreement.

The Ministry of Agriculture, Fisheries and Food, announced on the 28th November that the series of meetings between the parties to the Commonwealth Sugar Agreement which began on the 4th November had been concluded. Discussions had taken place on the price to be paid for the 1964 "negotiated price" sugar bought by the United Kingdom under the terms of the Agreement and on other matters arising under the Agreement.

It was agreed that the price paid for negotiated price sugar in 1964 will be £46 0s 10d, the same as in 1963. The agreement to hold the price at the same level was reached in view of the decision made in 1962 that the review of the price-fixing arrangements should be postponed from 1963 until 1964, and after full discussion between the Ministry and the Commonwealth Sugar Exporters of all the relevant considerations.

The parties to the Agreement have reviewed the level of the "negotiated price" quotas in accordance with Article 15 of the Agreement and the Exporters have noted the decision of the British Government to increase the permitted acreage for sugar beet in Great Britain in 1964 (see above). The Ministry offered to fix 1964 "negotiated price" quotas at 10% above basic (an increase of 5% over the 1963 level), and proposed that in subsequent years, so long as the increase in U.K. beet acreage continues, the quotas should be 5% above the level as calculated in the ordinary way under the provisions of the Agreement. This offer was accepted by the Exporters. The quotas for individual territories for 1964 will be as follows:

Australia	330,000	long tons
British Honduras	19,800	,, ,,
East Africa	5,500	,, ,,
Fiji	132,000	,, ,,
Mauritius	368,500	,, ,,
The West Indies and British Guiana	704,000	,, ,,
	1,559,800	,, ,,

The Agreement has been extended for a further year and will now run to the end of 1971.

* * *

South African sugar expansion[1].

Work has started on clearing the site at Amatikulu in Zululand, where a new sugar mill for Sir. J. L. Hulett & Sons Ltd. is to be erected. The new mill will cost £3,500,000 and will be one of the most modern in the world. It is hoped that it will be completed and in production by the early part of the 1965/66 season. Construction of the mill is part of a £4,250,000 expansion programme by the Company to provide the necessary capacity to meet increased cane supplies from full production on existing registered quota land. The programme includes expansion of the Company's

[1] *S. African Sugar J.*, 1963, **47**, 729.

factories at Darnall, Felixton and Empangeni, increasing their milling capacities and improving the quality of the raw sugar produced. Wherever possible, equipment required for the expansion programme will be obtained from South African sources.

* * *

U.K. Sugar Board distribution payments.

From the 28th November the Sugar Board's distribution payments on sugar were reduced from 46s 8d to 32s 8d per cwt of refined sugar (from 5d to 3½d per lb) while a further reduction to 28s 0d per cwt (3d per lb) took effect on 17th December. This made the thirteenth change in surcharge and distribution payment during 1963, a reflection of the instability of the world market in the year.

* * *

Queensland sugar inquiry report.

The report of the Committee of Inquiry[1] appointed by the Queensland Government last year was issued recently. The Committee unanimously considered that the Australian sugar industry should aim to produce 2,200,000 tons of actual raw sugar in 1965/66, increasing to 2,500,000 tons in 1970/71; current production is about 1,800,000 tons. Mill peaks should be increased to a total of 1,900,000 tons 94 n.t. sugar in 1965/66, rising to 2,130,000 tons in 1967/68, and to 2,430,000 in 1970/71. To guard against unfavourable seasonal conditions the total of mill peaks should be maintained at 15% more than the tonnage required for home consumption plus firm contractual commitments.

For payment purposes, sugar acquired within mill peaks should form two pools with different prices, one pool including the sugar required for home consumption and sold at stable prices, and the other including most of the sugar sold at world prices. To provide the increased production, 150,407 acres of new land should be assigned, of which 64,000 acres should go to about 1000 new growers. Clare, Millaroo and Dalbeg lands should be assigned to Invicta mill, but no new mills should be established at present. Preference should be given to small growers in increases of assignments.

* * *

Indian steps to safeguard factory cane supplies.

In a statement made by the Union Minister of Food and Agriculture in September 1963, he laid emphasis on the need to ensure adequate supplies of cane to sugar factories in order to achieve the desired production of 3,300,000 tons. New regulations to do this, at present delegated to the State Governments, give specific powers to reserve areas where cane is grown for factories and to require cane growers in the area to deliver a specified proportion of their production of cane to the sugar factory and for the factory in return to accept and crush the cane.

The regulations also provide for restriction of animal-drawn crushers not owned by cane growers, power crusher and khandsari units operating in the reserved areas. Units found operating without a valid licence are liable to seizure or being rendered inoperative, in addition to any other penalty which might be imposed. In addition, persons engaged in the production, manufacture, supply or distribution of cane, cane juice, sugar, gur, etc., may be required to maintain and produce for inspection such books, accounts and records as may be required relating to their business and to furnish any required information.

* * *

Philippines sugar production[2].

Milling of the 1962/63 cane crop in the Philippines was completed early in December with the record quantity of 1,713,905 short tons of sugar having been produced as compared with 1,618,396 tons in the previous season. Whilst the last mills were finishing operations for the 1962/63 crop others were opening up for the 1963/64 season and by 20th October eight factories had produced 42,584 tons of sugar. The preliminary estimate of production in 1963/64 is 1,970,214 short tons.

* * *

World raw sugar price.

After thirteen consecutive market days at the post-war record price of £105 per ton, the London Terminal Market price fell to £92·50 per ton following a sale to Tunisia at a low price. This price was again maintained, apart from a one-day drop to £91·50, until the 6th December when another sharp fall to £85·00 occurred. Almost immediately two successive increases brought the price to £87·50 at which it remains at the time of writing.

* * *

U.S. sugar requirements in 1964.

The Secretary of Agriculture announced early in December that U.S. sugar requirements had been put at 9,800,000 short tons for 1964, which compares with the total quota for 1963 of 10,400,000 tons. He stated that the need for imports to the U.S. would not be nearly so great as the 4,600,000 short tons imported in 1963 and would appear to be about 3,100,000 tons. He was suggesting a global quota of 1,000,000 tons in 1964, which compares with 1,725,658 tons in 1963.

Foreign Governments had advised the Department that in addition to the statutory quotas they could also supply substantially more than 1,500,000 tons global quota sugar.

The 130,000 tons of sugar allotted to the Dominican Republic as global quota sugar would be allowed to enter the U.S.A. but the Republic's basic quota of 192,152 tons would be held in abeyance pending settlement of the matter of the U.S. relations with the Republic.

[1] *I.S.J.*, 1963, **65**, 286.

[2] C. Czarnikow Ltd., *Sugar Review*, 1963, (639), 213.

ORGANIC MATTER AND SOIL FERTILITY

THIS subject is discussed in some detail in a recent paper[1] in which it is pointed out that the addition of organic matter to soils improves their fertility in at least two ways—(i) by releasing constituent nutrients, especially nitrogen, during decomposition and (ii) by improving the physical condition of the soil. It is pointed out that the relative importance of these two effects is not known for it has not been found possible, so far, to assess them, nor is it known with any degree of certainty what other significant effects organic matter has on soil fertility. There have been many claims, based on observation, that crops grown on soils supplied with large amounts of organic matter are more vigorous and healthy than crops grown on soils treated with equivalent amounts of inorganic nutrients in the form of fertilizers.

The question whether organic matter has additional effects on soil fertility has, in recent years, been approached by studying in isolation various factors which might be significant under soil conditions. MR. WHITEHEAD brings together much of this information which is discussed under three main headings, viz. (i) effects on the supply of available nutrients from sources other than the organic matter itself, (ii) effects on plant growth of various organic compounds occurring or likely to occur in the soil, and (iii) effects on the incidence of plant disease.

The nutrient elements are dealt with under the subheadings—nitrogen, phosphate, potassium, trace elements. The nutrients most likely to be affected by the presence of organic matter are phosphorus and the metallic trace elements. With regard to nitrogen the important rôle of *Rhizobium* nitrogen-fixing bacteria, dependent upon leguminous plants, is well known. Other nitrogen-fixing bacteria are free-living and depend upon soil organic matter for energy requirements. The extent to which nitrogen may be fixed in this matter is still very uncertain. It is usually considered to amount to less than 20 lb/acre/year but there is some evidence that it may amount to 60 lb. Many Russian agronomists feel that nitrogen-fixation by free-living bacteria is important and field inoculation with *Azotobacter* is widespread.

There is now evidence that the availability of phosphates in the soil is increased by the addition of organic matter, owing to the influence of organic acids on pH and their formation of stable complex or chelate compounds with the cations responsible for phosphate fixation.

With regard to potassium it is known that certain organisms (e.g. the fungus *Aspergillus niger*) can utilize potassium from unweathered rock, presumably through acid secretion; also that *Pseudomonas* organisms, isolated from soil, are capable of breaking down the crystal structure of various silicate minerals. Non-available soil potassium obtained by soil micro-organisms in this way increases the amount of available potassium on the death and decomposition of the organism itself. Yields of wheat planted in sterile soil were increased by 50–100% as a result of inoculation with *Bacterium siliceus* which attacks mineral silicates.

To what extent organic compounds in the soil may be absorbed by the root hairs of plants is very uncertain. It is known that plants can absorb quite large organic molecules, with molecular weights of the order of 200–500. Under natural conditions organic molecules may be obsorbed from the soil and so influence the plants' metabolism. The problem of elucidating whether soil organic compounds do affect growth is further complicated by the occurrence on plant root surfaces of rhizosphere micro-organisms able both to decompose and synthesize organic molecules.

It is now known that attack on some crop plants by eel-worms, as well as by certain fungi, may be reduced by the addition of organic matter to the soil. It has been shown that predaceous fungi, trapping and feeding upon eelworms, are extremely widespread in soils and that their numbers are increased by the addition or organic manures to the soil.

In summing up the main points of his paper the writer concludes as follows:—"The literature cited has indicated a number of possible ways in which organic compounds present in the soil may influence the growth of plants. There seems little doubt that various organic acids can increase the availability of insoluble forms of phosphate and some metallic trace elements, that IAA (indolyl acetic acid) at certain concentrations can stimulate root-hair production, that certain phenolic compounds can be absorbed by plant roots with consequent effects on metabolism, and that organic matter in general encourages the growth of saprophytic micro-organisms in the soil, thus reducing the population of certain pathogens. What is still uncertain in most cases is whether the content of these active compounds in the soil can be brought to significant levels by the application of organic manures, or whether inadequate production, further decomposition, or reaction with other soil constituents inevitably render them ineffective. The phenolic group of compounds is of particular interest in that some, e.g. salicylic acid, act as chelating agents, some, e.g. vanillic acid, have been reported as having both favourable and unfavourable effects on plant growth, and some are fungitoxic and may reduce the incidence of pathogen attack by acting in the soil or systemically in the plant. Although the significance of organic matter and of specific organic compounds for plants growing in both natural and cultivated soils clearly requires much further investigation, the circumstantial evidence for the possibilities described above meanwhile merits more general appreciation."

F. N. H.

[1] WHITEHEAD: *Soils and Fertilizers*, 1963, **26**, (4), 217–223.

GOLDEN JUBILEE AT COIMBATORE, INDIA

THE Coimbatore Sugarcane Breeding Institute, founded in 1912, celebrated its Golden Jubilee at the end of 1962. Accounts of the celebration have now appeared[1]. The Minister of Agriculture, Government of India (Dr. RAM SUBHAG SINGH), and the Minister of Agriculture for Madras State were present at Coimbatore for the occasion. The distribution of prizes for the All-India Sugar Cane Crop Competition for 1961–62 was held at the same time.

In his inaugural address Dr. RAM SUBHAG SINGH paid tribute to the fine work carried out by the Institute during the 50 years it has been in existence. He also stressed the fact that sugar is really made in the field and not the factory and that continuous research is needed to meet the needs of the cultivator and the industry. In referring to the growth of India's sugar industry he mentioned that the area under cane is now more than double what it was three decades ago and that there are now 170 sugar factories in the country as against 30 in 1932. The crop is grown in practically every state in India, under most varied climatic and soil conditions. This emphasizes the great need for breeding the best possible variety of sugar cane for any particular district or any given set of conditions. He wished the Institute continued success and even greater achievements in the future. Regarding yields he stated that yields of 60–70 tons of cane per acre are common in the cane competitions, while the All-India average is only 14.6 tons per acre. In many instances the limiting factor is the supply of adequate quantities of fertilizers and the provision of irrigation facilities.

In welcoming the Ministers and other visitors to the celebrations the President of the Indian Central Sugarcane Committee, Shri L. G. RAJWADI, dwelt upon the history of the Institute and its breeding of "Co" canes, which revolutionized the sugar industry of India, and have also been so useful in other cane growing countries. Tribute was paid to outstanding scientific workers or directors of the Institute such as Dr. C. A. BARBER, PADMA BHUSHAN, Dr. T. S. VENKATRAMAN and Shri N. L. DUTT.

It is of interest to recall that for some years after his retirement from India the late Dr. C. A. BARBER acted as botanical and agricultural editor of this journal, his wide knowledge and experience being put to very good use.

F.N.H.

A NEW METHOD OF WATERING AIRLAYERS IN SUGAR CANE BREEDING WORK

IN an article on "Production crossing and technical improvements in sugar cane breeding at Canal Point, Florida, 1961–1962 season" by P. H. DUNCKELMAN[2] an account is given of a new method of watering airlayers, described below. In the past four years the watering of 3000 airlayers in sugar cane field plots required the services of 3 labourers for 8 days. Valuable time and effort were spent on a variety of inefficient manual operations—untying strings at tops of airlayers, applying water from cans, retying strings, walking to refill water cans, and driving from field locations to water-spigots to refill 50-gallon drums.

In the fall of 1961 a more efficient method of watering airlayers was developed at Canal Point. This new method, the "injection" technique of watering, employs a 300-gallon-tank pump unit; it was put into use at the beginning of the air-layering period. The tractor-drawn unit is equipped with a self-priming centrifugal pump. Plumbing was modified to accommodate two hoses of any desired length. The hoses were fitted with pistol-grip water-control nozzles to which were welded quarter-inch brass pipes two inches long, with sharpened ends. These hypodermic-like "needles" are easily jabbed through the polyethylene film of the moss airlayers and into the moss. With finger-tip pressure on the trigger of the nozzle, water is injected under pump pressure into the air layer in seconds. An insignificant puncture is left in the film of the airlayer when the needle is withdrawn. With this technique, a tractor driver and two men handling hoses can now water 3000 air layers in two days.

This new injection system of watering airlayers has eliminated 75% of the labour and cost for a process essential to the efficient operation of the sugar cane breeding programme at Canal Point. It is fairly certain that the new method of watering airlayers will be used effectively at Canal Point in the future or as long as airlayering remains a standard procedure of the sugar cane breeding programme.

F.N.H.

[1] Sugarcane Breeding Institute, Coimbatore, celebrates Golden Jubilee. *Ind. J. Sugar Res. & Dev.*, 1962, **7**, (2), 73–75; Coimbatore Institute's Golden Jubilee. *Indian Sugar*, 1962, **12**, (9), 561–562.

[2] *Sugar J.* (La.), 1963, **25**, (10), 18–19.

Susceptibility of several Beta species to the sugar beet nematode (*Heterodera schachtii* **Schmidt).** A. E. STEELE and H. SAVITSKY. *Nematologica*, 1962, **8,** 242–243; through *Plant Breeding Abstracts*, 1963, **33,** (3), 441.—Six species were heavily infected but *Beta patellaris* was only slightly infected.

* * *

The health of the sugar beet crop in Great Britain. R. HULL. *J. Royal Agric. Soc.*, 1961, **122,** 101–112; through *Rev. Appl. Mycol.*, 1963, **42,** (7), 422. During the last twenty years sugar beet yield has increased from 8·98 to 13·7 tons per acre. This has been due, in part, to improved disease control, especially of the beet yellowing viruses (yellows and mild yellows), and other less important diseases such as seedling diseases, leaf diseases and especially downy mildew (*Peronospora schachtii* [*P. farinosa*), also violet root-rot (*Helicobasidium purpureum*). Rectifying boron and magnesium deficiencies has also played a part.

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Beet yellows. Results of tests on systemic insecticides conducted in Belgium in 1960 and 1961. L. VAN STEYVOORT. *Publ. Tech. Inst. Belge Amél. Betterave.*, 1962, **30,** (1), 25–66; through *Rev. Appl. Mycol.*, 1963, **42,** (7), 422.—It is concluded (from Inst. de la Betterave, Tirlemont, Belgium) that two sprayings with various systemic insecticides against aphids (mainly *Myzus persicae* and *Aphis fabae*) were worthwhile only if beet yellows virus infection was over 40% and one spraying if it was 20–40%. Seed dusting and application of granulated systemic compounds to the furrow at sowing failed to give desirable results, but the application of granulated preparations at the first appearance of the insects was promising.

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Isolation of individual strains of beet yellows virus. G. E. RUSSELL. *Nature*, 1963, **197,** (4867), 623–624. The upper leaves of *Claytonia perfoliata* were inoculated with infected sugar beet leaves ground with "Celite". Resulting single local lesions were excised individually and used for similar further inoculations, sap from resulting further single *Claytonia perfoliata* lesions being used to inoculate young sugar beet plants (by KASSANIS' technique). The inoculated leaves first developed small brown or purple lesions and eventually some of the plants became systemically infected. Some sugar beet lines were more susceptible to systemic infection than others. By this means several strains of the virus of different degrees of virulence were obtained, and retained this character for several transfers from sugar beet to sugar beet.

Spread of yellows virus by ***Myzus persicae*** **in sugar beet crops.** C. R. RIBBANDS. *Nature*, 1963, **197,** (4867), 624.—Wingless *M. persicae* infected by either sugar beet yellows virus or mild yellows virus, or both, were placed on widely separated plants in a $7\frac{1}{4}$ acre field of sugar beet. During June the apterae spread over and infected patches exceeding 10 feet in diameter. Mild yellows virus spread to over twice as many plants as yellows virus and the least rapid spread occurred from plants infected by both viruses.

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Some factors affecting the transmission of sugar-beet mosaic and pea mosaic viruses by ***Aphis fabae*** **and** ***Myzus persicae***. A. J. COCKBURN, A. J. GIBBS and G. D. HEATHCOTE. *Ann. Appl. Biol.*, 1963, **52,** (1), 133–143.—The scope of this work was to study the transmission of the non-persistent sugar-beet mosaic and pea mosaic viruses by alate and apterous *Aphis fabae* and *Myzus persicae* and to investigate the relationship between the flying, feeding and settling behaviour of the aphids and their ability to transmit the viruses.

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Growth, pests and diseases of the sugar beet in Belgium in 1960 and 1961. L. ERNOULD and L. VAN STEYVOORT. *Pub. Tech. Inst. Belge Amél. Betterave*, 1962, **30,** (3), 103–182.—This consists of two separate reports, one for each year, and discusses weather conditions, the development of the crop, and yields. Special emphasis is given to the incidence of the usual pests and deseases of the sugar beet in Europe. Losses due to virus yellows for the whole country were considered to be 7% in 1961 and 8% in 1960. A feature of the 1961 season was some severe and unusual slug damage, some fields having to be resown. Stem eelworm (*Ditylenchus dipsaci*) attack was also widespread in 1961.

* * *

A ratooning method used in the Burdekin district. J. A. HUCKNALL. *Cane Growers' Quarterly Bull.*, 1963, **27,** (1), 4–6.—The somewhat drastic method here described is only intended for irrigated areas of heavy soil in Queensland where irrigation water does not penetrate well to the stool for ratooning. It consists basically of a stubble shaving operation in which the cane hill or row is broken down to inter-row level—performed by a stubble shaver or rotary hoe. Attached to the stubble shaving implement is a mouldboard scraper directly over the cane stool, which causes irrigation water to be channelled directly over the cane stool, effectively soaking it. As soil is progressively worked over the stool later this provides effective weed control.

Studies with chlorotic streak disease of sugar cane. *Tech. Comm. Bureau Sugar Exp. Sta.*, 1963, (1, 2, 3). Three separate papers on chlorotic streak are here printed together, viz:—

1. **Some soil factors affecting streak production and disease transmission,** by B. T. EGAN, who presents the results of two experiments conducted in drums of soil. Chlorotic streak production by diseased plants was shown to be affected by steam sterilization of the soil, by the type of soil used and by surface sterilization of the setts at planting. Disease transmission was obtained only in steamed soil. There was a marked interaction between one soil type and sterilization.

2. **Transmission by mechanical means,** by O. W. STURGESS, in which two mechanical inoculation techniques for the transmission of chlorotic streak from diseased to healthy sugar cane roots are described. The causal agent is considered to be a virus, located mainly in the root system. Elephant Grass (*Pennisetum purpureum*) and probably Guinea Grass (*Panicum maximum*) are alternative hosts.

3. **Rapid transmission by infection at ratooning,** by B. T. EGAN. A high rate of transmission was obtained in nutrient gravel cultures by ratooning at the same time that a source of infection was introduced to the trough. To be effective the inoculum had to be added within three days of ratooning. The method was effective with all *Saccharum* tested and other grasses also.

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Cane cultivation at Cuatotolapam, Mexico. R. P. HUMBERT. *Bol. Azuc. Mex.*, 1963, (163), 3–6.—The author gives his impressions, as a result of a five-day visit. He considers the area is favourable for cane production and discusses field operations in general. Damage from insect pests and mosaic disease is not considered excessive.

* * *

Varieties may differ in their susceptibility to 2,4-D. ANON. *Cane Growers' Quarterly Bull.*, 1963, **27**, (1), 14.—A new seedling undergoing trial in the Ingham area of Queensland showed marked susceptibility to drift from spraying with 2,4-D for summer weed control, the standard variety Q 66, growing nearby, being unaffected. A photograph shows the malformed growth of the new canes, severely bent at the nodes and losing the erect habit.

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Germination isn't everything. J. H. BUZACOTT. *Cane Growers' Quarterly Bull.*, 1963, **27**, (1), 15–16.—Reference is made (with a photograph) to a cane field in the Mulgrave area of Queensland showing an unthrifty appearance except for two rows. These rows happened to be those where the vehicle with planting material was driven at the time and illustrates the value of compacting the soil and breaking down the lumps.

Unusual insect pests of cane. G. WILSON. *Cane Growers' Quarterly Bull.*, 1963, **27**, (1), 21–22. Two new or little known insect pests of sugar cane in Queensland are described, but their scientific names not given. The one termed Butt Weavil has a stout legless grub (photograph shown) which bores into the underground portions of the stalks of cane. It has been recorded on several cane farms in the Innisfail district where cane was severely damaged. The other pest, in the Mulgrave area, is the nymph of a species of *Cicada* which severely damages the underground stools of ratoon cane. It is thought three successive dry seasons may have accounted for its prevalence.

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Frenchi grub control. G. WILSON. *Cane Growers' Quarterly Bull.*, 1963, **27**, (1), 23–25.—Severe cane losses in the Mulgrave and Hambledon mill areas of Queensland, due to the Frenchi grub, are referred to. It is pointed out that BHC properly used gives complete protection.

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Irrigation channel weed control L. S. CHAPMAN. *Cane Growers' Quarterly Bull.*, 1963, **27**, (1), 26–27. The need to keep main irrigation channels and feeder drains free of weeds (non-aquatic weeds) to allow unrestricted flow of irrigation water is stressed. The most popular spray mixture is 5 lb 2,2-DPA ("Dalapon") plus 2 lb 2,4-D and 2/3 pint of a non-ionic wetting agent in 44 gallons of water. The wetting agent is important and is estimated to improve killing power by 30%.

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High yields from new cowpeas. J. C. SKINNER. *Cane Growers' Quarterly Bull.*, 1963, **27**, (1), 28–29.—The cowpea (*Vigna unguiculata*) is an important green manure crop, especially with sugar cane in Queensland. An account is here given of the success achieved in breeding improved varieties for Queensland conditions as a result of a project commenced in 1955. The results of trials with the six best varieties produced so far are given, the most outstanding variety being 58 NL 253, which proved consistently superior to the standard variety "Reeves" hitherto grown.

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The Mungomeryi cane grub. G. WILSON. *Cane Growers' Quarterly Bull.*, 1963, **27**, (1), 32.—The close similarity of this cane pest (now described as a new species—*Lepidiota mungomeryi* Brit.) with the Frenchi beetle grub is outlined, the two having been confused in the past. Sampling carried out so far suggests that Mungomeryi beetles may be more plentiful in southern districts while the reverse applies in the north.

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Spray irrigation system suitable for quick installation. F. ROLLESTON. *Cane Growers' Quarterly Bull.*, 1963, **27**, (1), 33–36.—In this system sprinklers on tripods are run by flexible hose at intervals from a common supply pipe. They are claimed to be of special value where irrigation water supplies are restricted and where it is desired to get young ratoons off to a good start in the dry spring or early summer months in Queensland.

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Cane cultivation at Tamazula, Mexico. R. P. HUMBERT. *Bol. Azuc. Mex.*, 1963, (165), 4–8.—The writer gives his impressions of a 4–5 day visit to this area and discusses such matters as irrigation, fertilizers, cane maturity and harvesting, and varieties. The desirability of an earlier maturing variety is stressed.

* * *

Cultivation and production costs of cane in different zones of Mexico. M. SÁNCHEZ. *Bol. Azuc. Mex.*, 1963, (165), 14–17.—Details are given, under numerous headings, of production costs of sugar cane in Mexico, the information having been taken from a recent book on the production of sugar in Mexico during the last three decades.

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Brazilian cane varieties. F. DE MENEZES VEIGA and R. DA SILVA PINTO. *Brasil Açuc.*, 1962, **60,** (5–6), 13–19.—Six of the newer C.B. varieties (Campos-Brazil) are here described in detail, to assist in identification in the field. The varieties are CB 38-22, CB 40-69, CB 40-77, CB 45-3, CB 45-6 and CB 41-76. Parentage is given and a full description based on general appearance, culm or stem, bud and leaf-sheath characters. A notable feature is the good coloured illustrations of the stems or culms (2-3 internodes) that accompany each description.

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Foliar analysis as a basis for fertilizing cane. R. S. PORTALES. *Proc. 4th Int. Conf. Sugar Ind. Consult. Tech.*, (Cosamaloapan, Ver., Mexico), 1962, 40–80.—An account is given of an extensive range of experiments in estimating N, P and K in leaf tissue of growing cane, the information obtained being presented in tabular form. Cane 3 to 4 months old is considered to be at the best age for this kind of work.

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Hybridizing cane in a greenhouse in Mexico. J. P. OJEDA HERRERA. *Proc. 4th Int. Conf. Sugar Ind. Consult Tech.* (Cosamaloapan, Ver., Mexico), 1962, 128–139.—In the Papaloapan area of Mexico hybridizing of sugar cane is difficult because of climatic conditions at certain times of the year, such as wide ranges of temperature and high winds. The advantages of the use of a greenhouse, with plastic instead of glass, and with means of temperature control are outlined.

* * *

Trials with herbicides at San Cristóbal, Mexico. J. V. HERNÁNDEZ OROZCO. *Proc. 4th Int. Conf. Sugar Ind. Consult. Tech.* (Cosamaloapan, Ver., Mexico), 1962, 185–205.—Results are given, on a cost basis, of trials with various modern herbicides for the destruction of weed growth in cane fields. Both pre-emergence and post-emergence weed destruction is considered. A mixture of "Dowpon" and 2,4-D proved to be the most satisfactory. The most favourable rate of application would vary with conditions, especially the density of weed growth.

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Importance of cane pests at San Cristóbal, Mexico. J. V. HERNÁNDEZ OROZCO. *Proc. 4th Int. Conf. Sugar Ind. Consult. Tech.* (Cosamaloapan, Ver., Mexico), 1960, 206–217.—Rats are considered to be the worst cane pest in the area concerned, followed by "maytito de junio" (*Evetheola bidentata*). The two cane borers *Xubida dentilineatella* and *Diatraea saccharalis* are numbered among the other pests. Costs are given for the use of rat-killers over large areas and brief notes on the other pests.

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Performance of variety Co 1148 in Uttar Pradesh, India. R. A. GUPTA and R. P. SINGH. *Indian Sugar*, 1963, **13,** (1), 19–20.—This variety and its characteristics are fully described. It shows promise in western Uttar Pradesh. The variety was introduced to the Sugar Cane Research Station at Muzaffarnagar, from Coimbatore, in 1955. Stocks were built up over 3 years. It is thought it may replace the existing varieties, Co 12 and CoS 245, which are said to be showing signs of deterioration in the western tract of Uttar Pradesh.

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Influence of mineral deficiencies on the growth and yield of sugar cane. G. SAMUELS and H. CIBES-VIADÉ. *J. Agric.* (Univ. Puerto Rico), 1963, **47,** (2), 61–75. In this work the deficiency of the elements nitrogen, phosphorus, potassium, calcium, magnesium, and boron were evaluated on four sugar cane varieties, grown in a greenhouse (in sand culture). It was found that different varieties responded differently with some of the treatments. The complete treatment produced the highest yield of millable cane and green matter. The minus-nitrogen treatment failed to produce any millable cane. With two of the varieties minus-phosphorus treatment gave notably poor tillering. Other results are given.

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Weeds and their control in sugar cane fields in India. O. P. GUPTA, R. B. L. BHARDWAJ and R. D. VERMA. *Indian J. Agron.*, 1960, **5,** 126—132; through *Weed Abstracts*, 1963, **12,** (3), 141.—Common weeds of Indian sugar cane crops are listed and their control by cultural and chemical means reviewed.

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Sugar cane in Jamaica. ANON. *Ann. Rpt. Min. Agriculture and Lands, Jamaica, 1960*, 1963, 16–19. This somewhat belated report on the sugar industry in Jamaica gives a résumé of the industry as it was in 1960. Sugar production for the year, 418,276 tons, was the largest in the island's history, compared with 152,225 tons in 1945. Figures are given for the production of "cane farmers cane" and "estates cane" over a number of years (1946–1960), also figures for rum and molasses exports. The United Kingdom and Canada remained the principal markets for the island's sugar.

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C.P. 55-30—A new variety for Louisiana. L. L. LAUDEN. *Sugar Bull.*, 1963, **41**, 240.—The release of this new variety, from the Louisiana Agricultural Experiment Station, is announced, 4000 tons of planting material being available to Louisiana cane growers in autumn 1963. This variety is claimed to be particularly well adapted to the Mississippi River delta region. Among its virtues are higher yield than existing commercial varieties (being adapted to both light and heavy soils), early maturity and good ratooning power. Among its weaknesses is the fact that it may be severely affected by mosaic and that it may be less tolerant towards cold than some of the existing commercial varieties.

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Combating ratoon stunting disease in Mexico. A. GONZALEZ GALLARDO. *Bol. Azuc. Mex.*, 1963, (166), 6–12.—The writer discusses ratoon stunting disease ("raquitismo") in Mexico at some length, and control measures. He gives details of tank construction for hot water treatment (on the Australian pattern).

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How to make compost. ANON. *Compost Science*, 1963, **4**, (1), 13–16.—This is an English translation of a pamphlet distributed in Taiwan, with diagrams and illustrations, designed to teach the peasant farmer the best way to make, and use, his own compost. Two of his main sources of raw material are paddy straw and sugar cane trash. The instructions given are lucid and practical.

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Sugar cane variety recommendations for Louisiana. ANON. *Sugar Bull.*, 1963, **41**, 254–255.—The survey and recommendations have been prepared jointly by the Louisiana State University Agricultural Experiment Station and the United States Department of Agriculture Sugarcane Field Station, Houma, Louisiana. For the 1963 crop the varieties C.P. 52-68, C.P. 44-101 and N:Co 310 are the most important, constituting 81% of the state acreage. Details of these and other varieties grown commercially are given. A detailed list is then given of recommendations of varieties for the different cane growing areas.

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An early maturing sugar cane variety. F. LE GRAND and T. BREGGER. *Circular Univ. Florida Agric. Exp. Sta.*, 1961, (S-133), 1–7.—A description of the new variety F. 46-136 is given with emphasis on its early maturing property, an advantage in escaping cold damage in some parts of Florida. A figure showing the pedigree of the variety is given. The stalks are greenish red when exposed to the sunlight and olive green in the shade.

Cane investigations in Mexico. A. GONZÁLEZ GALLARDO. *Bol. Azuc. Mex.*, 1963, (167), 3–21.—This article commences with a résumé of sugar cane cultivation in Mexico during the last three decades and then deals at some length with the varieties, both introduced and those bred in Mexico, that are or have been cultivated in the various cane growing regions of the country. Diseases and pests are then outlined and several photographs of the latter shown.

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Mechanical thinning of sugar beet in Belgium in 1962. M. MARTENS. *Pub. Tech. Inst. Belge Amél. Betterave*, 1963, **31**, (1), 1–20.—This constitutes an analysis or survey, with eleven tables, of mechanical thinning of sugar beet, including comparison with hand thinning, which took place in trials in 1962. Attention is drawn to irregularity in size of mechanically thinned beets, variability in yield and the number of small beets.

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Problems raised by mechanical harvesting of sugar beet. M. MARTENS. *Pub. Tech. Inst. Belge. Amél. Betterave*, 1963, **31**, (1), 21–31.—Attention is drawn to new problems that have arisen from mechanical harvesting of sugar beet, notably the prevalence of small beets and its effect on yield, estimated to range in losses from 2% to 6%. The performance of different types of harvesters in mechanically thinned fields is discussed.

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Gametogenesis in the sugar cane borer moth (*Diatraea saccharalis*). NIILO VIRKKI. *J. Agric.* (Univ. Puerto Rico), 1963, **47**, (2), 102–137.—In this detailed paper, with 109 entries in the bibliography, it is pointed out that *Diatraea saccharalis* is the only cytologically checked crambid moth up to the present, and that it has an unusually low chromosome number for a lepidopteran ($n = 17$). Based on his work and on data on irradiating insect testis, the writer gives a condensed guide for the male sterilization of *Diatraea saccharalis*.

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Effects of lime on sugar cane. F. O. BRIEGER. *Brasil Açuc.*, 1963, **61**, (1–2), 10–12.—The advantages of the use of lime with sugar cane on certain soils in Brazil are outlined, and yield figures given of trials carried out on the Sao Francisco estate at Campinas.

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On the utility of sheath moisture as a quality index. V. RANGANATHAN. *Indian Sugar*, 1963, **13**, (1), 13–17.—The writer points out that the moisture of the leaf sheath in sugar cane represents the physiological status of the crop and might provide a useful index under certain circumstances, if allowance can be made for certain factors such as season and age.

SUGAR LOSSES IN MOLASSES

in connexion with diffusion

By C. J. ASSELBERGS, P. W. VAN DER POEL, M. L. A. VERHAART and N. H. M. DE VISSER

Paper presented to the 12th Session C.I.T.S., 1963.

PART II

The influence of addition of sodium chloride to the feed water on the composition of the raw juice was investigated in a number of experiments in which we extracted beet of the same composition alternatively with deionized water and water containing 2 g NaCl per litre. One of the extraction balances has been given in Table II (extraction with deionized water), and one of the corresponding experiments with 2 g NaCl/litre in the feed water is given in Table III. In both tables all the data are given in absolute amounts which refer to 800 g of cossettes, which is the content of one cell of our micro-diffuser.

From the 2·83 g of chloride which was added to the feed water, only 0·194 g passes to the raw juice; this is not more than 7%. If we subtract the amount which is eliminated immediately with the pulp water, the quantity of chloride which enters the diffusion system amounts to 1·16 g. The 0·194 g which passes to the raw juice represents 17% of the supply to the feed water. This quantity is considerably lower than the 33% which was found by STANĚK on whose data BÖTTGER and MÜHLPFORTE based their calculations. Quantitative calculations can be based on the increase of the chloride contents of the raw juices because the sodium ions which pass to the raw juice, together with the potassium ions which are liberated from the beet cells, are in electrochemical balance with chloride ions. Another thing is that the chloride ion can be determined analytically by an easy method and with good accuracy.

Table III

Countercurrent extraction with 2 g NaCl/litre in the feed water of the diffuser

(g/800 g of cossettes)

	feed water	*beet*	*raw juice*	*pulp*	*pulp water*	*total input*	*total output*
Dry substance	4·6	167	127	41	5·7	171	175
Sucrose		117	118	3	2	117	123
K		1·68	1·43	0·10	0·10	1·68	1·63
Na	1·78	0·09	0·110	0·724	1·00	1·87	1·83
CaO		0·30	0·10	0·27		0·30	0·37
MgO		0·46	0·32	0·12	0·02	0·46	0·46
Cl	2·83	0·153	0·368	0·955	1·67	2·98	3·00

In comparison with the extraction with deionized water (Table II) the potassium and sodium contents of the raw juices have been increased respectively by 10% and 36%. The amount of chloride in the raw juice has been doubled. In absolute amounts on 800 g of cossettes the increases are 0·12 g for potassium, 0·036 g for sodium and for chloride 0·194 g. In equivalents the increases amount to 3·1 meq/800 g beet for potassium, 1·6 meq/800 g beet for sodium and 5·5 meq/800 g beet for the chloride. It is noteworthy that the addition of sodium chloride to the feed water of the diffuser does not only result in an increase of the amount of sodium in the raw juice but also considerably increases the amount of potassium in the raw juice.

The increase in the amount of potassium is even more important than the increase in the amount of sodium. These data indicate the importance of the ion exchange reactions between the juices in the killed cells of the plant tissue and the extracts outside these cells. From Table I it appeared that potassium and sodium ions are not bound to the cell walls. In these ion exchange reactions the cell wall plays only the rôle of a diaphragm between the two liquids inside and outside the cells. The cell wall itself does not act as an ion exchanger in this case. In equivalents the sum of the increases in the sodium and potassium contents corresponds to the increase in the chloride contents of the raw juices.

By means of the laws of countercurrent extraction predictions can be made as to the increases in the amounts of sodium which are to be expected as a result of the increase in the salt content of the feed water. For the removal of the sodium ions from the feed water by the cossettes the countercurrent extraction works in reverse. The cossettes extract the sodium ions from the feed water. This purifying extraction stops however when the concentrations inside and outside the killed cells are in equilibrium. This phenomenon can be demonstrated clearly by our data. The sodium concentration in the beet amounted to 0·0099 g/100 g of brei. Assuming a marc content of the beets of 4% and a density of the juice in the cells of the beet of 1·07, the sodium concentration in the cell juice of the beet amounts to $\frac{100}{96} \times 1{\cdot}07 \times 0{\cdot}0099$ g/100 ml = 0·0112 g/100 ml of cell juice. In the raw juice from our experiments with 2 g NaCl per litre in the feed water we found a sodium concentration of 0·0122 g/100 ml in the raw juice, which is almost the same as the sodium concentration in the cell juice of the beet. It is also misleading to consider the amount of sodium which passes from the feed water to the raw juice as a percentage of the amount of salt which was supplied. It is the sodium concentration in the beet which limits the extraction of the salt from the feed water by the cossettes and together with the conditions of the diffusion controls the partition of the sodium ions between the exhausted cossettes and the raw juice.

The ion exchange reactions between the juice inside and the extract outside the cell walls appear to be important in connexion with the formation of molasses. These ion exchange reactions, however, are also limited by the composition of the beet. With deionized water in normal extraction, 78% of the potassium from the beet passed to the raw juice (Table II). With 2 g NaCl per litre in the feed water the extraction of potassium from the beet increases to 85% with the same losses of sucrose in the exhausted cossettes and the pulp water. In practice this value will not be exceeded easily as a salt content of the feed water of 2 g per litre is already rather high. It is possible that these ion exchange reactions, in contrast to the countercurrent extraction, depend on the concentration of the salt in the feed water.

Although in the experiments the sum of the increases in the amounts of sodium and potassium in equivalents is almost the same as the rise in the chloride content of the raw juice, we may not expect this good agreement to be obtained in all the further experiments. The differences in the contents of sodium, potassium and chloride, which are caused by the addition of salts to the feed water, are so extemely small that a good cation/anion balance is seldom obtained even in the laboratory, not to mention in practice. The most reliable results are obtained if the increase in the amount of molasses is predicted from the increases in the chloride contents of the raw juices. The assumption should be made that 1 equivalent of chloride is accompanied by one equivalent of a cation; this is the case if no anion exchanger reactions occur. If anion exchange reactions *do* occur, the chloride can take the place of the other anions in the juice and in that case an increase in the amount of chloride in the raw juice does not necessarily cause a higher content of alkali salts. In order to study the influence of the addition of salt to the feed water on the composition of the anions in the raw juice these were determined analytically. The results are given in Table IV.

Table IV
Analyses of raw juices from countercurrent extraction with and without addition of 2 g NaCl/litre to the feed water

	Deionized water (per 100 ml raw juice)	*Deionized water with NaCl 2 g/l (per 100 ml raw juice)*
dry substance	13·94 g	14·15 g
sucrose	12·89 g	13·10 g
invert sugar	0·140 g	0·177 g
potassium	0·146 g	0·159 g
sodium	0·0082 g	0·0122 g
CaO	0·013 g	0·011 g
MgO	0·034 g	0·036 g
total α-amino	1·62 meq	1·47 meq
α-amino acids*	0·188 g	0·163 g
glutamine	0·023 g	0·031 g
PCA	0·024 g	0·020 g
NH_3	0·0090 g	0·0087 g
total anions	6·23 meq	6·64 meq
lactic acid	0·0010 g	0·0015 g
glycolic acid	0·0016 g	0·0027 g
malic acid	0·0235 g	0·0245 g
citric acid	0·065 g	0·067 g
oxalic acid	0·047 g	0·043 g
sulphate (SO_4^{--})	0·0088 g	0·0101 g
chloride (Cl^-)	0·0194 g	0·0409 g
phosphate (PO_4^{---})	0·086 g	0·086 g

* calculated as glutamic acid

From Table IV it appears that no anion exchange reactions of any importance occur. The addition of the NaCl to the feed water caused an increase in the total anion content of the raw juice of 0·41 meq per 100 ml of raw juice. The increase in the chloride content amounts to 0·61 meq/100 ml of raw juice. These figures are in good agreement.

The following experiments deal with the partition of calcium chloride between the exhausted cossettes and the raw juice. In a number of experiments, calcium chloride was added to the feed water of the laboratory diffuser in an amount of about 2 g/litre. Although the partition mechanism in the countercurrent extraction of calcium ions from the feed water is the same as in the case of the sodium chloride additions, the results are somewhat different. From the data which have been given in Table I we concluded that the beet cells contain only extremely small amounts of dissolved calcium ions.

In contrast to the sodium and potassium ions, the calcium ions are mostly bound to the cell wall. This results in different distribution of these ions between the raw juice and the exhausted cossettes. Table V gives the data of one of the experiments with calcium chloride addition to the feed water of the extraction apparatus. Again all the quantities are given in g/800 g of cossettes.

Table V
Countercurrent extraction with deionized water to which 2·3 g $CaCl_2$/litre had been added
(g/800 g of cossettes)

	feed water	*beet*	*raw juice*	*pulp*	*pulp water*	*total input*	*total output*
Dry substance	4·9	168	126·5	42·4	5·9	173	177
sucrose		117	117	3	3	117	123
K		1·67	1·43	0·09	0·11	1·67	1·63
Na		0·082	0·065	0·008	0·004	0·082	0·077
CaO	2·46	0·33	0·130	1·36	1·40	2·79	2·88
MgO		0·53	0·31	0·20	0·01	0·53	0·52
Cl	3·10	0·12	0·41	0·90	1·92	3·22	3·23

The increase in the amount of calcium in the raw juice in consequence of the addition of calcium chloride to the battery feed water appears to be negligible. In contrast to the sodium ions, the calcium ions are almost completely extracted from the feed water and eliminated with the exhausted cossettes. Ion exchange reactions however result in an increase in the potassium content of the raw juice. The increase in the potassium content of the raw juice appears to be almost as much as in the case of the sodium chloride addition to the feed water. The increases in the amounts of potassium and calcium are not in electrochemical balance with the increase in the amount of chloride. The increases are relatively small so that—as was pointed out in the experiment with the sodium chloride addition—from the normal variations in composition and analyses relatively large deviations from the electrochemical balance can be expected.

Conclusions

Although the most important factor controlling the formation of molasses is the composition of the beet, the diffusion process itself is not without influence on the production of molasses.

No clear idea can be formed from the data available in the literature concerning the phenomena which control the extraction of sucrose and non-sugars from the beet cossettes. In many studies which are recorded in the literature, the extraction phenomena have been investigated by means of model experiments. The results of the experiments may be interesting from a scientific point of view; however, the models often represent an oversimplified picture of the diffusion process. As an example we can take the diffusion of potassium salts. BRÜNICHE-OLSEN determined the diffusion coefficient of potassium chloride in killed sugar beet tissue. The diffusion coefficient of potassion chloride appeared to be bigger than the diffusion coefficient of sucrose. RATHJE found that the diffusion of ash in the sugar beet tissue is as rapid as the diffusion of sucrose. In practice, it is evident that sucrose is extracted faster than the salts.

By means of countercurrent extraction experiments in which corresponding material balances were obtained, a quantitative correlation between the extraction of sucrose and the extraction of potassium has been found. For relative sucrose extractions between 91% and 98%, which correspond to sucrose losses in the pulp + pulp water between 1% and 0·3% on beet, 30% of the extra sugar which is gained by improvement of the extraction conditions passes to the molasses.

A salt content of 2 g of sodium chloride per litre in the feed water of a diffusion battery appeared to increase the amount of chloride in the raw juice by 0·194 g/800 g of cossettes or 0·024 g/100 g of beet. Assuming that the chloride is accompanied by alkali or alkaline earth salts, we may conclude that this gives an increase in the production of molasses of $0{\cdot}024 \times \frac{342}{35{\cdot}5} = 0{\cdot}23\%$ on beet. From the mechanism of countercurrent extraction it may be expected that the relationship between these losses and the salt content of the feed water will not be linear.

The supply of sodium chloride to the feed water caused a marked increase in the amount of potassium in the raw juice. Sodium and potassium ions in the beet are not bound to the cell walls. In these ion exchange reactions the cell wall plays the rôle of a diaphragm.

Anion exchange reactions do not occur. The increases in the amounts of sodium and potassium were in good agreement with the increase of the amount of chloride in the raw juices.

The addition of 2 g of calcium chloride per litre to the feed water of a diffuser resulted in an increase of the chloride content of the raw juice of 0·23 g/800 g of cossettes or 0·029 g/100 g of beet. The resulting sucrose loss to the molasses amounts to $0{\cdot}029 \times \frac{342}{35{\cdot}5} = 0{\cdot}28\%$ on beet.

For this calculation the assumption is made that no anion exchange reactions take place. The increase in the amount of chloride in the raw juice should be in equilibrium with the increase in the amount of cations. The potassium content of the raw juice was increased markedly by the addition of calcium chloride to the feed water of the diffuser. The increase in the potassium content was exactly the same as in the case of the sodium chloride supply to the feed water. If we subtract the amount of chloride which is eliminated directly with the pulp water, the amount of chloride which was introduced to the diffuser was 1·18 g/100 g of cossettes. From this quantity 0·90 g remained in the exhausted cossettes. If the diffusion system is operated with return of pulp press water all the calcium chloride which does not pass to the raw juice remains in the exhausted cossettes and is sold as dried cossettes. In our experiments 24% of the chloride supply passes to the raw juice. The greatest economical disadvantage of the calcium chloride is the extra sucrose loss to molasses and not the cost of the chemicals.

Summary

A review of the recent literature concerning the subject is given. The extraction of the melassigenic non-sugars potassium and sodium has been studied as a function of the extraction of the sucrose and the addition of salts to the feed water. The non-sugars in the beet brei can be divided into one part which is soluble in hot deionized water and another part which is insoluble. Sodium and potassium salts in the beet brei appeared to be completely soluble in hot deionized water, and are not bound to the cell walls (marc); 60% of the magnesium in the beet brei is soluble, the insoluble 40% being bound to the cell walls. No more than 35% of the calcium salts in the beet brei can be extracted with deionized water.

The countercurrent extraction of beet cossettes with deionized water has been studied by means of an extraction apparatus which has been described in

an earlier paper. In countercurrent extraction of the cossettes the non-sugars potassium and sodium are extracted more slowly than the sucrose. In the exhausted cossettes the concentrations of these non-sugars are relatively high in comparison with the sucrose concentration. From these experiments on a laboratory scale a quantitative correlation was found between the extraction of sucrose and the extraction of potassium. The results of these experiments are in accordance with experience in the factory.

The influence on the production of molasses of the addition of sodium and calcium chloride to the feed water has been investigated. In this case the countercurrent extraction works in reverse: there is a purifying action by the cossettes on the feed water. The amount of salt removed from the feed water is controlled by the concentration of the salt in question in the cell juice of the cossettes. Calcium ions are almost quantitatively extracted from the feed water because the cell juice contains only very small amounts of dissolved calcium. The amount of sodium which passes from the feed water to the raw juice, however, is larger because the cell juice contains considerable amounts of dissolved sodium salts. Additions of calcium and sodium salts to the feed water of a diffuser cause ion exchange reactions between the liquids inside and outside the cells of the cossettes. This results in an increase in the potassium content of the raw juice. In equivalents this increase is even larger than the respective increases in the amounts of sodium and calcium in the raw juices. Chloride passes from the feed water to the raw juice in amounts which are necessary to maintain an electrochemical balance.

In all experiments described material balances have been obtained for sucrose and non-sugars. Analyses were made of brei from the beet, the raw juices, the exhausted cossettes and the pulp-waters. The molasses factor, which has been mentioned in earlier work, was used for the calculation of the increase in the amount of molasses. The relationship $\frac{\text{equivalents of sucrose}}{\text{equivalents of K + Na}}$ is a constant in normal molasses, the absolute value of the constant depending on the installation of the factory.

JUICE PURIFICATION IN BEET SUGAR FACTORIES

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Paper presented to the Société Technique et Chimique de Sucrerie de Belgique, Brussels, January 1963.

PART II

RESULTS

Considering the problem as a whole, we can say that:

(i) the flowrates in litres/hr/sq.m. were somewhere between 643 and 1405, which means that the true hourly flow for a 50 square meter flow is somewhere between 32 and 70 cu.m.

(ii) the insoluble dry substances content of the sludge discharged during the main purges varied from 300 to 500 g/litre according to the flowrates achieved, which resulted in very easy filtration of muds on the rotary filters.

(iii) the recirculation of the small quantity of turbid juice produced when the cycle is started has been discontinued, owing to the fact that the amount of precipitate going through the cloth is only 0·02% of the volume of filtered juice.

The broad limits of the flowrate arise from the large variations we endeavoured to secure for a few parameters.

As during the previous year, we tried to investigate the influence on filtrability of the preliming temperature, of the amount of lime used in first liming, and also of the hydrocyclones.

(1) *Influence of preliming temperature.*

With a total lime amount of 1·20 g CaO/100 ml in first carbonatation and a mud recirculation corresponding to 75% of the lime added, the effect of preliming temperature is given in Table I.

Table I

T° preliming	*Flowrate in litres/hr/ sq.m.*	*Flowrate in cu.m/hr for the 50 sq.m. filter*	*Yield of filtrate % incoming juice*
50°C	643	32	82
54°C	682	34	83
72°C	852	42·5	86
72°C*	1405	70	91

* This last experiment differs from the previous one in that we had intentionally left out the other filter in order to ascertain the ultimate capacity of a 50 sq.m. filter. The one in operation thus dealt with the whole flow from the 80 cu.m. pump, the pressure being below 600 g, while under less favourable conditions it reached 1 kg. It may be inferred from this that the flow of 70 cu.m. per hour is not a maximum value.

It seems unnecessary to add any comments to Fig. 7 in which the favourable influence of a higher preliming temperature on first carbonatation juice filtrability is self-evident, a temperature increase from 52°C to 72°C resulting in a 30 to 35% increase in flowrate.

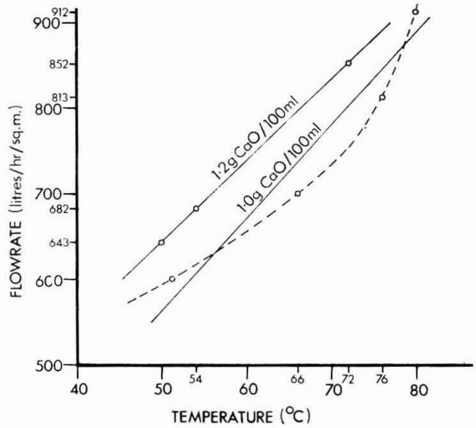

Fig. 7.

(2) *The influence of the amount of lime added* in first liming for a constant preliming temperature and a constant recirculation by means of hydrocyclones is indicated in Table II.

Table II

CaO (g/100 ml)	Preliming temperature (°C)	Flowrate (litres/hr/ sq.m.)	Flowrate for a 50 sq.m. filter (cu.m./hr.)	Yield of filtered juice % incoming juice
1·0	53	600	30.0	81·5
1·1	53	650	32·5	82·5
1·2	54	682	34·0	83·0
1·0	76	813	40·5	85·5
1·2	72	852	42·5	86·0

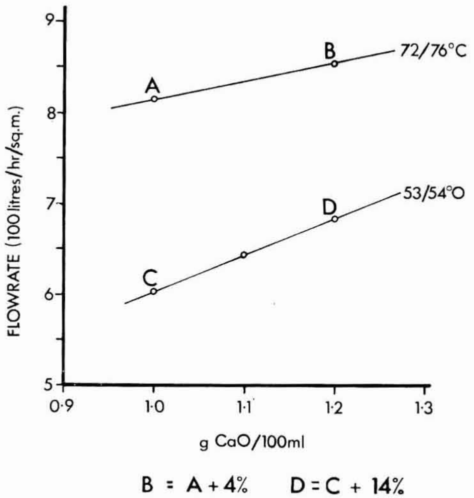

Fig. 8.

The figures of the preceding table seem to show that when sludge is recirculated, the amount of lime added in first liming has little influence on juice filtrability for a given preliming temperature of 70/75°C. At a lower temperature, a distinct influence of the amount of lime is noticeable (Fig. 8).

(3) *Influence of sludge recirculation.*

During the 1960 campaign we had the opportunity to show the favourable effect of a downflow recirculation on first carbonatation juice filtrability, corroborating Mr. DUCHATEAU's observations at Genappe. As our previous experiments had been made at a preliming temperature of 35/39°C, we wondered whether it should be also true at 72°C. The results appear to be convincing, and we joined them to the earlier ones (1960) in the following table referred to a liming of 1·20 g CaO/100 ml.

Table III

Preliming temperature	35/39°C		72°C*	
	With recirculation	*Without recirculation*	*With recirculation*	*Without recirculation*
Flow of the automatic first carbonatation 50 sq.m. filter in litres/hr/sq.m. (cu.m./hr)	495 (24·8)	650 (32·5)	718 (36·0)	852 (42·5)
Pressure	1000 g	1000 g	600 g	600 g

* The figure related to the flow "72°C with recirculation" is a minimum one, owing to the fact that the feeding pressure could not be pushed over 600 g. It should be remembered that one filter was able to deal with the whole flow from the feed pump (1405 litre/hr/sq.m., i.e. 70 cu.m. per hour) while not exceeding the pressure of 600 g.

(4) *Is sludge recirculation a necessity for using the automatic filter in first carbonatation?*

This is certainly not the case since it all depends on the working conditions of each factory. It is well known that filtration and sedimentation coefficients of the many defecation processes in use are somewhere between the best and the worst. It is for instance well-known that a WIKLUND scheme or the like improves considerably the physical characteristics of juice and we selected it as a reference at Fismes factory (France). Moreover, bearing in mind the WIKLUND process, we were able to devise a modification to the downflow recirculation process. (Recently we have learnt that something similar has been done in Germany, but we have no information on either the method or performance.)

If we did not mention the F_k in the present report, it is because we did not find any close connexion between the F_k values and the flowrates. Again, we have noticed that the time required to filter juices of similar F_k values can be quite different. However all reported results were obtained with juices having a F_k equal to or greater than 5; this should satisfy the most sceptical about the automatic filter performance.

Considering the scheme (Fig. 2) of work with cyclones, we found that it was far from perfect. Although the thickened *downflow* recirculation (500 to 550 g insoluble solids per litre) to the first compartment of the preliming tank is advantageous for filtrability, on the other side the *overflow* is harmful because it is mixed with the carbonatation juice to be filtered, which cancels part of the benefit.

At all events, the following conflicting effects are obtained: *the increase in the output of hydrocyclones, which increases the insoluble dry substances content of the downflow, creates simultaneously an overflow containing finer particles which will be reintroduced as such in the filtration circuit.*

Our idea is that these should participate again in the first carbonatation by sending them to the liming tank or, if this is impossible, to the recirculating tank of 1st carbonatation. If hydrocyclones are located properly, it is possible to return downflow and overflow at the selected points merely by gravity (Fig. 9).

This scheme affords several advantages:

(1) it is possible for the finer particles to grow;

(2) the volume of carbonatation juice treated in the hydrocyclones is no longer restricted to 90%. As the overflow is recirculated to carbonatation, it is possible to treat in hydrocyclones 100% or perhaps 150% of carbonatated juice volume (without circulation); and

(3) the recirculation of hydrocyclones downflow is nothing more than a concentrated mud recirculation. The effect is already known, for instance in the BRIEGHEL-MÜLLER scheme.

Furthermore, compared with that of WIKLUND, the characteristic of this process is to require only a small sludge recirculation, as the overflow is returned by gravity to first carbonatation, thus by-passing the pump after preliming and juice heaters before first carbonatation.

We have experimented with this "variant process" at Fismes during the last part of the 1962 campaign, both on a micro-plant scale and full scale, thanks to Mr. LEMOINE (manager of Fismes) to his staff and to a G.T.S. team.

(*a*) *micro-plant experiments.*

During the period Fismes factory worked according to a 40% WIKLUND process, with a liming of 1·70 CaO/100 ml limed juice (raw juice + milk-of-lime only).

Part of the limed juice was processed in the micro-plant with continuous carbonatation; another part of the limed juice added to overflow obtained independently (3 parts limed juice + 2 parts overflow) was continuously carbonatated, and a third part of carbonatated limed juice was mixed in the ratio 3:2 with the same overflow.

Nine series of experiments were made, the juices giving average F_k values of 2·1, 2·3 and 6·4 respectively. These early results confirmed our expectations from the new scheme, but it was wise to try it on an industrial scale, without WIKLUND 40%.

(*b*) *full-scale experiments.*

Thanks to a late modification (two days before the end of the campaign) it was possible to purify the juice as anticipated, i.e. with "Dorrclones" without WIKLUND, the downflow being returned to the NAVEAU prelimer and the overflow to the carbonatation tank.

The carbonatated juice characteristics were

F_k from 2·5 to 3·5, and

S_k from 5·5 to 6·0,

which compares with averages of 3·4 F_k and 5·3 S_k obtained during the same week with the 40% WIKLUND process. These results are significant and lead us to think that the "overflow" problem is solved.

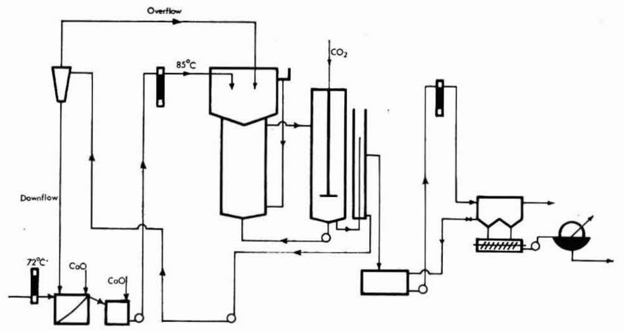

Fig. 9. Modified Scheme—Recirculation of the overflow to first carbonatation (hot liming tank)

Furthermore this purification process variant can only improve flowrates obtained in the Grand Pont filter for first carbonatation.

It is likely that in the future, flow rates of over 1500 litres/hr/sq.m. will be reached; each 50 sq.m. filter would then deliver 75 cubic metres of filtered juice per hour. The cycle should then be altered as follows:

period of filtration—about 25 minutes

partial purge, followed by a main purge, and then filling again about 5 minutes

etc.

As a matter of fact, this large output, with the new cycle, would allow achievement of a sufficient density of sludge (>400 g insoluble dry substances per litre) in half the time required formerly. This would furthermore shorten the time during which the muds are retained in the filter to 13 minutes instead of 25 minutes.

For the 1963 campaign the Hougaerde factory will be provided with 5 automatic bag-filters, namely:

4 filters fitted with 25 frames 1 m × 1 m each, 4 × 50 sq.m.
1 filter fitted with 25 frames 1 m × 1 m each, i.e. 1 × 40 sq.m.
Total area 240 sq.m.

Considering a flowrate of 800 litres/hr/sq.m. and one filter out of service, the hourly output of each filter will be 40 cu.m. per filter; we will thus have an "active possible flow" of 160 cu.m. filtered juice per hour.

The factory slicing capacity being 2500 tons, the hourly flow of first carbonatation juice is 140 cu.m., which becomes 165 cu.m. when the 16·5% recirculation arising from the partial purges are accounted for. This figure of 165 cu.m. incoming juice corresponds to 160 cu.m. filtered juice.

We are convinced that the area available is excessive as we know that flowrates of over 1400 litres/hr/sq.m. can be achieved. But as it is the first installation of its kind, safety is necessary although we are aware that, as occurs in all other fields, the pilot plant always turns out to be the least efficient. There are a lot of examples showing that reasonable expectations are always considerably exceeded, e.g. R.T. diffusers, and the Grand Pont filter for second carbonatation.

Economic viewpoint

Considering a factory with a slicing capacity of 2500 tons/day processing 125,000 tons of beets in fifty days, which wants to discard its press-filter station for first carbonatation, we calculate the following balance:

(*a*) Installation cost:

5 automatic filters of 50 square metres filter surface,
2 rotary filters of 30 square metres filter surface (for filtration of the sludge), and

Cluster of 30 "Dorrclones" (optional).

Approximate investment Frs. 6,000,000
(This assumes one unused bag-filter and one unused rotary filter for emergency operation)

(*b*) Annual cost of new equipment

Cloth (bag-rotary)	Frs. 83,000
Offseason material	25,000
Offseason labour costs	21,000
	Frs. 129,000

(*c*) Annual cost of the old press-filter station

Cost of seasonal labour (a yearly increase of 5% on a basis of ten years is assumed)	Frs. 500,000
Cloths	270,000
Offseason material	26,000
Offseason labour costs	93,000
	Frs. 889,000

∴ Annual savings = 760,000 Belgian francs.

Assuming a 0·100% (on beets) known loss of sugar in carbonatation muds from filter presses against a 0·042% total loss in muds from rotary filters, when dealing with the sludge from Grand-Pont filters, a saving of 75,000 kg sugar is secured per campaign.

Assuming Frs. 4 per kg to be the value of that sugar this gives a further saving of 300,000 Belgian francs.

∴ Total annual savings: 1,060,000 Belgian francs.

The new installation thus pays for itself in less than seven years allowing for interest at 5%.

Conclusions

Our aim during these three years experimentation has been to develop a simple device for automatic filtration.

Each process has its advantages and its drawbacks, and we shall leave it to better qualified people to judge ours. We are only a little afraid of the length of this communication related to an apparatus which has not the slightest mechanical movement, except for its valves. It is next to indecent in present days.

Our aim was also to make that filter usable with various processes, especially the Dormal system of Oreye, for the thickening of prelimed juice in cane sugar processing and perhaps in other fields outside the sugar industry. We are not the only people to struggle with filtration and sedimentation problems.

Let us point out once more our main idea during these experiments toward a better filtration of first carbonatation juice: the importance of the preliming temperature. When it is 72°C, sludge recirculation and the amount of lime used are only of minor importance, the last only to a limited extent, of course.

It only remains for me to thank all those who have taken part in the project, especially at the Oreye factory, at the Fismes factory, at the G.T.S. and—last but not least—the large team at Gembloux and Hougaerde, without which nothing would have been possible.

BREVITIES

New sugar factories for India[1].—The Chief Minister of the Mysore Government stated that application had been made to the Central Government for permission to set up additional sugar factories at Kanapur, Gangavati and Chikkodi Taluk as well as those already proposed for Bifar, Hiriur and Mugutkhan Hubli. The State Government has also requested permission to expand the existing sugar factories in the State.

* * *

Czech sugar factory for Uruguay[2].—Under an agreement reached in Montevideo, Uruguay is to supply meat to Czechoslovakia in exchange for a sugar factory to be erected in the Department of San José.

* * *

Chile sugar production 1962/63[3].—Beet sugar production in Chile during the 1962/63 season amounted to 98,644 metric tons manufactured from 692,288 tons of roots. In the previous crop 61,476 tons of sugar were produced from 430,614 tons of beet.

[1] *Idian Sugar*, 1963, **13**, 309.
[2] *La Ind. Azuc.*, 1963, **99**, 254.
[3] C. Czarnikow Ltd., *Sugar Review*, 1963, (640), 216.

THE POLISH SUGAR INDUSTRY

THE Polish sugar industry, one of the largest in Europe, has a history dating back to the founding in 1802 by F. K. ACHARD, a Berlin chemist, of the first beet factory in the world at Kunern (Konarach) in Silesia. Two factories erected 25 years later, Czestocice and Guzów, are still in operation, with a daily beet slice of approximately 1030 and 650 metric tons respectively. By 1850, sixty sugar factories of various outputs were in operation. Not all survived, however; some operated for only short periods, but the rest continued to apply the latest developments in juice extraction and introduced new processes and equipment, particularly new schemes for steam utilization.

The first Robert battery diffuser was installed in the Jozefow factory in 1865. Several large factories at Chelmza, Gostyn, Janikowo, Kruszwica, Matwy, Szamotuly and Znin were equipped from the start with battery diffusers and with quadruple-effect evaporators.

Polish publications on sugar beet started to appear at an early date; in 1837 was published a book by Prof. J. Belza entitled "The Manufacture of Sugar from Beet" and in 1895 a "Handbook for Sugar Factory and Refinery Operators" was published in three volumes. In the period 1884–1906 approximately 250 papers were read to the Sugar Section of the Warsaw branch of the Society for Promotion of Russian Trade and Industry. "Gazeta Cukrownicza", the official organ of the Sugar Technologists' Association, has appeared regularly since 1893.

At the outbreak of World War I, 86 sugar factories were in operation in Poland, producing a total of 540,000 tons of sugar annually. Many of these were destroyed during the war and were never rebuilt.

After Poland gained her independence in 1918, a number of new sugar factories were established and in 1929/30, 840,000 tons of sugar were produced by 72 factories compared with 152,000 tons in 1920/21.

The Sugar Industry Institute was set up in 1927 to replace the Central Sugar Laboratory which had been founded in 1898 to investigate new techniques and for the planning and development of new types of equipment, etc.

In the early thirties, sugar production in Poland fell to 310,000 tons per year as a result of the world sugar market slump. Small factories were liquidated and only 61 remained in operation. It was only during the few years just preceding World War II that production started to pick up again to reach 500,000 tons of sugar per year. Old factories were modernized, electrified and fitted with drying plants. The 1937/38 campaign saw a beet area of 150,000 ha with a sugar yield of 4·5 tons per ha. However, the campaign was short and only a few factories worked more than 50 days.

During World War II many factories were destroyed or dismantled and the equipment confiscated, while many of the leading sugar technologists were killed.

In 1945, only 53 sugar factories were in operation, producing a total of 170,000 tons of sugar. However, in the following year 71 factories were in operation and 383,000 tons of sugar were produced despite many difficulties concerned with the lack of skilled labour and with transport. During the 1950/55 period, ten raw sugar factories were modified for the production of white sugar. From 1956 onwards, sugar factories were enlarged, their equipment modernized and the latest processes introduced, so that by 1961/62 sugar production had reached a level above 1½ million tons, a figure exceeded by only two other European countries. Sugar consumption had risen from 11·3 kg per caput in 1930 to 30·6 kg per caput in 1961, by which year 76 factories were in operation with an average campaign length of 106 days.

Rapid expansion in the capacities of the factories in order to handle the increasing supplies of beet has meant that a certain number of factories still lack continuous diffusers, although all have modern filtration, crystallization and curing equipment and automatic control has been introduced for all processes up to and including the evaporators. The overall daily slice is now about 120,000 tons of beet. Of the 76 factories, five produce direct consumption as well as refined sugar, three produce raw sugar, and three have facilities for producing molasses alcohol, acetone and citric acid. Most of the factories have pulp drying plants, which during the off-season are used for the drying of other products such as green fodder, etc.

Because of the small sizes of the factories in relation to the available beet, it is necessary to operate during the winter, when, in December and January, the temperatures vary from —15°C to +10°C. Under such conditions, there is rapid deterioration of the beet so that this problem is of great importance and is the subject of studies at both the Sugar Industry Institute and the Sugar Industry and Food Processing Faculty at Lodz Polytechnic.

Polish sugar factories use the conventional scheme of progressive predefecation, main liming, 1st and 2nd carbonatation and sulphitation, with a 3-massecuite boiling scheme. The 3rd massecuite is purified by affination. The average sugar yield is 13–14% on beet, with average losses of about 3·5% on beet (about 1·7% in molasses). Beet pol is about 16·7–17·0%.

The planning and designing of processes and equipment and all sugar technology problems are left to three organizations: Cukroprojekt (Central Designing Office of the Sugar Industry), the Sugar Industry Faculty at Lodz, set up in 1950 under Prof. ZAGRODZKI—this is responsible for awarding diplomas and sponsors research work in a number of sugar fields, in particular juice purification—and the Sugar Industry Institute, which is divided into five departments covering sugar beet, sugar technology, mechanics and energetics, analysis, and economics. Sugar technologists are trained as factory foremen at the School of Sugar Technology in Torun.

Cukroprojekt was established in 1949 and comprises the following departments: sugar technology, fat-processing technology, building and architecture, power supply/steam boilers, turbosets, automation, electricity, water supply and waste disposal, and a planning and estimation division. A special group of experts also deals with technical information and studies problems concerning technical progress. Cukroprojekt is responsible for the building, expansion and modernization of local sugar factories, as well as for beet and cane factories that have been exported. Automation is being widely introduced and problems connected with it are receiving attention.

The export of complete factories and equipment is handled by CEKOP, the Polish trade organisation, which also makes thorough examinations of the raw material as well as the resources and agricultural possibilitites. In Ghana, for instance, Polish specialists developed the area adjacent to the projected factory and created a model cane plantation. Other factories have been exported to Mainland China (two beet and one cane with a molasses distillery and a solid CO_2 plant), Persia, Viet-Nam, Ceylon and Greece, and 10 are being exported to the USSR and to Indonesia. Among equipment manufactured in Poland are a 4-speed automatic centrifugal, the DdS diffuser (made under licence), the Szarejko filter, complete beet and cane equipment and steam turbines.

In 1958 a second Sugar Factory Design Office was set up, working in conjunction with ZEMAK, the Union of Heavy Machinery Industry, which builds complete sugar factories. This office has designed three more factories for the USSR and one each for Syria and Morocco. The possibilitity of a beet factory and a refinery in Tunisia has also been studied.

SUMMER COURSE IN SUGAR TECHNOLOGY 1963

WITHIN the framework of sugar technology training, a course was again held at the Technische Hochschule, Braunschweig, from 18th April to 19th July 1963 for advanced training of sugar technologists.

Apart from the students at the Technische Hochschule, this year two men from the German sugar industry and nine young sugar technologists from Ireland, Spain and Iran took part in the summer course. The number of young foreign sugar technologists, which has been steadily growing for years, is an indication that these participants receive valuable preparation and schooling at the Braunschweig Institut with a view to their future occupation in their home country.

The training programme of the 13-week term included the following:—

Prof. Dr. F. SCHNEIDER lectured on chemistry and technology of sugar manufacture, and chemistry of carbohydrates, while he was also in charge of a sugar technology seminar, and sugar technology colloquium (general discussion with Prof. Dr. R. WEIDENHAGEN, Dr. A. EMMERICH and Dr. E. REINEFELD).

Prof. Dr. H. LÜDECKE lectured on sugar beet and sugar beet cultivation, while Prof. Dr. R. WEIDENHAGEN taught the chemistry and technology of juice purification in sugar manufacture.

Dr. A. EMMERICH gave lectures on analytical factory control in the sugar industry, and Dr. E. REINEFELD on extraction processes in sugar manufacture.

The lectures were supplemented by practical exercises in the individual departments of the Institute as well as by the seminars held by the respective experts.

A three-day course on measuring and control techniques in the sugar industry, organized this year by the firms of Dreyer, Rosenkranz and Droop A.G. and J. C. Eckardt A.G. at the Institute, and to which young men from the Lower Saxony sugar industry were invited, completed the course.

Towards the end of the course short trips were made to firms in the Braunschweig area which work in close collaboration with the sugar industry, including Braunschweigische Maschinenbauanstalt A.G. Salzgitter Maschinen A.G., Oppermann & Deichmann, Selwig & Lange, Librawerk Pelz & Nagel K.G. as well as Kleinwanzlebener Saatzucht in Einbeck/Hannover. The Sugar Beet Research Institute at Göttingen was visited in connexion with the lectures given by the Director of the Institute, Prof. Dr. H. LÜDECKE.

The close of the course again took the form of a five-day grand tour, this year through the Rhineland, under the leadership of Prof. Dr. F. SCHNEIDER and Dr. G. BAUMGARTEN, visiting the following works: Sprengel, Hannover; the Elsdorf and Dormagen sugar factories of the firm Pfeifer & Langen; Buckau R. Wolf, Grevenbroich; Deutsche Maizena-Werke, Krefeld; Farbenfabriken Bayer A.G., Leverkusen; Deutsche Babcock & Wilcoxdampfkesselwerke, Oberhausen; and Putsch & Co., Hagen.

The next sugar technology summer course will take place from 21st April to 25th July 1964. Applications are to be sent by 31st January 1964 to: Institut für landwirtschaftliche Technologie und Zuckerindustrie an der TH Braunschweig, Braunschweig, Langer Kamp 5, Germany.

Empirical estimates of roll load and roll torque. J. E. Holt. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 111–116.—A method of calculating roll load and torque is described. This is based on determination of the area under the pressure curve, which when multiplied by (roll radius × roll length) gives the roll load. A pressure curve is considered in three parts: the "constant" maximum pressure region and the regions of increase to and decrease from the maximum. The conditions are satisfied by a parabola of form $y = a(x - b)^2$, which is modified for a given maximum pressure. Equations are developed for calculation of the roll load per foot, cos α (entry angle) and cos θ (angle of the neutral plane). The maximum pressure is calculated from a simple expression based on the fact that the maximum pressure increases with increasing coarseness of preparation and decreases with increasing roll surface speed. Comparison of results obtained with the assumed empirical distribution and experimental results shows that the predicted values lie within the range of the experimental values. The roll torque is calculated from the roll load by means of a simple expression. A worked example is presented.

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Factors affecting the deterioration of clarified juice. A. G. Noble. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 141–146.—In laboratory tests, the drop in apparent purity of clarified juice stored in a water bath maintained at 190°F was noted and the effect of adding 1000 p.p.m. of soda ash was determined. Deterioration of the untreated juice increased with time, whereas with soda ash added during the initial 20 hr there was little change in the apparent purity, subsequent deterioration being at a much lower rate than with the untreated juice. Over the 40 hours of storage, the respective purity drops for treated and untreated juice were 1·36 and 5·44 units. Caustic soda at concentrations of up to 1500 p.p.m. was found to be more effective than soda ash, although at higher concentrations the effects were practically the same. Thus, to obtain a purity drop of <1 in 40 hr required the addition of either 500 p.p.m. caustic soda or 1500 p.p.m. soda ash. Caustic soda, while dearer than soda ash, is still more economical in this case. Soda ash had a greater reducing effect on the purity drop at 190°F than at 180°F or 170°F, while the purity drop in untreated juice was lower at 180°F than at 190°F as a result, it is suggested, of less chemical decomposition at 180°F. The purity drop at 190°F rose sharply towards the end of the 40-hr period when the pH of the juice fell below 7·2. At least 1500 p.p.m. of soda ash is necessary to keep the pH above this value. At 170–190°F formalin at up to 1000 p.p.m. had no effect on the purity drop, whereas at 150–160°F 200 p.p.m. formalin reduced purity drop over the 40-hr period to less than 0·2 units. The difference in the effects at the higher and the lower temperatures is attributed to the chemical decomposition largely responsible for the sucrose losses at the higher temperatures and to the bactericidal effect of the formalin at the lower temperatures. Storage at 160–165°F with addition of formalin is therefore recommended. The purity drop was reduced with increased concentration of muds in the clarified juice. A procedure for controlling the temperature of stored juice and adding formalin is outlined and the economic aspects of formalin treatment are discussed.

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Some more on the weekend storage of subsiders. C. S. Henderson. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 147–156.—Causes of increased purity drops in juice stored in clarifiers at Racecourse mill are discussed. Tests with formalin showed that this is effective only a temperature below 160°F and that amounts of 150–300 p.p.m. must be added at a point as close to the clarifier as possible to minimize evaporation. Temperature distribution in the clarifier was investigated and irregularity in this rejected as a cause of juice deterioration. Since purities were found to vary throughout the clarifier, the procedure whereby snap samples were taken and combined was replaced by one where samples were withdrawn from each tray at 10–15 min intervals to get a vertical and a horizontal range of samples. Some variation in purity was found to be due to spindle Brix analysis errors when juice was dirty as a result of stirring up mud in the clarifiers. Readings to 0·1°Bx with a Galileo Abbé-type refractometer were not reproducible. The storage temperature may be up to 190°F or slightly higher without harmful effects if the juice is likely to be cooled below 160°F before the resumption of crushing. Temperature and pH are two of the most important factors in juice storage. Maintenance of the pH above 7 is possible by adding 1400 p.p.m. soda ash. Results are given of a 50-hr storage test in which soda ash and formalin were added. The final purity was about 80·5 compared with the initial purity of about 83·8, and it is considered that storage could have been extended had the initial temperature of 184°F been maintained.

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Some notes on sugar filtrability and clarification. L. J. Briggs. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 157–160.—Fluctuations in the filtrability of raw sugar from Inkerman mill are discussed. A close correlation was found between sugar filtrability, its phosphate content and the pH of clarified juice, and the low filtrabilities are attributed to high phosphate content in the sugar as a result of a low clarified juice pH. Determination of clarified juice pH throughout the season revealed fluctuations, which are discussed, and particularly a marked deterioration in conditions after early November, reasons for which are sought. Filtrability of the raw sugar is good if the pH of the clarified juice is maintained at about 7.

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Automation of a lime mixing machine. K. A. STUART. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 161–162.—Some details are given of the automatic lime mixer station at Pleystowe which includes a 3000 gal storage tank provided with probes so that when the level falls to the bottom probe, mixing commences. Lime is gravity-fed to the mixer by a chute to which it is metered by means of a 3 ft dia. turntable which is rotated by the action of a thruster at 8 r.p.h. The mixer drum rotates at 7·5 r.p.m. Water flushes the lime down the feed chute and the lime slurry is discharged over a lip and through a mesh screen to a 75 gal storage tank. The screen is attached to the mixer in the form of a truncated cone and thus traps rocks lifted by projections inside the drum. As the small storage tank fills, the slurry is pumped away. The mixer may be started manually. Variations in the slurry density were small enough to have no effect on pH control. The installation has proved reliable and necessitates only occasional inspection by a shift overseer.

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Experiences with automatic control of low grade boiling. W. F. CLARKE and G. R. COOK. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 173–176.—Installation of an automatic feed control on the low-grade vacuum pan at Proserpine has resulted in the production of a clean massecuite of uniform density. The conductivity controller operates when the footing has reached a Brix of 86–87° (obtained by manual water feeding). *B*-molasses is then fed automatically during about 4 hr, with manual feeding of a small amount of movement water. When the pan is full, the molasses feed is shut off and control is switched to the pneumatic water valve. After a further short period, a time schedule cam device is actuated, the cam follower gradually lowering the set point of the instrument from 45 to 30 in 1½ hr. This controls the heavying rate and the Brix of the massecuite is 98·5–100 at dropping. The instrument is then reset for the next strike. Suggested improvements include a vacuum and a steam pressure control. A molasses Brix control has been installed and is operating satisfactorily. The optimum position of the electrodes in the control system is in the downtake, extension tubes being used for this purpose.

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Nucleation in sugar boiling. P. PENKLIS and P. G. WRIGHT. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 177–182.—The influence of temperature, mother liquor purity and crystal content on nucleation was determined using a laboratory vacuum pan 20 inches tall and 10 inches in dia. provided with a belt-driven marine propeller. Feed was controlled through a conductivity instrument with pneumatic operation of a pinch valve. The massecuites were prepared by adding raw sugar to a molasses blend adjusted to a required purity. The supersaturation was brought to about 0·05 below the expected nucleation region, and a time schedule controller used to decrease the conductivity progressively so that the molasses supersaturation rose at a rate of 0·004 per min. The tests were conducted on syrups of 80, 65 and 55 purity and at 140° and 160°F, comparative tests being made in the absence of crystals. The presence of crystal appreciably lowered the nucleation supersaturation, which rose steeply with reduction in molasses purity. The relevant over-saturation levels at 60 purity were approximately double those at 80 purity. Nucleation occurred at 65–75% lower over-saturation in molasses at 160°F than at 140°F, but the crystallization rates indicated that the higher temperature would still permit higher crystallization rates.

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Automatic truck handling in a mill yard. J. L. SHANN and K. P. CRANITCH. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 189–194.—Details are given of the automatic cane truck handling system at Kalamia. The equipment includes two hydraulic pump units, four hydraulic pushers, an electrical relay panel and control desk, and a number of track switches. Each item is discussed individually. After some modifications, the system has operated smoothly and efficiently.

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Modifications to an A.C. carrier drive at Racecourse. N. A. NIELSEN. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 195–200.—Details are given of the automatic carrier control and of certain problems encountered with the system. The carrier is driven by a 960 r.p.m. motor, stalling of which at low speeds is prevented by means of a relay-timer circuit, as with the cane elevator drive. The top four speeds of the elevator are controlled by the lower of two feeler plates in the chute to No. 1 mill, the top plate controlling the 1st speed. A feeler plate between the two sets of knives control the carrier speeds when the feed is lighter or heavier than average. Lost time during 3,690 hr when crushing over ½ million tons of cane in 1962 was only 3 min.

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Sugar cane carrier control by automatic Ward-Leonard system. F. C. CHAPLIN and J. L. READ. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 201–206.—The cane carrier at Plane Creek mill was split into a carrier and elevator and a Ward-Leonard system installed with separate motor-generator sets for the carrier and elevator. Full details are given of the electronic control system, which has proved satisfactory in operation, although improvements in the acceleration control after a complete stoppage are considered desirable. The depth of the cane mat is sensed by a feeler plate and a position signal is transmitted to the elevator speed regulator and to the integrating device on the input to the carrier speed control. A second feeler plate on the carrier before the cane knives transmits a second position signal to the carrier speed control input integrator, so that the algebraic sum of the two position signals is the reference applied to the carrier control. Limit controls reduce the carrier speed if overloading occurs on either knife motor, but these do not affect the elevator control systems.

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The operation of a bagasse weigher. W. N. ADCOCK and R. K. HUNTER. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 207–211.—Details are given of the Avery 4804 Ely totalizing conveyor weigher installed at Pioneer mill to weigh the bagasse in transit from No. 5 mill. The results of weekly tests in which bags and trolleys were weighed are given and show an accuracy of about $\pm 1\%$.

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The determination of bagasse weight. B. G. ADKINS, A. G. CLAIRE and K. W. CROUTHER. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 213–218.—Three methods of determining the quantity of bagasse produced were tested at Pioneer mill, viz. (1) direct weighing, using the Avery conveyor weigher (see preceding abstract) ; (2) a mass balance, giving losses from the milling train; and (3) the fibre-ratio method, in which all insoluble matter entering or leaving the milling train is determined. Details are given of the test procedure and the results are tabulated. It was found that the fibre-ratio method gave lower values than did the conveyor weigher, results recorded by the weigher being taken as standard. The mass balance method showed there to be a loss of some 10% on bagasse for the milling train; this is attributed to evaporation.

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Some notes on the assessment of roller surface conditions. W. A. GREENWOOD. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 219–222. The relationship between the reabsorption factor (k) and the weight of fibre per unit of escribed volume (or bagasse volume) (lb/cu.ft.) was used as a guide to the surface condition of mill rollers. Weekly calculations were made of the bagasse volumes, fibre % cane (for pre-setting of mill rolls), and the top roll diameters, groove depths and set openings measured at each week-end. The roll speeds were determined using revolution counters (more accurate than previous tachometer measurements). A graph is presented of k *vs.* lb fibre/cu.ft. escribed discharge volume. Where low values of $\frac{\text{lb/cu.ft.}}{k}$ occurred, the rollers were found to have visible signs of polish and were roughened. The ratio increased when the discharge opening decreased. It was also found that as crushing proceeds, much greater pressures can be applied at succeeding mills for the same degree of reabsorption. The method of assessing roll surface condition is considered a useful guide on a weekly basis but not on a daily basis except where larger samples than usual may be taken more frequently.

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Notes on the use of superheated steam. R. F. BEALE and P. N. STEWART. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 223–228.—The advantages and disadvantages of superheated steam for power and process heating are discussed and results of tests with the 1st effect of an evaporator are presented in the form of a graph of apparent heat transfer coefficient *vs.* superheat. Evaporation was calculated by two methods: measuring the change in Brix of clarified juice as it flowed through the effect, and metering the condensate from the evaporator calandria. Superheat was found to have no adverse effect on the heat transfer coefficient (based on the saturation temperature) up to 80°F of superheat. The coefficient fell only slowly above 80°F, a 7·5% reduction occurring at 180°F of superheat. In pan tests, a temperature gradient was found to exist as a result of steam throttling in the mains, giving up to 30°F superheat in the calandria. After desuperheating sprays had been fitted to the steam pipes, only insignicant temperature variations occurred. Pronounced ebullition of the massecuite adjacent to the steam inlets is attributed to the higher steam velocities in the area.

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Pressure feeders and multi-twin roller mills. W. M. LIVIE. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 229–240.—Experimental work carried out in the development of the continuous pressure feeder and the multi-twin roller mill by The C.S.R. Co. Ltd. and by John Thompson (Australia) Pty. Ltd. on the advice of the author is surveyed. Details are given of an experimental eight-roller multi-twin and a six-roller multi-twin mill, both of which incorporated continuous pressure feed chutes[1]. These C.S.R. mills attained a maximum extraction of 82·2%, a maximum fibre rate of 4·8 tons of fibre/ft/hr, and a maximum cane rate of 36·9 tons/ft/hr. A very small eight-roller multi-twin mill manufactured by John Thompson (Australia) Pty. Ltd. is also described. At a crushing rate of 800 lb/hr this attained an extraction of 92·0% at a roll speed of 12·5 r.p.m. and a final bagasse moisture of 48·0%. The advantages of the multi-twin mill are listed. The capital and installation costs are estimated at one-half to two-thirds of those of a comparable three-roller mill.

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Air filtration in industry. A. H. ROBERTS. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 241–247.—Descriptions, applications and advantages

[1] *See also I.S.J.*, 1963, **65**, 310.

of various types of air filters are presented. The range covers porous diaphragm, oil wetted, oil bath, centrifugal and in-line filters for compressed air.

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Petroleum standards recognized in the manufacture and use of industrial lubricants. G. E. WILSON. *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 249–259.—Standards laid down by the American Gear Manufacturers' Association for lubricants and the N.L.G.I. grading system for greases are presented with specifications laid down by gear and bearing manufacturers. Tests procedures laid down by the American Society of Testing Materials are quoted.

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Cleaning the raw cane juice prior to the process of heating and clarification. J. A. ACOSTA. *Sugar J.* (La.), 1963, **25**, (12), 22–24.—The benefits of removing bacteria-forming impurities from cane juice before it is heated are considered and mention is made of the author's patented clarifier[1] which is claimed to remove 55–65% of the juice dirt and trash. One of these clarifiers has been installed in Fellsmere factory, Florida, and enquiries from any factories interested in the clarifier are invited.

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Graining of low purity massecuites. SIR JOHN SAINT, R. R. TROTT and F. J. HUTCHINS. *Sugar J.* (La.), 1963, **25**, (12), 24–30.—See *I.S.J.*, 1963, **65**, 18.

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Factory research in Hawaii. ANON. *Rpt. H.S.P.A. Expt. Sta.*, 1962, 59–63.—A programme has been set up to investigate the possibility of centralizing sugar factory control processes with the aim of operating a factory with just one or two operators. Instruments suitable for continuous or semi-continuous automatic analysis of various process streams for polarization, refractometric determinations, etc. are being studied. Computer application in control operations and new sensing devices for use in control systems are to be investigated. Methods of controlling the feed to the cane cleaner at McBryde factory are being studied in order to relate this automatically to the mill feed rate[2]. A continuous saccharimeter and refractometer are to be installed in the factory. Calcium silicate slag has been tested and found to be of limited use in clarification, because of plugging of the percolation bed and its low capacity. The effect of salts on sucrose crystallization has been studied[3]. The effects of "Versene" (EDTA) and sodium hydrosulphite on the quality of sugar crystal were investigated using a laboratory vacuum pan. Neither chemical affected the filtrability. "Versene" at 20 p.p.m. has a slight reducing effect on crystal colour, but sodium hydrosulphite had an even greater effect, 3·5 p.p.m. giving a colour of 4·4 compared with 5·3 for the control. A pan control system, designed and manufactured by Taylor Instrument Co., is being tested at Puna. The system measures massecuite consistency and controls it by regulating syrup feed, the temperature of the vapour leaving the massecuite being used as an indirect indication of mother liquor Brix. The system appears to enable boiling to continue with very little attention. Consistency is preferably measured with a probe rather than by the load on the circulator motor. No clear trend was found in scaling tests in which clarified juice was treated with lime or soda ash. No apparent relationship was established between the purity rise resulting from clarification and the treatment with lime or soda ash. Further tests are planned to compare magnesium oxide with soda ash and caustic soda with lime. New ion-exchange membranes with high sugar transfer rates are to be tested for ash removal capacity and power consumption. Accurate sugar yield figures have been obtained by using the core sampling and disintegrator method of cane analysis. A remote-controlled calibrating filter has been developed for bagasse weighers which enables calibration checks to be made without the need to leave the instrument panel. A zero suppression circuit for the micro-microammeter used in the weighing system eliminates the need for specially modified recorders or intermediate transmitters. This circuit is to be factory tested at Ewa. The effect of high-speed centrifuging on filtrability of solutions indicated that Hawaii Island sugar contained more insoluble particles removable in this way than sugar from Oahu. Higher *g* forces, however, have lower subsequent effects and the filtrability of Hawaii Island sugar is still low after treatment at 105,400 *g* compared with that of Oahu sugar. This is attributed to substances, probably mainly water-soluble hydrated polymers, that cannot be sedimented at the higher *g* forces. Since the colour of melanoidins in sugar crystal is not much affected by pH, differences in crystal colour with pH are a valuable quantitative indication of the presence of thermal decomposition products, the other principal class of colour compounds in crystals. An experimental cell designed to measure saturation temperature has walls made of crystalline sucrose, so that when the sample in the cell is heated beyond its saturation temperature, the walls start to dissolve. This is accompanied by heat absorption and a change in the electrical conductivity of the solution. The cell is provided with platinum electrodes and a thermistor for measurement of either the conductivity or heat effect. The sensitivity is to be further improved by installing a second cell without sucrose walls in a bridge circuit with the measuring cell. A study of the relationship between light scatter and crystal colour has shown that since light scattering increases with a decrease in the angle of measurement, it may have a significant effect on crystal colour measurements. Since a large part of the substances contributing to light scatter in Hawaii Island sugars is removed by ultra-centrifuging, and these substances also affect filtrability (*see above*),

[1] *I.S.J.*, 1959, **61**, 253.
[2] *See also* MORGAN: *I.S.J.*, 1963, **65**, 368.
[3] MORITSUGU & ONNA: *I.S.J.*, 1963, **65**, 375.

there is a close relationship between light scatter and filtrability as well as crystal colour. Only a slight improvement in some of the operational phases was found when processing syrup at pH 5·7 instead of slightly above pH 6·0.

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Bulk reception of raw sugar at sugar factories in the Lithuanian SSR. A. N. DAUIOTAS. *Sakhar. Prom.*, 1963, (6), 18–20.—Details are given of the methods and equipment used to unload bulk sugar from rail cars and to reclaim sugar from the warehouses. The advantages, including reductions in labour requirements, are discussed.

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Production of filter powder from tripolite. A. K. KARTASHOV, V. A. SKRIPLEV and V. A. CHERNENKO. *Sakhar. Prom.*, 1963, (6), 20–23.—A scheme for production of filter-aid from Ukrainian tripolite is described with the aid of a flow-sheet. In tests of the finished product (activated by heating at 970°C for 2 hr) against "Hyflo Super-Cel", the filtration rate for a 100-ml 60°Bx syrup sample at 80°C (giving an absolutely pure and sparkling filtrate) was 3% greater.

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Control of cane sugar waste in Puerto Rico. R. M. GUZMÁN. *J. Water Pollution Control Fed.*, 1962, **34,** 1213–1218; through *S.I.A.*, 1963, **25,** Abs. 294. Experiences in water pollution control at Santa Juana factory are reported. The major BOD load was due to concentrated wastes, especially from factory cleaning operations. Anaerobic digestion of the wastes in the laboratory with 25% of aged filter cake sludge led to an average BOD decrease of 78% after 8 days at 29°C. The wastes were treated in a series of lagoons and discharged at a controlled rate. The BOD load of the condenser waters, which were discharged into the river without recirculation, was effectively decreased by the installation of new entrainment separators and the reduction of evaporator and vacuum pan syrup levels.

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The amine smell of the anion exchange resin. K. KIMURA, T. KAWAMURA and H. HASHIMOTO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12,** 9–15.—Sugar solution passed through a fresh bed of strongly basic anion exchange resin retains the fishy smell of amine during the early cycles. Even pre-washing with warm water was not effective in preventing the dissolving of amine substances in the sugar solution effluent and as the pH of the effluent rises, so does the smell. The best method for removing the amine substances was found to be treatment with 5% Na_2CO_3 (3 litres/litre of resin), followed by washing with water, and regenerating with 10% NaCl, repeating this procedure at least three times. Without such treatment, the effluent sugar solutions should be kept below pH 6·8 during refining.

Caking of refined soft sugar. T. YAMANE and T. IWAKURA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12,** 83–89.—A simple apparatus is described for determining the degree of caking of refined soft sugar (to which invert sugar is added in the centrifugals before drying) and the measurements are related to the reducing sugar and glycerin contents of the samples. The samples were stored for 2 weeks in desiccators at constant relative humidities of 81–32%. The relationship between the moisture loss and reducing sugar content is expressed by a straight line graph. The addition of invert syrup does not prevent caking if the sugar is first stored at an R.H. higher than 66% and later at lower R.H. values, the degree of caking being almost proportional to the moisture loss. Sugars of high reducing sugar content first absorbed and later lost more moisture during storage, and addition of glycerin was found to be more effective than invert in preventing moisture loss.

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Outline of the facilities at the Edfu factory and a general outline of the sugar industry in Egypt. S. ABE. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12,** 90–99.—An illustrated survey of the Egyptian sugar industry with factory data for the Armant, Kom Ombo and Edfu factories.

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Improving mill drainage with Messchaert grooving. C. M. AVRILL. *Proc. Amer. Soc. Sugar Cane Tech.*, 1959, 59–60.—Grooving back rollers of the cane mills at Sterling Sugars Inc. with Messchaert grooving and installing Messchaert fingers on the bottom roller scraper blades together with increased maceration water resulted in increased juice extraction and a reduction in bagasse moisture.

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More effective clarification. M. M. MORON and A. G. KELLER. *Proc. Amer. Soc. Sugar Cane Tech.*, 1959, 61–75. See *I.S.J.*, 1959, **61,** 306.

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The problem of excessive trash—Glenwood sugar factory. L. SUAREZ. *Proc. Amer. Soc. Sugar Cane Tech.*, 1959, 80–82.—See *I.S.J.*, 1959, **61,** 368.

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Improved cane mud filtration with the "RotoBelt" filter. E. R. VRABLIK and D. A. DAHLSTROM. *Proc. Amer. Soc. Sugar Cane Tech.*, 1959, 83–120.—See *I.S.J.*, 1959, **61,** 307.

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The manufacture of refractories. R. C. WEIGEL. *Proc. Amer. Soc. Sugar Cane Tech.*, 1959, 143–153.—A brief history of refractory manufacture in the U.S. is presented and the manufacturing processes and recent developments and applications are discussed.

Flow resistance in juice heaters. A. BUCZOLICH. *Cukoripar*, 1963, **16**, 131–134.—The increase in hydrodynamic resistance in juice heaters with increased flow rates is discussed and measures to overcome this are considered, with the aid of graphs. Rather than increase feed pressure by installing higher duty pumps or by increasing the number of pumps, it was found preferable to modify the juice chambers in the heater and thus reduce flow resistance.

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Investigations of the effects of beet sugar industry waste waters on the quality of river waters. U. KRALIK. *Wiss. Z. Karl-Marx-Univ. Leipzig, Math.-Naturwiss. Reihe*, 1962, **11**, 159–165; through *S.I.A.*, 1963, **25**, Abs. 296.—Biological and chemical analyses were carried out at several points along the Weisse Elster, Salza and Unstrut rivers, East Germany, during the 1958–59 beet campaign. The Salza, with four beet factories, was heavily polluted. The results show that biological indices such as the "saprobial value" are more sensitive than the determinations of O_2, BOD, permanganate value, etc., particularly in cases of moderate pollution. Accumulation of *Sphaerotilus natans* mats greatly reduces the subsequent self-purifying capacity of the river. The subject is discussed and remedial measures are considered.

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Flow rate and level control systems in juice purification process. K. NISHIO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12**, 60–66.—The flow rate and level control system adopted at Kitami beet sugar factory is described. Special float and displacement type level transmitters send non-linear signals which describe the level of the juice in the raw juice tank, thin juice tank, etc. This system prevents emptying and overflowing of the tanks while maintaining a more or less constant flow rate. The flow rate of the thin juice to the first evaporator effect changes only once or twice per shift and the deviation from the mean flow rate is only 1–2%.

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Low raw sugar crystallization in connexion with affination. H. L. MEMMOTT and E. C. JONES. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 288–295.—Details are given of a boiling procedure tested at Moses Lake factory. A 400 cu.ft. graining charge of high green syrup is fed into the pan, and the charge boiled until the B.P.E. is 9°C. Then 275–300 ml of milled seed, prepared by grinding 2 lb of sugar with 2 litres of anhydrous isopropyl alcohol in a ball mill for 24 hr, is added and at a B.P.E. of 11°C the steam valve to the calandria is turned to half open. Crystal growth proceeds for about 15 min until the B.P.E. starts to fall, and feeding of intermediate green syrup is started and the steam valve opened fully. When the massecuite volume reaches 1000 cu.ft., half of it is cut to a second, similar pan. The pan used for graining is fed at a fast evaporating rate and the other at a slower rate, thus balancing the boiling schedule. The milled seed has the advantages of being a stable mixture of which only a small quantity is required, gives approximately the same number of grains each time, and permits a very simple seeding operation. When the final pan volume is reached, the feed is shut off and the contents brought to a required Brix. Both pans are boiled at a constant absolute pressure of 4 in Hg for 4 hr per pan. A mechanical agitator is required for the slow rate of evaporation, the aim of which is to establish a good grain footing for crystal growth, giving a crystal area necessary to take more sucrose in the form of feed liquor. The M.A. of the low raw sugar was increased to an average of 0·0115 from 0·0050, the plant capacity raised from 3,579 tons in 1959 to 4,620 tons per day in 1961, and the purity of the raw sugar raised from 93·1 to 94·6. The raw sugar could be affined to 99 purity and returned via the affination tank to the white pan.

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Control of the evaporator station in the sugar industry. G. STRAUSS. *Zuckererzeugung*, 1963, **7**, 114–122, 137 and back outer cover.—Evaporator control schemes described in the literature are examined to see which of them meets five basic requirements: maintenance of optimum steam consumption, thick juice Brix and vapour temperatures under varying factory conditions; maintenance of a given adjustable apparent juice level in the evaporator; maintenance of optimum juice temperatures, boiling times, etc. without adversely affecting the factory throughout; easy adaptability of the control scheme to variations in the factory conditions (with variation in beet); and the ability to prevent deterioration in evaporator operation (e.g. excess thickening-up of juice) in the event of such exigencies as factory standstills, although the system must be cheap, simple and reliable. The schemes described, particularly those of SCHINK[1] and DIEKERS[2], are considered to fall short of the requirements, especially as regards the discrepancy between the actual and required evaporation in kg/100 kg beet, and the control of juice flow at the beet end. A scheme for a quadruple-effect evaporator is described which is claimed to meet the requirements. A reserve water feed at the thin juice tank is used in the event of a drop in juice feed to the evaporator. The thin juice is pumped to the 1st effect via a volume

[1] *Zeitsch. Zuckerind.*, 1961, **86**, 671–674; *I.S.J.*, 1962, **64**, 147.
[2] *Zucker*, 1962, **15**, 120–125; *I.S.J.*, 1962, **64**, 209.

control and a pre-heater, the volume of feed depending on the juice level in the 1st effect. The passage of juice through the evaporator depends on the level of juice in the preceding effect. A juice circulator is provided in the 4th effect; a valve in the circulation line regulates the amount of juice in circulation at constant pump duty and thus controls the amount of thick juice passed to the boiling house. It operates in accordance with the level of juice in the thick juice tank before the filters. The evaporator level control or flow meters are adjusted to the juice level in the feed tanks. The pan station is fed with 2nd vapour, the temperature or pressure in the 2nd vapour line regulating the amount bled, on the basis of the so-called "middle juice" concentration, by means of a disturbance system. Make-up of 2nd vapour with exhaust steam is also provided for. Full details are given of the vapour transfer between effects and two variants are given of a scheme for linking the 4th effect to the condenser. The minimum control programme required and the economics of the scheme are also discussed.

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Control of yeasts in sucrose syrup by control of syrup pH. D. D. LEETHEM and F. G. EIS. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 559–560.—Investigations of yeast metabolism in liquid sucrose inoculated with yeast showed that the rate of metabolism decreased with increasing pH values up to about 8. At pH 8 and above it was found that yeast metabolism stopped and yeasts present in the syrup died during storage. To increase the pH of the syrup, the hydroxyl alkalinity of the water used to dissolve the pH is increased, a 5 p.p.m. increase (equivalent to about 10 p.p.m. NaOH) raising the pH from 7 to about 8. No effect on colour, taste, odour, etc. was discerned, but an objectionable colour increase occurs in the case of sucrose syrup-corn syrup blends.

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Measuring and control equipment in an evaporator station. H. J. STOCK and W. WINKLER. *Zuckererzeugung*, 1963, **7**, 123–125, 138.—The equipment and techniques for measuring and regulating the various factors incorporated in the evaporator control scheme described by STRAUSS[1] are described in detail with the aid of flow sheets and diagrams. The themes covered include temperature, pressure, volume, level and juice density measurement, condensate make-up in the thin juice tank, level control in the evaporator and thick juice tank, control of the exhaust steam make-up for 2nd vapour, thick juice Brix control in the evaporator, pressure control for the exhaust steam fed to the 1st effect and the limit control for the volume of 2nd vapour bled to the pan station.

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Chemical effect on the respiration of stored beet. W. WÖHLERT. *Zuckererzeugung*, 1963, **7**, 126–133. A large number of references to the literature accompanies this article on beet respiration during storage. The most significant factor affecting respiration is temperature, which over a range of 5–30°C can rise by approximately 10° in stored beet and thus double or even treble the respiration. Tests have also shown that chemicals will affect beet respiration and experiments have been carried out on the use of chemical inhibitors for stored beet. Of a long list of preparations and reagents tested by application to topped beet (a graph shows the mg of CO_2 absorbed by 100 g of beet per day after 30–80 days at 1°C and 85% R.H.), only five were found to be suitable as inhibitors: tetrachloronitrobenzene, dipyridyl, phenylthiourea, methylnaphthylether, and V-K chalk. Their effects varied according to the test period (November 1960–February 1961 and March–May 1961) ranging from approximately 40% reduction in the respiration rate to slight stimulation. Dipyridyl was used to demonstrate the penetration of the inhibitor into the beet tissue.

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Sugar centrifugals. Y. COUPLET. *Sucr. Belge*, 1963, **82**, 353–359.—Some of the features of the fully automatic batch centrifugals at Wez (Belgium) are discussed and some details are given of the operational procedures. The *A*-massecuite is double-cured with intermediate mingling, the level in the supply distributors to the first centrifugals being maintained constant by means of a pneumatic valve on the mixer pump. Viscosity of the massecuite is also kept constant by automatic addition of the run-off syrup feed from the second centrifugals. The two pairs of centrifugals are kept in step with the materials flow in the factory by means of an automatic variable-speed time controller, which delays the next batch when a full charge of massecuite is not required. The basket weight has been found sufficient to keep the basket on its vertical axis without oscillation, while four single-acting shock absorbers are used (these are equivalent to two double-acting shock absorbers). The charging is automatically controlled through the weight of the contents of the basket which rests on a lever. When the basket is full, the weight on the lever causes it to close the electric circuit to the massecuite valve, which then closes. Washing is carried out with a single oscillating nozzle with water at about 105°C (3 litres/100 kg for the two *A*-massecuite spinnings) followed by steam washing made necessary by the absence of a sugar dryer. Details are given of the speed steps of the automatic motor and of the basket construction.

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Molasses de-sugaring in the German patent literature. H. OLBRICH. *Zeitsch. Zuckerind.*, 1963, **88**, 307–315. Since 1877, 156 German patents have been entered in Class 89h (molasses exhaustion) and others relating to the subject have been taken out, but are classified in other categories. A survey is presented of the patents in the form of: (1) a chronological list showing the number of patents in each year or period of years, sub-divided into Groups 1–7 which cover, respectively, osmosis, Ca saccharate precipitation and other

[1] *I.S.J.*, 1964, **66**, 23.

precipitation techniques, elution, strontium compound techniques, barium techniques, lead oxide techniques, and other various techniques; (2) an alphabetical list of patentees; and (3) a list of patent numbers by groups. The techniques which involve reducing the sucrose solubility by mixing organic solvents such as dimethylformamide, ethyl alchohol, propyl alcohol and butyl alcohol with the molasses and adding methanol (giving a sucrose yield of up to 68%) or concentrated acetic acid dominate the post-war field and these are discussed separately in more detail.

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Danube water supply to Acsi sugar factory. B. WEINRICH. *Cukoripar*, 1963, **16**, 165–169.—Difficulties in maintaining the water supply to the factory from the Concó river during dry seasons and the poor quality of the water under these conditions necessitated drawing water from the Danube, about 3 km from the factory. Details are given of the temporary plant for drawing and pumping the water. The costs are discussed and show that a permanent station would be economical.

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Flocculating agents in the sugar industry. I. R. OSVALD and K. TLUČHOŘ. *Listy Cukr.*, 1963, **79**, 129–137.—"Separan AP 30" was laboratory tested together with four flocculating agents of Czechoslovak origin; these were ELP (a linseed cake extract), VAMA 1 (the ammonium salt of a vinyl acetate-maleic anhydride copolymer), VAMA 2 (also a vinyl acetate-maleic anhydride copolymer), and KMA 6634 (a methacrylic acid-sodium methacrylate copolymer). The effect on their efficacy of the following factors was studied: the amount of flocculant added, the juice purification system used (i.e. the structure of the mud aggregates), the purity of the raw juice after treatment, the amount of milk-of-lime used for defecation and the 1st carbonatation alkalinity. When KMA 6634 and "Separan AP 30" were added at the rate of 2 mg/100 ml they resulted in a sedimentation rate 500% greater and a filtration rate 200% greater than did the other flocculants, and while they reduced the mud volume by 25–30%, the other three flocculants caused less than 10% reduction. KMA 6634 and "Separan AP 30" gave a clearer supernatant than did the others. ELP was unsuitable because of its adverse effect on the filtration rate. The effect of the flocculants depended on the carbonatation method, the maximum effect being obtained with modern methods, such as progressive pre-liming or simultaneous defeco-saturation, whereby uniform coagulation occurs and regular aggregates are formed with an even surface to the carbonate; the effect was minimal with instantaneous liming. The other factors studied were also found to affect the results, the optimum effect being obtained with high purity raw juice to which 1·5% CaO is added and at a carbonatation alkalinity of 0·060–0·080% CaO. The results are tabulated and expressed in graph form.

P. M. Silin's theory in practice. J. ČERNÝ. *Listy Cukr.*, 1963, **79**, 139–140.—SILIN's diffusion theory[1] has been tested in application to the battery diffuser performance during two campaigns at Drahanovice sugar factory. SILIN considers that the higher the value of Al, where A = diffuser constant and l = length of cossette (100 g/m), the higher will be the diffusion efficiency and considers that for satisfactory operation of a 16-cell battery A and Al should have values of $5{\cdot}1 \times 10^{-5}$ and $11{\cdot}2 \times 10^{-4}$ respectively. Values of $A \times 10^5$ and $Al \times 10^4$ are given together with other factors and the suitability of the theory as a criterion for both battery and mechanical diffusers is confirmed.

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New Ankara beet sugar factory. T. M. OZIL. *Sugar y Azúcar*, 1963, **58**, (6), 44–45.—Information is given on the 1350-ton Ankara beet sugar factory (located at Etimesgut, about 11 miles from Ankara), which started operations in October 1962 and was designed and erected by Turkish personnel. The equipment includes a 1650-ton BMA tower diffuser, two Buckau-Wolf vacuum filters for muddy juice, nine crystallizers and thirteen semi-automatic centrifugals. A 3-boiling system is used.

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Exergetic studies in the sugar industry. III. T. BALOH. *Zucker*, 1963, **16**, 277–283, 348–354.—A beet white sugar factory is used as an example for exergetic calculations, heat flow sheets being presented and balances and hence losses calculated for the boilers, turbines, throttling valves, steam coolers, diffusers, carbonatation, evaporators, and boiling house. The highest exergy losses occur in the boiler house and can be reduced by using high pressure steam with greater superheating. Power production can thus be increased, particularly when all the live steam is passed through the turbines. The exergy losses in diffusion are considerable and can be reduced by lowering the raw juice temperature and using low pressure steam. In carbonatation 30% of the exergy input is eliminated, while the losses in evaporators are low. In the boiling house, the losses are extremely high and can be only partially reduced by vapour compression. Further cuts in losses are possible if low-temperature steam is used for boiling, and evaporation in the pans reduced. All the improvements mentioned will help increase power production with the factory ultimately acting as electricity producer for the national grid.

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A unit for sugar drying in a fluidized bed. G. A. KHOMCHUK and A. YU. VOLOKHOV. *Sakhar. Prom.*, 1963, (7), 18–22.—Details are given of a pilot unit installed at "Pravda" sugar factory for fluidized bed drying of sugar. This consists of a compartment divided by a telescopic screen wall into a drying and cooling chamber. The screen is used to regulate the height of the bed of sugar from 250 to 500 mm

[1] *I.S.J.*, 1958, **60**, 144.

at 125 mm intervals. Air is blown along two parallel pipelines by a fan; in one line it is heated to 68–93°C and is then compressed in a diffusion chamber directly beneath the drying section, while the other pipeline is used merely to feed the cold air via another diffusion chamber into the cooling section. The air passes at a pressure of 240–360 mm w.g. into the bed of sugar through a screen unit comprising an upper screen (3–5 mm dia. perforations), a lower screen (8 mm dia. holes 20 mm apart) with a bed of 10–15 mm washed quartz granules between. The pressure of air in the pipelines is regulated by gate valves. The sugar is fed to the top of the dryer through a hermetic seal. During fluidization, it is thrown across the screen to the cooling section whence it is discharged to a conveyor which transfers it to sieves above the sugar hoppers. The air is discharged through a pipeline at the top of the dryer and is blown to a cyclone for sugar dust separation. The dryer throughput varied from 13 to 18 tons of sugar per hr. The moisture content of the sugar was reduced from 1·06–0·79% to 0·10–0·11% and the temperature from 40–62°C to 32–51°C. With unheated air at 25–28°C and low R.H., the moisture content was reduced to a maximum of 0·10% at 13 tons/hr throughput. No differences were found in the sugar grain analysis before and after treatment nor between this dryer and a drum dryer. Nor was any difference found in the brilliance of the crystals from the two dryers. A factory unit to be installed this year at Krasnozvezdinsk refinery is designed to reduce the sugar moisture content to a maximum of 0·05% at a throughput of 25 tons/hr.

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The Philippe candle filter and its regeneration. I. G. CHUGUNOV. *Sakhar. Prom.*, 1963, (7), 22–23.—Details are given of the Philippe filter which contains a number of 1 m long perforated stainless steel candles enclosed within synthetic fibre sleeves. It is used for 2nd carbonatation juice and syrup, in the latter case kieselguhr being applied to the candles. The procedures for mud removal and regeneration with sodium carbonate and HCl are briefly described.

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Results of national tests on beet unloading-pilers in 1962. V. A. NOVIKOV and N. M. KICHIGIN. *Sakhar. Prom.*, 1963, (7), 24–29.—Details are given of tests carried out with five different Soviet-made beet unloading-pilers. The results are tabulated and certain recommendations are made. It is stated that more than 60 different types of such equipment are used in the Soviet sugar industry.

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Computers in the sugar industry. V. I. TUZHILKIN and I. N. KAGANOV. *Sakhar. Prom.*, 1963, (7), 31–37. The use of digital and analogue computers in the sugar industry for automatic process control is discussed with particular reference to the scheme at the Wissington factory of the British Sugar Corporation Ltd.[1,2]

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Sugar balance from beet reception to its processing. G. S. BENIN. *Sakhar. Prom.*, 1963, (7), 38–41.—The calculation of sugar and weight losses in the beet between reception and processing is demonstrated and the breakdown of these losses into the individual factors is discussed. Beet "deficiency" is defined as the sum of weight loss due to drying (N_u) and mechanical loss in the form of leaves, tails and root damage (N_m). N_u may have a plus or minus sign; in most cases there is a weight loss in storage, but if the beet are received during very dry, hot weather and rain falls during storage, the beet may absorb some of the rainwater and hence increase their weight. Other factors to be considered in calculating the changes in beet weight are: the amount of water adhering to the beet after washing, this amount depending on the root dimensions; and the loss of some of the cell juice to flume and wash water, the extent of which depends on the temperature of the water and the extent of root damage. Formulae are presented for calculating N_u and N_m. The total sugar losses are broken down into the individual loss factors: sugar lost with beet "deficiency", in storage, in flume and wash water, and in temporary clamps. The last of these is calculated from the difference between the total sugar losses and the sum of the other three factors, so will include unknown losses and errors in the calculations. Sample calculations are presented. The lack of attention to losses in unprocessed beet is criticized; it is pointed out that the sugar losses may attain a level of 1·5–2·0% on weight of beet, of which only 0·25–0·40% is lost in storage.

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An atomizer unit for washing filter mud in vacuum filters. E. D. ZINCHENKO and A. F. KIZENKO. *Sakhar. Prom.*, 1963, (7), 57–59.—Details are given of the atomizer spray unit for mud washing at L'gov sugar factory. Used for two Oliver filters only, it resulted in an average mud sugar content of 0·08% on weight of beet; the third, B 40, filter was subsequently included in the system. The mud sugar content has been reduced by at least 0·02% on weight of beet from the level when normal jet nozzles are used.

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Purifying milk-of-lime with hydrocyclones. K. G. VOVIKOV. *Sakhar. Prom.*, 1963, (7), 61–62.—A number of defects in TsINS-design hydrocyclones are noted and details given of a hydrocyclone of the author's design which over a period of 150 days has treated milk-of-lime required for juice from 2800–3000 tons of beet daily. A lime loss of 0·5% by volume of sand has been recorded. The hydrocyclone treatment has eliminated the need for a sand trap.

[1] *I.S.J.*, 1962, **64**, 292–294, 330–332, 360–362.
[2] *I.S.J.*, 1963, **65**, 149.

Partition chromatography on ion exchange resins. Separation of sugars. O. SAMUELSON and B. SWENSON. *Acta Chem. Scand.*, 1962, **16**, 2056–2058; through *S.I.A.*, 1963, **25**, Abs. 275.—A mixture of glucose, sucrose, raffinose, stachyose and verbascose was added in 75% ethanol solution to a column of "Dowex IX-8" resin (sulphate form, 45–75μ fraction), and was completely separated by elution with 74% ethanol (to remove glucose and sucrose) followed by 65% ethanol. A simpler mixture (glucose, raffinose and stachyose) was completely separated by elution with 65% ethanol.

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Determination of reducing sugar by polarization current-titration method. T. YAMAUCHI and T. TAKEBE. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12**, 1–8.—Details are given of an apparatus and results obtained with it in the detection of the end-point in the Lane-Eynon method of reducing sugars determination. The end-point is indicated by a change in electric current. The results are more accurate than those given by methylene blue decolorization and very low reducing sugar concentrations are determinable (0·01% in the laboratory or 0·02% in factory routine). The values given are as accurate as with the Ofner method, but measurements are easier.

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Browning of refined soft sugar and its amino compounds. I. S. SHINADA and M. MIZUSHIMA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12**, 16–24. The browning of white soft sugar was investigated. It was found to occur near the surface of the packaged sugar and was bleached in a few days in a transparent polyethylene bag stored in sunlight. The white portion of the sugar when packed in a paper bag and stored in a dark place browned slightly in 2 weeks. The pH of the browned sugar ranged from 5·5 to 5·8 (at 20°C), i.e. slightly lower than the white portion. The browning substance was unstable to light, was soluble in water, methanol and ethanol, showed positive reaction to the ninhydrin test and had an absorption maximum at 277·5 mμ, becoming amorphous if condensed at 60°C. The nitrogen content of the brown sugar was not much higher than that of the other sugar, whereas the amino acid content as determined by the formol titration method was considerably lower than normal. A volatile amine was detected in the brown sugar and was identified as originating from a strongly basic anion-exchange resin used in refining. One such amine isolated from a sugar solution effluent from the resin as its chloroaurate was thought to be trimethylamine from m.p. determinations and analysis. A refined soft sugar containing a small amount of added amino compounds browned slightly in a month at 85% R.H. but not at 40%.

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Photometric determination of a minute amount of total nitrogen in sugar. A. KAGAYA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12**, 35–47. The shortest decomposing period for determining very small quantities of total nitrogen in sugar was given by a mixture of K_2SO_4, $HgSO_4$ and Se (32:5:1). A decomposing time of 20 min after clarification was found adequate. In the distillation procedure, the complete recovery of ammonia necessitated withdrawing more than 20 ml distillate. The Kruse-Mellon method for colorimetric determination of NH_3 in the distillate gave more accurate results than did the Nessler reagent method and was as accurate as the Kjeldahl semi-micro method.

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Determination of betaine in beet juice. T. SANO and H. MATSUNO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12**, 48–54.—Of the reineckate, periodate and ion-exchange methods of determining betaine in beet juice, the first proved to be the simplest, most reliable and most reproducible for routine analysis. The standard curve presented for betaine reineckate was linear up to 2·4 mg/ml as betaine hydrochloride. The pH of the test solution and of the ammonium reineckate solution must be adjusted to 1·0 to avoid significant errors in the results. Pre-treating the beet juice with CaO did not affect the amount of betaine lost. However, the more active carbon used in preliminary treatment, the higher was the betaine loss; but 0·15 g of active carbon per 50 ml of beet thick juice had little effect on betaine recovery and removed substances inhibiting betaine reineckate precipitation. Diluted thick juice or thin juice (50 ml at 20–30°Bx) is treated with 0·15 g of active carbon for 30 min at 80–90°C, filtered and washed. The combined filtrate and washings are adjusted accurately to pH 1 with HCl and diluted to a given volume so as to contain less than 2·4 mg/ml betaine as betaine hydrochloride. Five ml of this solution is pipetted into a test tube which is chilled to 0 $\pm$3°C during 10–15 min. Chilled 1·5% ammonium reineckate solution (5 ml) at pH 1 and 0 $\pm$3°C is added gradually while stirring and the test tube left to stand for at least 3 hr. The betaine reineckate formed is washed with 3 $\times$ 2 ml of wash solution (1 ml water in 140 ml ethyl ether) and the betaine reineckate dissolved in 70% aqueous acetone and the absorbance measured at 525 mμ, with 70% acetone as reference. The % betaine in the original juice is calculated from the standard curve.

The reference of sugars in the acid hydrolysis products from sucrose. H. ITO, M. KAMODA and M. ANDO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12**, 55–59.—Hydrolysis of sucrose with 1N HCl and subsequent chromatography revealed only glucose and fructose in the hydrolysate, while treatment of the sucrose with 2% oxalic acid followed by paper chromatography revealed only glucose, fructose and unchanged sucrose. Infra-red spectroscopy and elementary analysis of the resultant syrups revealed no mannose and "reducing sucrose" as found by WADA[1] in identical experiments. Details are given of the infra-red spectroscopy and ion-exchange procedures for separation of the sugars contained in the syrups.

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The quantitative estimation by densitometer of amino acids in molasses. F. ONNA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, **12**, 67–72.—After absorption on ion-exchange resin, elution with 2N NH_4OH and 2N HCl, drying and separation by paper chromatography, the amino acids from final molasses samples were located by dipping the chromatogram in 0·2% solution of ninhydrin in water-saturated *n*-butanol, kept at 80°C for 12 min, and the spot concentrations were measured with a densitometer with a 540 mμ filter (a 440 mμ filter was also used for proline detection). Leucine, valine, proline, alanine and γ-amino-*n*-butyric acid were identified as free acids with 2–3 spots of unidentified acids. Molasses from Brazil raw sugar had a higher amino acid content than other molasses tested, while other samples had approximately the same, low, content. No clear relationship was established between the clarification methods used and the amino acid content of the molasses. The method used is considered simpler than that of STEIN & MOORE but not as accurate for free amino acid determination.

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A guide to the Mutual Milling Control Project. A. VAN HENGEL, E. J. BUCHANAN and K. DOUWES DEKKER. *Proc. 35th Congr. S. African Sugar Tech. Assoc.*, 1961, 95–103.—The so-called "Mutual Milling Control Project" is a method developed by the Sugar Milling Research Institute for statistical analysis of factors determining milling efficiency. It involves the collection of data from a number of mills for correlation in terms which will be independent of process variables. Details are given of the type of information required with nomenclature and formulae for calculation of the various factors. A sample data sheet is given.

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Molasses colouring substances. E. REINEFELD and M. H. MUSSAWAI-BARAB. *Zucker*, 1963, **16**, 322–332. Fractionation of molasses colouring matter is described, the first technique involving dialysis, and precipitation of acidic and basic colour fractions at pH 1·5 and 10·5, a third, neutral, fraction being the residue. The acidic colour fraction was the greatest in amount (25% of the total), had the highest extinction at 560 mμ, and contained the highest proportion of nitrogen. The second technique involved adsorption on a cation exchanger, the ammonia eluate yielding one fraction on acidification and a second after dialysis to remove low-molecular compounds such as amino acids. A further fraction was obtained by passing the cation exchanger effluent through a weakly basic anion exchanger. Hydrolysis of these fractions yielded 8 amino acids which were identified by paper chromatography. Melanoidin was precipitated using the method of STANĚK[2]; this gave material which yielded 11 amino acids on hydrolysis (glutamic acid, lysine, aspartic acid, leucine, tyrosine, alanine, phenylalanine, valine, serine, glycine and arginine) as well as peptides having higher R_f values than the amino acids. The molasses colour components were found to influence the crystallization rate of sucrose, a 5–16% reduction occurring in the presence of 0·1–0·5% of the components.

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Status of sugar colour and turbidity measurements. F. G. CARPENTER and V. R. DEITZ. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 326–347.—The optical properties of sugar solutions are discussed with mention of transmittancy measurements and the significance of the "attenuation index" (a*) to describe such a measurement in which scattering is not negligible. The separation of "colour" and "turbidity" by determining the absorbancy and scattering of light is demonstrated with some tabulated data. The dependence of optical measurements on wavelength is discussed, and the effect of scattering considered to be less significant than on absorption. In tests in which a constant amount of raw sugar solution was added to purified sucrose solutions of different densities, it was found that as the refractive index of the medium approached that of the colloidal material causing the light scattering, the turbidity approached zero. At a constant refractive index, the turbidity increased linearly with the number of scattering particles. Turbidity of a commercial sugar solution increased with the concentration of the sugar solids to a maximum at about 35°Bx, and then fell as the refractive index increased. The same effect was observed with highly purified sucrose, granulated sugar and with process liquors. Turbidity may be expressed as a scattering index, additive with absorbancy and attenuancy. The dependence of the attenuation index on pH is demonstrated by a graph showing marked variation with wavelength and maximum changes with pH in the vicinity of pH 7. The scattering index is almost independent of pH, so that the changes noted are due to variations in the absorbancy index. The effect of filtration through various media on light scattering is also discussed. The scattering in

[1] *Rpt. presented to the 212th Meeting of the Kanto branch of the Agric. Chem. Soc. Japan*, 1961.

[2] *Zeitsch. Zuckerind. Bohmen*, 1916/17, **41**, 298, 306, 607, 618.

the filtrate decreased with porosity, although appreciable scattering remained even after filtration through a 0·45μ "Millipore" filter. Adding active carbon reduced the scattering almost to that predicted by theory for molecular sucrose, indicating that part of the light scattering is caused by dissolved material that could never be removed by filtering. The turbidity of sugar liquors may be modified by centrifuging at high *g*. The attenuation index decreased with increase in *g* but above 150,000 *g* it was found to be considerably less dependent on Brix, indicating reduced scattering. Fluorescence can be simply eliminated by inserting a filter before the detector. The use of fluorescence as a measure of impurities in commercial sugar liquors has not been adequately studied. The amount of forward-scattering light that is mistakenly measured with the transmitted beam should be evaluated to avoid instrument error. The conditions of measurement of attenuation and scattering are discussed, and recommendations are given regarding choice of wavelength, pH, and concentration. Details are given of a recommended procedure that meets all requirements covered. The various methods that have been used to measure sugar colour are examined.

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Mechanism of the formation of malonic acid during processing of sugar cane juice. S. Bose and S. Mukherjee. *J. Sci. Industr. Res.*, 1962, **21B**, 507–508; through *J. Sci. Food Agric. Abs.*, 1963, **14**, i-317. Malonic acid is present when sugar cane juice is subjected to the clarification process and boiling. It is suggested that this takes place via glucic acid which subsequently undergoes internal disproportionation to the half aldehyde of malonic acid and then oxidation to malonic acid.

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Determination of mud content and its application. H. Haucke. *Zeitsch. Zuckerind.*, 1963, **88**, 316–318. A technique for determining the mud content of juice is described, whereby a small sample of juice (e.g. 200 g) is filtered and the residual solids weighed and calculated as a percentage of the original weight. The result is then used to calculate (i) the ratio of mud in the mud suspension after clarification:mud in the unclarified juices, (ii) the thickened suspension yield (reciprocal of (i)), (iii) the proportion of thickened suspension in raw juice when the former is recycled, and (iv) the proportion of muddy juice and defecation juice in raw juice when these are returned. Formulae are presented for all these calculations, and the determination of alkalinity or lime content by titration is compared with the above procedure. While both are suitable for controlling clarification, the weight determination is considered preferable for purposes of calculating balances for subsequent processes.

* * *

A preliminary study on the colour substances in Taiwan plantation white sugar. H. C. Tsai. *Rpt. Taiwan Sugar Expt. Sta.*, 1963, (31), 147–153.—Sugar samples were passed through "Asmit 259" decolorizing resin and the colour substances eluted from the resin with dilute HCl. Ferric ions and phenolic compounds were found by qualitative analysis, and, after hydrolysis with HCl, amino acids were determined by the method of Prey *et al.*[1]. The results indicated a tendency for the amino acid content to be proportional to the colour changes occurring in stored sugar. Hower, further tests are considered necessary because of the complications in the formation of melanoidins by amino acid-reducing sugar reactions caused by degradation, polymerization and decarboxylation. No relationship was established between the total N content of Taiwan plantation white sugar and the colour content.

* * *

Lignin fragments extracted from Taiwan sugar cane bagasse with acidic chloroform-ethanol solvent. C. I. Nee and Y. S. Li. *Rpt. Taiwan Sugar Expt. Sta.*, 1963, (31), 167–176.—Milled bagasse was passed through a 60-mesh screen and extracted with 1:2 alcohol-benzene and with cold water to remove the wax and sucrose. The pre-treated bagasse (200 g) was extracted with 2 litres of acidic chloroform-ethanol in a CO_2 atmosphere for 43 hr, and the solid residue then separated from the black liquor and washed with chloroform-ethanol four times. After twice repeating the extraction as above, each black liquor portion was combined with the washing of the separated residue of the corresponding extraction and neutralized with 5% sodium bicarbonate solution. Water separating on neutralizing is decanted, and the neutralized liquor dehydrated over magnesium sulphate and concentrated to 100 ml under pressure. Ligroin (light petroleum) was added for precipitation and the precipitate washed thoroughly with ligroin and dried under vacuum. Carbon, hydrogen, M.W., intrinsic viscosity and characteristic groups of the precipitate (lignin) were determined and the results are tabulated for three different precipitates. While the basic composition of the lignin was similar to that from spruce, the average methoxyl group content of 19·2 was higher than that of lignin from various woods. The fibrous residue after lignin extraction is not pure cellulose but contains pentosans as well as Klason lignin.

* * *

Conversion of raw sugar recovery to equivalent white sugar of 99·8 pol and vice versa. S. C. Gupta. *Indian Sugar*, 1963, **12**, 733–734.—Because of the lower pol, a greater quantity of raw sugar is produced from the same cane than if white sugar were being produced. By applying the *s-j-m* formula, conversion factors are obtained from which equivalent quantities of 96 pol raw sugar and 99·8 pol white sugar may be calculated. Thus, the quantity of 96 pol raw sugar equivalent to unit weight of sugar of a given pol is given by 1 − 0·01518 (pol − 96). The quantity of 99·8 pol white sugar equivalent to unit raw sugar weight of a given pol is given by this factor, multiplied by 0·945545.

[1] *I.S.J.*, 1960, **62**, 52.

Determination of molasses exhaustibility. G. VAVRINECZ. *Cukoripar*, 1963, **16**, 153–161.—The molasses saturation methods of CLAASSEN[1,2], SILIN[3] and WAGNEROWSKI *et al.*[5] are described and compared, the techniques being applied to Hungarian molasses. It is stated that the concept of exhausted molasses and methods of effecting exhaustion have changed with time, low-grade crystallization being dependent on molasses composition. SILIN's determination of the viscosity of molasses at 82°Bx and 40°C (approximately 44 poises) is verified and his nomogram is recommended for determining equivalent molasses viscosities. The method of WAGNEROWSKI *et al.* has reduced the time required from 4 days to 3 hr so that it is recommended for routine checking of factory performance. It has been found using WIKLUND's crystallization rule[4] that the coefficient of molasses saturation is linearly dependent on the non-sugars: water ratio but not on temperature. The method of CHEN'[6] has not been sufficiently tested.

* * *

A new method of determining the whiteness of crystal sugar. K. JÁNOSFY. *Cukoripar*, 1963, **16**, 161–164. The method described is based on that of OIKAWA[7]. The reflectance values are measured at different wavelengths from those used by OIKAWA, the A.C.D. (Achromatic Colour Degree) being given by $100\left(\frac{\text{reflectance at 471 m}\mu}{\text{reflectance at 535 m}\mu}\right)$. A correction factor is added to the A.C.D. (a table of the factors for A.C.D. values from 75 to 98 in unit intervals is given), and the result is very close to that given by the trichromatic method (a deviation of $\pm$ 0·5%); since the method is comparatively simple, it is suitable for routine checks and factory control.

* * *

Spectrographic study of the metallic composition of cane juice. A. AMARAL RODRIGUEZ. *Inst. Cubano Invest. Tecnol.* (I.C.I.T.) *Bol. Inform.*, 1961, **5**, (4), 3–5; through *S.I.A.*, 1963, **25**, Abs. 378.—Filtered crusher juice samples (30 g) were mixed in a polyethylene flask with 5 ml of cobalt nitrate solution (19·75 g in 200 ml of water; 20 ml of this mixed with 300 ml of HCl and diluted to 2 litres), and 2 ml of lithium sulphate solution (77·4 g in 200 ml of water). Tests were also made on juice samples initially diluted 1:1 and 1:2, to allow for variations in metal contents, and on synthetic samples of sugar solutions with known amounts of different metals, for calibration. Four drops of the prepared samples were dried and carbonized on circular electrodes and examined in the spectrograph. Figures (p.p.m.) are tabulated for iron (2–9), calcium (145–300), potassium (500–1200), manganese (2–8), magnesium (110–240), phosphorus (70–270), sodium (2–12), silicon (37–93) and aluminium (0·2–3·5) in juices from different factories.

Spectrophotometric investigation of sucrose caramelization. A. R. SAPRONOV. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1963, (1), 33–37; through *S.I.A.*, 1963, **25**, Abs. 395.—Sucrose was heated at 150°C for up to 26 hr and the ultraviolet absorption spectrum of the product was periodically determined. No change was observed after 5 min. A faint colour appeared after 15 min together with absorption peaks at 225 and 282 mμ. The peak at 225 mμ was initially greater, but the peak at 282 mμ increased in intensity with longer heating (characteristic of caramelan). After 8 hr the peak at 225 mμ again increased in intensity and the product began to show colloidal properties and diminished solubility in ethanol (appearance of caramelen and caramelin). The absence of hydroxymethylfurfural was demonstrated. It was shown by a micro-diffusion method that the particle sizes of caramelan, caramelen and caramelin in solution were 0·46, 0·95 and 4·33 mμ respectively. The colloidal nature of caramelin was confirmed, whereas caramelan and caramelen formed molecular-disperse solutions. It is concluded that the optical and colloidal properties of caramels depend on the conditions of preparation.

* * *

Studies on the osmophilic yeasts in raw sugars. R. ANTOINE, R. DE FROBERVILLE and C. RICAUD. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1962, 95–97. Eight yeasts taken from raw sugar samples were identified. Of these, one of the most noxious was *Saccharomyces rouxii*; while this does not ferment sucrose, it can tolerate high osmotic pressures (up to 70°Bx) and will attack glucose and cause a dangerous drop in pH. Details are given of sugar storage tests for 5 months in stoppered conical flasks. All samples, from six different factories, suffered a pol loss and an increase in moisture content, while the number of yeast colonies per g of sugar increased considerably. Species of *Aspergillus* have been found in plate counts of samples taken from sugar stored under normal conditions. It has been found that the original yeast colonies probably introduced with the cane are completely destroyed in boiling but that re-contamination occurs in the crystallizers. Massecuite from pans has been found to contain no viable yeasts but only colonies of *Bacillus subtilis*. "Weladyne", a bactericide containing iodine, has proved effective at 10 p.p.m. again *S. rouxii* and *Torulopsis versatilis* in the absence of sucrose. In the presence of sucrose in such concentrations as to be expected in crystallizer wash water (40–50°Bx), a longer exposure time is needed, *S. rouxii* being killed after 15 min in the presence of 100 g of sucrose or after 5 min at 25 p.p.m. of germicide.

1 Die Zuckerfabrikation. (Magdeburg, 1943.)
2 Die praktische Kristallisation des Zuckers und die Melassebildung. (Magdeburg, 1940).
3 Tekhnologiya sveklosakharnogo i raffinadnogo proizvodstva. (Moscow, 1958.)
4 *I.S.J.*, 1961, **63**, 352; 1962, **64**, 115.
5 *I.S.J.*, 1956, **58**, 171.
6 *I.S.J.*, 1963, **65**, 152.
7 *I.S.J.*, 1963, **65**, 245.

WORLD SUGAR REQUIREMENTS

The following estimate of net import requirements for the calendar year 1964 was made by the International Sugar Council at its Fourteenth Session on 4th November, 1963[1]:—

A. FREE MARKET
(*Metric tons, raw value*)

Country or area	1964	1963 (*I.S.C. 2nd estimate*)
EUROPE:		
Albania	5,000	5,000
Austria	30,000	30,000
Cyprus	15,000	16,300
Finland	140,000	148,000
Germany (West)	60,000	150,000
Gibraltar	4,000	3,000
Greece	78,000	75,000
Iceland	10,000	10,300
Ireland	30,000	6,000
Italy	300,000	150,000
Malta	16,000	14,000
Netherlands	240,000	200,000
Norway	160,000	150,000
Portugal	15,000	15,000
Spain	300,000	55,000
Sweden	100,000	75,000
Switzerland	230,000	230,000
United Kingdom	1,850,000	2,075,000
U.S.S.R.	1,800,000	2,000,000
Yugoslavia	65,000	70,000
NORTH AMERICA:		
Canada	715,000	700,000
CENTRAL AMERICA:		
Bahamas } Bermuda }	6,000	5,000
Honduras	2,000	2,000
Panama Canal Zone	5,000	5,000
Virgin Islands (U.K.)	400	400
SOUTH AMERICA:		
Bolivia	—	10,000
Chile	170,000	200,000
Uruguay	65,000	50,000
ASIA:		
Afghanistan	38,000	40,000
Arabian Peninsula:		
Aden, Colony and Protectorate	25,000	26,000
Saudi Arabia and neighbouring Red Sea and Persian Gulf Territories	100,000	90,000
Brunei	3,500	4,000
Burma	20,000	25,000
Cambodia	15,000	11,900
Ceylon	203,000	204,000
China (Mainland)	1,100,000	1,100,000
Hong Kong	72,000	73,000
Iran	180,000	350,000
Iraq	247,000	257,000
Israel	55,000	50,000
Japan	1,250,000	1,300,000
Jordan	50,000	49,000
Korea (North)	50,000	50,000
Korea (South)	75,000	75,000
Laos	3,000	2,700
Lebanon	30,000	35,000
Malaysia:		
Malaya	178,000	232,000
North Borneo	10,000	10,000
Sarawak	13,000	13,000
Singapore	96,000	73,000
Mongolia	20,000	19,600
Nepal	4,500	4,500
Pakistan	50,000	125,000
Syria	80,000	75,000
Vietnam (North)	20,000	20,000
Vietnam (South)	50,000	55,000
AFRICA:		
Gambia	4,000	4,000
Ghana	71,000	77,000
Kenya	—	30,000
Liberia	2,500	2,000
Libya	25,500	25,000
Morocco	400,000	400,000
Nigeria	75,000	75,000
Sierra Leone	15,000	15,000
Somalia	15,000	15,000
Sudan	109,000	110,000
Tanganyika	10,000	20,000
Tunisia	60,000	80,000
U.A.R. (Egypt)	50,000	130,000
Uganda	—	500
Zanzibar and Pemba	6,500	6,500
OCEANIA:		
New Zealand	128,000	125,000
U.K. Admin. Oceania	2,000	2,500
U.S. Admin. Oceania	4,000	4,000
Western Samoa	2,800	2,800
TOTAL FREE MARKET	11,429,700	11,944,000
B. U.S. MARKET		
U.S.A. net import requirements from foreign countries	3,540,000	3,810,000
C. GRAND TOTAL	14,969,700	15,754,000
GRAND TOTAL ROUNDED	14,970,000	15,750,000

Brevities

Irish Sugar Co. Ltd., 1963 report.—Sugar production in 1962 totalled 124,540 tons, compared with 114,636 tons in 1961, the yield on beet being 86·19% as compared with 85·09%. The campaign lasted 86·25 days on average for the four factories, compared with 82·3 in 1961, the average total slice being slightly lower at 10,664 tons *vs.* 10,761 tons. The Irish beet area in 1963 has been raised from 77,634 acres to 88,027 acres and the capacities of Carlow and Thurles factories expanded to deal with the increased beet supplies. Mechanical harvesting of beets rose from 25% of the crop in 1961 to 31% in 1962.

* * *

European Common Market sugar tariff suspension[2].—Following an Italian request, the Council of Ministers of the European Economic Community has suspended until 31st March 1964 the Community's external tariff on sugar. This decision means that the six Common Market countries will be able to import sugar duty-free from non-members until that date. The Council is due to decide later on another Italian request to suspend the tariff on molasses.

* * *

Bulk storage in Australia[3].—The Minister for Primary Industries has advised that additional bulk storage capacity is to be built at Bundaberg, Mackay and Townsville, at a cost of more than £A4,000,000. The new stores will hold a total of 380,000 tons of raw sugar and are scheduled for completion by the 1965 season.

[1] *I.S.J.*, 1963, **65**, 349.
[2] *Public Ledger*, 16th November 1963.
[3] *Queensland Newsletter*, 6th December 1963.

BREVITIES

Sugar factories for Indonesia[1].—The Indonesian Government has offered to purchase eight or ten sugar factories from Japanese manufacturers, to be paid for by exporting raw sugar to Japan. The Japanese Government has approved the plan in principle and a mission is to visit Indonesia to conduct a preliminary survey.

* * *

Colombian sugar expansion.[2]—An encouraging start has been made in the sugar development programme, the aim of which is to help to diversify the country's economy and to achieve a significant increase in exchange income. Under this programme companies have been formed for the installation of four new sugar mills, one in the north of Cauca and three in Valle. One of the latter is being financed by a Philippine investor[3]. The installation of these four additional sugar mills could double production and make possible a four-fold increase in exports within five years provided that the irrigation plans of the Corporación del Valle del Cauca and the Instituto Colombiano de la Reforma Agraria enable 300,000 hectares of land to be planted to sugar during that period.

* * *

Israel sugar production, 1963.—During the 1963 campaign the three sugar factories sliced a total of 231,000 tons of beet, to produce 31,000 tons of sugar, according to the Board of Trade Journal[4]. In 1962, some 215,000 tons were processed to give 34,000 tons of sugar. The area sown to beet is to be increased by 1500 acres next year, to 13,750 acres.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at* 17*th December* 1963)	s d
Anglo-Ceylon (5s)	22/6
Antigua Sugar Factory (£1)	10/–
Booker Bros. (10s)	22/9
British Sugar Corp. Ltd. (£1)	39/3
Caroni Ord. (2s)	7/1½
Caroni 6% Cum. Pref. (£1)	15/9
Demerara Co. (Holdings) Ltd.*	9/–
Distillers Co. Ltd. (10s units)	39/1½
Gledhow Chaka's Kraal (R1)	26/6
Hulett & Sons (R1)	65/–
Jamaica Sugar Estates Ltd. (5s units)	5/6
Leach's Argentine (10s units)	17/9
Manbré & Garton Ltd. (10s)	49/9
Reynolds Bros. (R1)	26/6
St. Kitts (London) Ltd. (£1)	19/–
Sena Sugar Estates Ltd. (10s)	8/6
Tate & Lyle Ltd. (£1)	53/6
Trinidad Sugar (5s stock units)	3/6
United Molasses (10s stock units)	41/9
West Indies Sugar Co. Ltd. (£1)	27/6

CLOSING MIDDLE

New York Stocks (*at* 16*th December* 1963)	$
American Crystal ($10)	88
Amer. Sugar Ref. Co. ($12.50)	23¾
Central Aguirre ($5)	36
North American Ind. ($10)	20½
Great Western Sugar Co.	45¼
South P.R. Sugar Co.	42
United Fruit Co.	21

* Ex-dividend

New sugar factory for Colombia[5].—Following a study made by Colombia's finance corporations[6], a large sugar factory, to be known as Central Azucarera del Norte del Valle, is to be installed at Cartago.

* * *

Canadian beet crop estimate[7].—The latest estimate of sugar beet production in Canada for the 1963 crop is 1,201,376 short tons, according to Reuter. The yield of beet per acre is forecast at 12·58 tons as compared with a yield of 13·06 tons per acre in the previous campaign when 1,105,704 tons were harvested.

* * *

West German beet crop estimate[8].—The sugar beet crop in West Germany is placed at 11,416,900 tons in the first official estimate made by the Federal Bureau of Statistics. This compares with a crop of 9,524,900 tons last year and is 14% higher than the 10,033,400-tons average of the years 1957 to 1962. The beet area this year, at 300,655 hectares, is 4% larger than last year and about 8% larger than the average for 1957/62. The yield per hectare is expected to be 16% higher than the final estimate of 1962 and about 6% higher than the long term average. It is expected to be 37·97 tons per hectare as against 32·83 last year and 36·97 in the six-year average.

* * *

New sugar factory for Kenya[9].—East African Sugar Industries Ltd. are to build a new sugar factory at Muhuroni, near Kisumu; initial production should be not less than 40,000 tons of sugar per annum, increasing later to 45,000 tons. It is reported that the scheme will cost more than £2,000,000.

* * *

Uruguay beet production[10].—Production of sugar beet in Uruguay amounted to 376,207 tons in the 1962/63 season, an increase of 20·8% over the 1961/62 figure.

* * *

Iran sugar expansion plans[11].—Ministerial approval has been granted recently for the establishment of five sugar factories in Iran, according to Reuter. Finance for this project will be obtained from private sources although a $15 million credit by the Polish Government is to be utilized in equipping the factories.

* * *

Sugar expansion in Venezuela[12].—In addition to expansion of existing plants, erection of two new sugar factories is projected for Venezuela: Centrals Portuguesa and Pastora, of 2500 and 1200 tons cane per day capacity, respectively.

* * *

Yugoslavia beet area[13].—The area sown to sugar beet for the 1963/64 crop in Yugoslavia was, at 93,512 hectares, some 20,000 hectares more than that of the previous season and a crop of post-war record proportions has been in prospect since an early stage of root development. Recent indications are that sugar production will amount to some 330,000 tons, about 100,000 tons more than were manufactured in the 1962/63 season.

* * *

Bagasse pulp project for Mexico[14].—Ingenio Tamazula plans to erect a bagasse pulp plant adjoining the cane sugar mill.

1 *Sugar y Azúcar*, 1963, **58**, (10), 42.
2 *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 860.
3 *I.S.J.*, 1963, **65**, 347.
4 C. Czarnikow Ltd., *Sugar Review*, 1963, (632), 182.
5 *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 899.
6 *I.S.J.*, 1963, **65**, 222.
7 C. Czarnikow Ltd., *Sugar Review*, 1963, (634), 191.
8 *Public Ledger*, 2nd November 1963.
9 *Overseas Review* (Barclays Bank D.C.O.), November 1963, p. 42.
10 *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 800.
11 C. Czarnikow Ltd., *Sugar Review*, 1963, (636), 200.
12 *Sugar y Azúcar*, 1963, **58**, (10), 42.
13 C. Czarnikow Ltd., *Sugar Review*, 1963, (636), 201.
14 *Sugar y Azúcar*, 1963, **58**, (10), 42.

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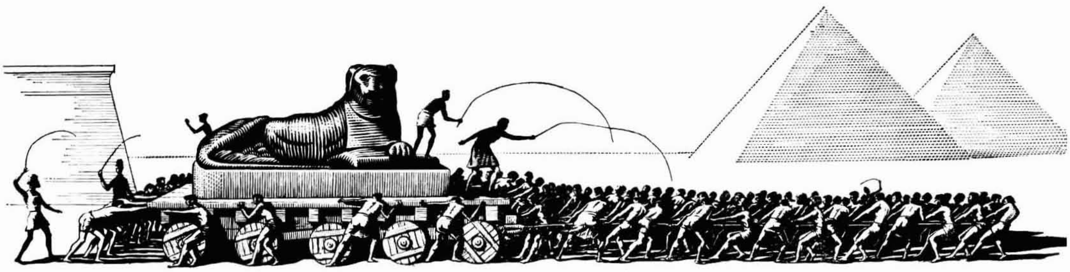

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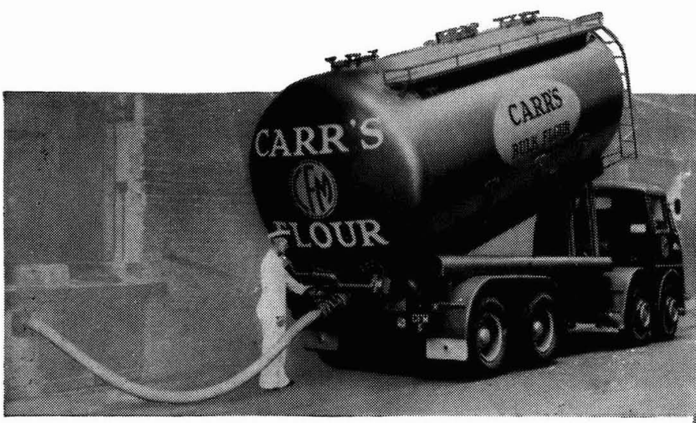

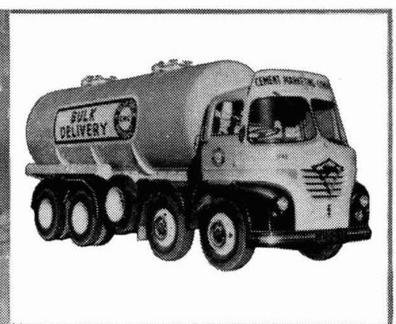

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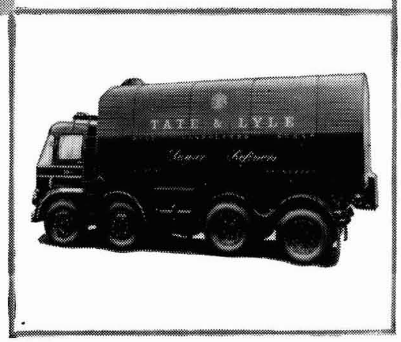

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BUYERS' GUIDE

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.

Air clutches.
Crofts (Engineers) Ltd.
Eisenwerk Wülfel.
Farrel Corporation.

Air compressors.
Alley Compressors Ltd.
Krupp-Dolberg.
Richardsons, Westgarth & Co. Ltd.
G. &. J. Weir Ltd.
Worthington Corporation.

Air conditioning equipment.
Carrier Engineering Co. Ltd.
A.B. Svenska Fläktfabriken.

Air coolers.
A.B. Svenska Fläktfabriken.
Wellington Engineering Works Ltd.

Air filters.
Farnell Carbons.
Locker Industries Ltd.
Norit Sales Corporation Ltd.
A.B. Svenska Fläktfabriken.

Air heaters.
Babcock & Wilcox Ltd.
E. Green & Son Ltd.
Stabilag Engineering Ltd.
A.B. Svenska Fläktfabriken.
Wellington Engineering Works Ltd.

Air receivers.
Robert Jenkins & Co. Ltd.
Richardsons, Westgarth & Co. Ltd.
Towler & Son Ltd.

Alcohol plant.
A.P.V. Co. Ltd.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Honolulu Iron Works Co.
Lepage, Urbain & Cie.
S. P. E. I. Chim.
Stork-Werkspoor (V.M.F.)
Technoexport Czechoslovakia.

Anti-foam agents.
Schill & Seilacher Chemische Fabrik.

Asbestos products.
British Belting & Asbestos Ltd.
Cape Insulation and Asbestos Products Ltd.
Johns-Manville International Corp.
Turner Brothers Asbestos Co. Ltd.

Automatic saccharimeters and polarimeters.
Schmidt & Haensch.

Bagasse baling presses.
Port Engineering Works Ltd.

Bagasse depithing equipment.
Parsons & Whittemore Lyddon Ltd.

Bagasse furnaces.
Babcock & Wilcox Ltd.
Honolulu Iron Works Co.

Bagasse—Pulp and paper plant.
Parsons & Whittemore Lyddon Ltd.
Simon Handling Engineers Ltd.

Bearings and pillow blocks.
Chain Belt Company.
Crofts (Engineers) Ltd.
Eisenwerk Wülfel.
Ransome & Marles Bearing Co. Ltd.
The Skefko Ball Bearing Co. Ltd.

Beet diffusers, Continuous.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
A/S De danske Sukkerfabrikker.
Extraction De Smet S.A.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Société Française des Constructions Babcock & Wilcox.
Stork-Werkspoor (V.M.F.)
U.C.M.A.S.

Beet flume equipment.
Cocksedge & Co. Ltd.
Elfa-Apparate-Vertriebs G.m.b.H.
New Conveyor Co. Ltd.

Beet harvesters.
Catchpole Engineering Co. Ltd.

Beet hoes.
Martin-Markham Ltd.

Beet mechanical discharging and storage equipment.
Elfa-Apparate-Vertriebs G.m.b.H.
U.C.M.A.S.

Beet pulp presses.
BMA Braunschweigische Maschinenbauanstalt.
Choquenet L. Fonderies et Ateliers.
Cocksedge & Co. Ltd.
Fletcher and Stewart Ltd.
Hein, Lehmann & Co. A.G.
AB. Landsverk.
Rose, Downs & Thompson Ltd.
Stord Bartz Industri A/S.
U.C.M.A.S.
Weigelwerk G.m.b.H.

Beet seed.
A/S De danske Sukkerfabrikker.

Beet seed rubbing machines.
Cocksedge & Co. Ltd.

Beet slicers.
Choquenet L. Fonderies et Atelie
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.
Soc. Fives Lille—Cail.
Köllman & Gruhn.
H. Putsch & Comp.
U.C.M.A.S.

Beet tail utilization plant.
Elfa-Apparate-Vertriebs G.m.b.H.
Köllmann & Gruhn.
New Conveyor Co. Ltd.
H. Putsch & Comp.

Beet tare house equipment.
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.
Elfa-Apparate-Vertriebs G.m.b.H.
New Conveyor Co. Ltd.

Beet washing plant.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cocksedge & Co. Ltd.
Elfa-Apparate-Vertriebs G.m.b.H.
New Conveyor Co. Ltd.
Salzgitter Maschinen A.G.
U.C.M.A.S.

Beet water-jet unloading equipment.
Cocksedge & Co. Ltd.
New Conveyor Co. Ltd.

Boiler water treatment.
Houseman & Thompson Ltd.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.
Unifloc Ltd.

Boilers, Vertical.
Clayton, Son & Co. Ltd.
Cochran & Co., Annan, Ltd.

Boilers, Water tube.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. W A.G.
Cochran & Co., Annan, Ltd.
George Cohen Machinery Ltd.
Davey, Paxman & Co. Ltd.
Escher Wyss (U.K.) Ltd.
Soc. Fives-Penhoet.
Foster Wheeler Ltd.
Richardsons, Westgarth & Co. Ltd.
Stork-Werkspoor (V.M.F.)

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

Bulk handling.
see Conveyors and Elevators.

Bulk storage hoppers.
Clayton, Son & Co. Ltd.
Cocksedge & Co. Ltd.
George Fletcher & Co. Ltd.
New Conveyor Co. Ltd.
Spencer (Melksham) Ltd.
Towler & Son Ltd.

Bulk sugar containers, Transportable.
Robert Hudson (Raletrux) Ltd.

Bunker discharge equipment.
Carmichael & Sons (Worcester) Ltd.
Sinex Engineering Co. Ltd.

Cable reeling drums.
Deco Engineering Co. Ltd.

Cane cars and trailers.
Cary Iron Works.
Robert Hudson (Raletrux) Ltd.
Kingston Industrial Works Ltd.
Krupp-Dolberg.
N.V. Locospoor.
Martin-Markham Ltd.
F. W. Pettit Ltd.
Railway Mine & Plantation Equipment Ltd.
Whitlock Bros. Ltd.

Cane car tippers.
Fletcher and Stewart Ltd.
Honolulu Iron Works Co.
The Mirrlees Watson Co. Ltd.
Strachan & Henshaw Ltd.

Cane carts.
Cary Iron Works.
Firestone International Company.
Kingston Industrial Works Ltd.
Martin-Markham Ltd.
F. W. Pettit Ltd.
Whitlock Bros. Ltd.

Cane cultivation equipment.
Broussard Machine Co.

Cane diffusers, Continuous.
BMA Braunschweigische Maschinenbauanstalt.
Extraction De Smet S.A.

Cane grapples.
Priestman Brothers Ltd.
Joseph Westwood & Co. Ltd.

Cane harvesters.
Cary Iron Works.

Cane loaders.
Broussard Machine Co.
Cary Iron Works.

Carbon, Decolorizing.
C.E.C.A.
The Clydesdale Chemical Co. Ltd.
Farnell Carbons.
Haller & Phillips Ltd.
Norit Sales Corporation Ltd.
Pittsburgh Chemical Company, Activated Carbon Division.
Suchar Sales Corporation.
The Sugar Manufacturers' Supply Co. Ltd.

Carbon decolorizing systems.
Graver Water Conditioning Co.

Carbon reactivation.
Huntington, Heberlein & Co. Ltd.

Carbonatation equipment.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Neyrpic.
Port Engineering Works Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Société Française des Constructions Babcock & Wilcox.
Stork-Werkspoor (V.M.F.)
U.C.M.A.S.

Cement (Sugar-Resistant).
Lafarge Aluminous Cement Co. Ltd.

Centrifugals and accessories.
ASEA.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co. A.G.

Centrifugals and accessories—*continued.*
Honolulu Iron Works Co.
AB. Landsverk.
Pott, Cassels & Williamson Ltd.
Machinefabriek Reineveld N.V.
Salzgitter Maschinen A.G.
Sharples Centrifuges Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Toyo Chemical Engineering Co. Ltd.
Watson, Laidlaw & Co. Ltd.
The Western States Machine Co.

Centrifugals—complete electrical equipment.
Siemens-Schuckertwerke A.G.

Centrifugals—Continuous.
BMA Braunschweigische Maschinenbauanstalt.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
Hein, Lehmann & Co. A.G.
Sharples Centrifuges Ltd.
U.C.M.A.S.
Watson, Laidlaw & Co. Ltd.
Western States Machine Co.

Centrifugals—Fully automatic batch-type.
ASEA.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Invest Export.
AB. Landsverk.
Pott, Cassels & Williamson Ltd.
Machinefabriek Reineveld N.V.
Salzgitter Maschinen A.G.
Sharples Centrifuges Ltd.
Watson, Laidlaw & Co. Ltd.
The Western States Machine Co.

Centrifugals—Semi-automatic batch-type.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Escher Wyss Ltd.
Pott, Cassels & Williamson Ltd.
Salzgitter Maschinen A.G.
Sharples Centrifuges Ltd.
Watson, Laidlaw & Co. Ltd.
The Western States Machine Co.

Centrifugal backings.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
Harvey Perforators and Weavers Ltd.
Ets Krieg et Zivy.
The Western States Machine Co.

Centrifugal clarifiers.
Alfa-Laval AB.
Sharples Centrifuges Ltd.
Westfalia Separator A.G.

Centrifugal motors.
Hinz Elektromaschinen und Apparatebau.
Siemens-Schuckertwerke A.G.
The Western States Machine Co.

Centrifugal screens.
Balco Filtertechnik G.m.b.H.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Divn.

Centrifugal screens—*continued.*
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
Harvey Perforators and Weavers Ltd.
Hein, Lehmann & Co. A.G.
Ets Krieg et Zivy.
Multi-Metal Wire Cloth Co. Inc.
Nordberg Manufacturing Company.
The Sugar Manufacturers' Supply Co. Ltd.
The Western States Machine Co.

Chains.
Chain Belt Company.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Parsons Chain Co. Ltd.
Pennine Chainbelt Co. Ltd.
Renold Chains Ltd.
A. & W. Smith & Co. Ltd.

Char revivifying plants.
James Buchanan & Son (Liverpool) Ltd.
Honolulu Iron Works Co.
Huntington, Heberlein & Co. Ltd.
Stein Atkinson Stordy Ltd.

Chemicals.
Associated Chemical Companies (Sales) Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Caustic Soda.
Diamond Alkali Company.

Muriatic Acid.
Diamond Alkali Company.

Chemical plants.
A.P.V. Co. Ltd.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Burnett & Rolfe Ltd.
George Clark & Sons (Hull) Ltd.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
Kestner Evaporator & Engineering Co. Ltd.
S.P.E.I. Chim.
Unifloc Ltd.

Chromatography materials.
W. R. Balston Ltd.

Clarifiers.
Alfa-Laval AB.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Dorr-Oliver Inc., Cane Sugar Divn.
Eimco (Great Britain) Ltd.
Fletcher and Stewart Ltd.
Graver Water Conditioning Company.
Honolulu Iron Works Co.
Johns-Manville International Corp.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Sharples Centrifuges Ltd.
Stockdale Engineering Ltd.
Unifloc Ltd.
Westfalia Separator A.G.

Clarifiers, Tray-type.
The Eimco Corporation.

Colorimeters.
Metrimpex, Budapest.
The Sugar Manufacturers' Supply Co. Ltd.

Condenser water treatment.
Houseman & Thompson Ltd.

Condensers, Water jet ejector.
Korting Brothers (1917) Ltd.

Continuous belt weighing machines.
Adequate Weighers Ltd.
Howe Richardson Scale Co. Ltd.

Control switchgear—limit switches, centrifugal switches, emergency trip gear, etc.
Deco Engineering Co. Ltd.

Conveyor bearings.
Chain Belt Company.
Link-Belt Company.

Conveyor belt rotary brushes.
Unifloc Ltd.

Conveyor belting.
Turner Brothers Asbestos Co. Ltd.

Conveyor chains.
Chain Belt Company.
Ewart Chainbelt Co. Ltd.
G. Hopkins & Sons Ltd.
Link-Belt Company.
Pennine Chainbelt Co. Ltd.
Renold Chains Ltd.
A. & W. Smith & Co. Ltd.

Conveyors and elevators.
ASEA
Babcock & Wilcox Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Clayton, Son & Co. Ltd.
Cocksedge & Co. Ltd.
Fletcher and Stewart Ltd.
Hein, Lehmann & Co. A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
AB. Landsverk.
The Lawrence Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
Mitchell Ropeways Ltd.
Herbert Morris Ltd.
Pennine Chainbelt Co. Ltd.
Pott, Cassels & Williamson Ltd.
Salzgitter Maschinen A.G.
Simon Handling Engineers Ltd.
A. & W. Smith & Co. Ltd.
Spencer (Melksham) Ltd.
Stork-Werkspoor (V.M.F.)
Strachan & Henshaw Ltd.
U.C.M.A.S.

Apron conveyors.
Birtley Engineering Ltd.
Chain Belt Company.
Darrold Engineering Co. Ltd.
Link-Belt Company.
New Conveyor Co. Ltd.
Unifloc Ltd.

Belt and bucket elevators.
Aldersley Engineers Ltd.
Birtley Engineering Ltd.
Frederick Braby & Co. Ltd.
Chain Belt Company.
Darrold Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Belt conveyors.
Aldersley Engineers Ltd.
Birtley Engineering Ltd.
Chain Belt Company.
Darrold Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Bucket elevators.
Frederick Braby & Co. Ltd.
Chain Belt Company.
New Conveyor Co. Ltd.
Unifloc Ltd.

Chain and bucket elevators.
Frederick Braby & Co. Ltd.
Chain Belt Company.
Darrold Engineerng Co. Ltd.
Link-Belt Company.
New Conveyor Co. Ltd.
Unifloc Ltd.

Chain conveyors.
Chain Belt Company.
Darrold Engineering Co. Ltd.
G. Hopkins & Sons Ltd.
Link-Belt Company.
New Conveyor Co. Ltd.
Unifloc Ltd.

Drag-bar conveyors.
Darrold Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Feeder conveyors.
Birtley Engineering Ltd.
Chain Belt Company.
Locker Industries (Sales) Ltd.
Unifloc Ltd.
see also Sugar throwers and trimmers.

Flight conveyors.
Chain Belt Company.
Darrold Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Grasshopper conveyors.
Birtley Engineering Ltd.
Thomas Broadbent & Sons Ltd.
New Conveyor Co. Ltd.

Plate conveyors.
Chain Belt Company.
Darrold Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Pneumatic conveyors.
Carmichael & Sons (Worcs.) Ltd.

Scraper conveyors.
Chain Belt Company.
Darrold Engineering Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Screw conveyors.
Aldersley Engineers Ltd.
Birtley Engineering Ltd.
Darrold Engineering Ltd.
G. Hopkins & Sons Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Slat conveyors.
Chain Belt Company.
Darrold Engineering Ltd.
Fourways (Engineers) Ltd.
G. Hopkins & Sons Ltd.

Steel band conveyors.
Unifloc Ltd.

"U"-link conveyors.
New Conveyor Co. Ltd.
Unifloc Ltd.

Vibratory conveyors.
Birtley Engineering Ltd.
Chain Belt Company.
Locker Industries (Sales) Ltd.
Sinex Engineering Co. Ltd.

Conveyors and elevators, Mobile.
Aldersley Engineers Ltd.
Babcock & Wilcox Ltd.
Fourways (Engineers) Ltd.
G. Hopkins & Sons Ltd.
Mitchell Ropeways Ltd.

Coolers, Sugar.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Buell Ltd.
Büttner-Werke A.G.
Buttner Works Inc.
John Dore & Co. Ltd.
Dunford & Elliott Process Engineering Ltd.
Fletcher and Stewart Ltd.
Honolulu Iron Works Co.
G. Hopkins & Sons Ltd.
Manlove Alliott & Co. Ltd.
Richard Simon & Sons Ltd.
Standard Steel Corporation.
U.C.M.A.S.
Werkspoor N.V.
see also Dryers.

Coolers, Water.
Film Cooling Towers (1925) Ltd.
Heenan & Froude Ltd.
Wellington Engineering Works Ltd.

Crane collector columns, tee bar and copper conductor systems.
Deco Engineering Co. Ltd.

Cranes.
Babcock & Wilcox Ltd.
Butters Bros. & Co. Ltd.
J. H. Carruthers & Co. Ltd.
Cary Iron Works.
Herbert Morris Ltd.
Southern Cross Engineering & Foundry Works.
Stork-Werkspoor (V.M.F.)
Stothert & Pitt Ltd.
U.C.M.A.S.
Vaughan Crane Co. Ltd.

Crystallizers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Harvey Fabrication Ltd.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
AB. Landsverk.

Crystallizers—*continued.*
The Mirrlees Watson Co. Ltd.
Port Engineering Works Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Société Française des Constructions Babcock & Wilcox.
Standard Steel Corporation.
U.C.M.A.S.
Werkspoor N.V.

Cube-making machinery.
Maschinenfabrik Buckau R. Wolf A.G.
Goka N.V. Machine Works.
The Mirrlees Watson Co. Ltd.
Standard Steel Corporation.

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

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

Decolorizing plants.
BMA Braunschweigische Maschinenbauanstalt.
Graver Water Conditioning Co.
Norit Sales Corporation Ltd.
The Permutit Co. Ltd.
Pittsburgh Chemical Company, Activated Carbon Divn.
Machinefabriek Reineveld N.V.
Suchar Sales Corporation.

Decolorizing resins.
Diamond Alkali Company, Western Division.
Lennig Chemicals Ltd.
The Permutit Co. Ltd.

Deliming plants.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Divn.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Demineralization plants.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Divn.
The Eimco Corporation.
Graver Water Conditioning Co.
Paterson Engineering Co. Ltd.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Diatomaceous earth, *see* Bentonite ***and*** Filter-aids.

Diesel alternator sets.
Auto Diesels Ltd.
The English Electric Co. Ltd., Electrical Plant Divn.

Distillery plant, *see* Alcohol plant.

Drainage and ridging machinery.
James A. Cuthbertson Ltd.

Drives, Variable speed.
Crofts (Engineers) Ltd.
Eisenwerk Wülfel.
Heenan & Froude Ltd.
Salzgitter Maschinen A.G.
Western Gear Corporation.

Dryers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Buell Ltd.
Büttner-Werke A.G.
Buttner Works Inc.
Dunford & Elliott Process Engineering Ltd.
Fletcher and Stewart Ltd.
Honolulu Iron Works Co.
Robert Jenkins & Co. Ltd.
Kestner Evaporator & Engineering Co. Ltd.
Manlove Alliott & Co. Ltd.
Pott, Cassels & Williamson Ltd.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
Spencer (Melksham) Ltd.
Standard Steel Corporation.
A.B. Svenska Fläktfabriken.
Toyo Chemical Engineering Co. Ltd.
U.C.M.A.S.
Werkspoor N.V.

Duck boards.
Grill Floors Ltd.

Dust control equipment.
Buell Ltd.
Büttner-Werke A.G.
Centrifix Corporation.
Dunford & Elliott Process Engineering Ltd.
Dust Control Equipment Ltd.
A.B. Svenska Fläktfabriken.

Dust sleeves and bags.
Dunford & Elliott Process Engineering Ltd.
Samuel Hill Ltd.
Porritt Bro. & Austin Ltd.
Porritts & Spencer Ltd., Industrial Fabrics Export Division.

Economizers.
Babcock & Wilcox Ltd.
Soc. Fives Lille-Cail.
E. Green & Son Ltd.

Ejectors, Water and steam operated.
Korting Brothers (1917) Ltd.

Electric heating tapes and mantles.
Isopad Ltd.
Stabilag Engineering Ltd.

Electric motors.
ASEA.
The English Electric Co. Ltd. Electrical Plant Divn.
The Harland Engineering Co. Ltd.
Heemaf N.V.
Hinz Elektromaschinen und Apparatebau.
Siemens-Schuckerwterke A.G.

Electric motors, Fractional horse power.
The English Electric Co. Ltd. Electrical Plant Divn.
Evershed & Vignoles Ltd.
Siemens-Schuckertwerke A.G.

Electric power generators.
The English Electric Co. Ltd. Electrical Plant Divn.
Soc. Fives Lille-Cail.
Heemaf N.V.
Krupp-Dolberg.
Richardsons, Westgarth & Co. Ltd.
Siemens-Schuckertwerke A.G.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor (V.M.F.)

Electrical meters and relays.
The English Electric Co. Ltd., Electrical Plant Divn.
Siemens-Schuckertwerke A.G.

Electronic equipment.
Bendix Ericsson U.K. Ltd.
The English Electric Co. Ltd., Electrical Plant Divn.
Evershed & Vignoles Ltd.
Fielden Electronics Ltd.
Meter-Flow Ltd.

Engines, Diesel.
Belliss & Morcom Ltd.
Davey, Paxman & Co. Ltd.
The English Electric Co. Ltd., Electrical Plant Divn.
Stork-Werkspoor (V.M.F.)
Worthington Corporation.

Engines, Steam.
Belliss & Morcom Ltd.
Blairs Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor (V.M.F.)
Walmsleys (Bury) Ltd.

Entrainment separators.
Centrifix Corporation.
Dunford & Elliott Process Engineering Ltd.
Honolulu Iron Works Co.
Otto H. York Co. Inc.

Evaporators and condensing plant.
Alfa-Laval AB.
A.P.V. Co. Ltd.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Burnett & Rolfe Ltd.
A. F. Craig & Co. Ltd.
John Dore & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kestner Evaporator & Engineering Co. Ltd.
Kingston Industrial Works Ltd.
AB. Landsverk.
The Mirrlees Watson Co. Ltd.
Richardsons, Westgarth & Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Société Française des Constructions Babcock & Wilcox.
Southern Cross Engineering & Foundry Works.
S.P.E.I. Chim.

Evaporators and condensing plant—*continued.*
Stork-Werkspoor (V.M.F.)
Technoexport Czechoslovakia.
Toyo Chemical Engineering Co. Ltd.
U.C.M.A.S.
Wellington Engineering Works Ltd.

Evaporator tube cleaners.
see Tube cleaners.

Fabrications in all metals.
American Plant Equipment Co.
Harvey Fabrication Ltd.
Robert Jenkins & Co. Ltd.

Filters.
Maschinenfabrik Buckau R. Wolf A.G.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Invest Export.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Sankey Green Wire Weaving Co. Ltd.
Sparkler Filter Manufacturing Co.
U.C.M.A.S.
Werkspoor N.V.

Automatically controlled filters.
American Plant Equipment Co.
Paterson Engineering Co. Ltd.
Stockdale Engineering Ltd.

Bag pressure filters.
American Plant Equipment Co.
A. F. Craig & Co. Ltd.

Diatomite filters.
American Plant Equipment Co.
Niagara Filters Europe.
Paterson Engineering Co. Ltd.
Schumacher'sche Fabrik.
Sparkler Filters (G.B.) Ltd.
Unifloc Ltd.

Filter presses.
BMA Braunschweigische Maschinenbauanstalt.
Choquenet L. Fonderies et Ateliers
S. H. Johnson & Co. Ltd.
Manlove Alliott & Co. Ltd.
Salzgitter Maschinen A.G.
Unifloc Ltd.

Gravity and pressure filters.
American Plant Equipment Co.
Davey, Paxman & Co. Ltd.
Graver Water Conditioning Co.
G. Hopkins & Sons Ltd.
The Permutit Co. Ltd.

Iron removal filters.
Electromagnets Ltd.
Graver Water Conditioning Co.
The Permutit Co. Ltd.
Rapid Magnetic Ltd.
Unifloc Ltd.

Leaf filters.
American Plant Equipment Co.
Dorr-Oliver Inc., Cane Sugar Divn.
Ferguson Perforating & Wire Co.
G. Hopkins & Sons Ltd.
Niagara Filters Europe.
A. & W. Smith & Co. Ltd.
Suchar Sales Corporation.

Plate and frame filters.
Blairs Ltd.
G. Hopkins & Sons Ltd.
S. H. Johnson & Co. Ltd.
Manlove Alliott & Co. Ltd.
Port Engineering Works Ltd.

Pressure filters.
American Plant Equipment Co.
BMA Braunschweigische Maschinenbauanstalt.
Davey, Paxman & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
The Eimco Corporation.
Eimco (Great Britain) Ltd.
Graver Water Conditioning Co.
G. Hopkins & Sons Ltd.
Niagara Filters Europe.
The Permutit Co. Ltd.
Schumacher'sche Fabrik.
A. & W. Smith & Co. Ltd.
Suchar Sales Corporation.

Rotary vacuum filters.
BMA Braunschweigische Maschinenbauanstalt.
Davey, Paxman & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
The Eimco Corporation.
Eimco (Great Britain) Ltd.
Stockdale Engineering Ltd.
Unifloc Ltd.

Filter-aids.
Carlson-Ford Sales Ltd.
C.E.C.A.
Dorr-Oliver Inc., Cane Sugar Divn.
The Eagle-Picher Company.
Haller & Phillips Ltd.
Johns-Manville International Corp.
The Sugar Manufacturers' Supply Co. Ltd.

Filtercloths.
Jeremiah Ambler Ltd.
American Plant Equipment Co.
Fothergill & Harvey Ltd.
Harvey Perforators and Weavers Ltd.
Samuel Hill Ltd.
S. H. Johnson & Co. Ltd.
James Kenyon & Son Ltd.
Locker Industries (Sales) Ltd.
Multi-Metal Wire Cloth Co. Inc.
Nordiska Maskinfilt AB.
Porritt Bro. & Austin Ltd.
Porritts & Spencer Ltd., Industrial Fabrics Export Division.
Sankey Green Wire Weaving Co. Ltd.

Filter-leaves.
American Plant Equipment Co.
Dorr-Oliver Inc., Cane Sugar Divn. (*Sweetland*).
Ferguson Perforating & Wire Co.
G. Hopkins & Sons Ltd.
Multi-Metal Wire Cloth Co. Inc.
Niagara Filters Europe.
Porrits & Spencer Ltd., Industrial Fabrics Export Division.
Sankey Green Wire Weaving Co. Ltd.
Sparkler Filter Manufacturing Co.

Filter papers.
W. & R. Balston Ltd.
Carlson-Ford Sales Ltd.
J. Barcham Green Ltd.
G. Hopkins & Sons Ltd.
S. H. Johnson & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Technical Paper Sales Ltd.

Filter screens.
American Plant Equipment Co.
Endecotts (Filters) Ltd.
Fontaine & Co. G.m.b.H.
Ets. Krieg et Zivy.
Locker Industries (Sales) Ltd.
Sankey Green Wire Weaving Co. Ltd.

Flanges, Non-Ferrous.
Blundell & Crompton Ltd.

Flexible drives.
Rotatools (U.K.) Ltd.

Flexible shafting.
Rotatools (U.K.) Ltd.

Flowmeters.
Alfa-Laval AB.
Evershed & Vignoles Ltd.
Fielden Electronics Ltd.
G. Hopkins & Sons Ltd.
Meter-Flow Ltd.
Negretti & Zambra Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.

Friction materials (Industrial).
British Belting & Asbestos Ltd.
Johns-Manville International Corp.

Fumigants.
Diamond Alkali Company.

Fuse Gear.
The English Electric Co. Ltd., Electrical Plant Divn.

Gas purifying equipment.
Centrifix Corporation.
Maschinenfabrik H. Eberhardt.

Gearing, *see* Reduction gears.

Gearmotors.
Crofts (Engineers) Ltd.
The English Electric Co. Ltd., Electrical Plant Divn.
Siemens-Schuckertwerke A.G.

Grabs, Cane, Beet and Raw Sugar.
Priestman Brothers Ltd.
Joseph Westwood & Co. Ltd.

Granulators, *see* Dryers.

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

Heat exchangers, Air-cooled.
Wellington Engineering Works Ltd.

Heat exchangers, Plate type.
Alfa-Laval AB.
A.P.V. Co. Ltd.
Clayton, Son & Co. Ltd.
Harvey Fabrication Ltd.

Heat exchangers, Tubular.
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Blairs Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Burnett & Rolfe Ltd.
Carrier Engineering Co. Ltd.
Clayton, Son & Co. Ltd.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
Foster Wheeler Ltd.

Heat exchangers—*continued.*
Robert Jenkins & Co. Ltd.
Kingston Industrial Works Ltd.
AB. Landsverk.
Lepage, Urbain & Cie.
Richardsons, Westgarth & Co. Ltd.
Salzgitter Maschinen A.G.
S.P.E.I. Chim.
Towler & Son Ltd.
U.C.M.A.S.
Wellington Engineering Works Ltd.
Worthington Corporation.

Herbicides.
Diamond Alkali Company.

Hydraulic controls for valves, etc.
Edwards Engineering Corp.

Hydraulic lifting equipment.
Cotterell & Pither Ltd.

Insecticides.
Diamond Alkali Company.

Instruments, Process control.
Bellingham & Stanley Ltd.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Cleveland Meters Ltd.
Evershed & Vignoles Ltd.
Metrimpex, Budapest.
Negretti & Zambra Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.

Insulation, Thermal (heat and cold).
Cape Insulation and Asbestos Products Ltd.
The Eagle-Picher Company.
Johns-Manville International Corp.
Lafarge Aluminous Cement Co. Ltd.

Ion exchangers.
W. & R. Balston Ltd.
Diamond Alkali Company, Westerm Division.
Dorr-Oliver Inc., Cane Sugar Divn.
Graver Water Conditioning Co.
Lennig Chemicals Ltd.
Paterson Engineering Co. Ltd.
The Permutit Co. Ltd.

Irrigation equipment.
British Overhead Irrigation Ltd.
Farrow & Sons Ltd.
Harvey Fabrication Ltd.
Chas. P. Kinnell & Co. Ltd.
Martin-Markham Ltd.
Worthington Corporation.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Jointings, *see* Packings and gaskets.

Juice heaters.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.

Juice heaters—*continued.*
Port Engineering Works Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Société Française des Constructions Babcock & Wilcox.
Southern Cross Engineering & Foundry Works.
Stork-Werkspoor (V.M.F.)
Wellington Engineering Works Ltd.

Juice scales.
Fletcher and Stewart Ltd.
Howe Richardson Scale Co. Ltd.
N.V. Servo-Balans.
see also Weighing Machines

Juice strainers and screens.
Blairs Ltd.
Frederick Braby & Co. Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Cocksedge & Co. Ltd.
Davey, Paxman & Co. Ltd.
The Deister Concentrator Co. Inc.
Dorr-Oliver Inc., Cane Sugar Divn.
Endecotts (Filters) Ltd.
Ferguson Perforating & Wire Co.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fontaine & Co. G.m.b.H.
Gutehoffnungshütte Sterkrade A.G.
Harvey Perforators and Weavers Ltd.
Locker Industries (Sales) Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.
Walmsleys (Bury) Ltd.

Juice and syrup mixers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Burnett & Rolfe Ltd.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

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

Knives, Milling.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Broussard Machine Co.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Farrel Corporation.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Société Française des Constructions Babcock & Wilcox.
Stork-Werkspoor (V.M.F.)

Knives, Milling—Drives.
Siemens-Schuckertwerke A.G.
Western Gear Corporation.

Laboratory apparatus and equipment.
Endecotts (Filters) Ltd.
Netherlands Instruments and Apparatus Manufacturing and Trading Co., A. H. Korthof Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Electric heating appliances
Isopad Ltd.

see also Laboratory Instruments *and* Saccharimeters and Polarimeters, *etc.*

Laboratory instruments.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Metrimpex, Budapest.
Negretti & Zambra Ltd.
Netherlands Instruments and Apparatus Manufacturing and Trading Co., A. H. Korthof Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
G. H. Zeal Ltd.

Refractometers.
Bellingham & Stanley Ltd.
Schmidt & Haensch.

Laboratory reagents.
Netherlands Instruments and Apparatus Manufacturing and Trading Co., A. H. Korthof Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Ladders, steel lattice.
Grill Floors Ltd.

Lens cleaning tissues.
J. Barcham Green Ltd.

Level indicators and controllers.
Fielden Electronics Ltd.

Lifting tables.
Cotterell & Pither Ltd.

Lime density meters.
Rotameter Manufacturing Co. Ltd.

Lime slaking equipment.
Maschinenfabrick H. Eberhardt.
The Eimco Corporation.
Port Engineering Works Ltd.

Liming equipment.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cocksedge & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Maschinenfabrik H. Eberhardt.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Port Engineering Works Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.
U.C.M.A.S.
Unifloc Ltd.

Loading machinery.
F. E. Weatherill Ltd.

Locomotives, Diesel.
Andrew Barclay, Sons & Co. Ltd.
The English Electric Co. Ltd., Electrical Plant Divn.
F. C. Hibberd & Co. Ltd.
Robert Hudson (Raletrux) Ltd.
Krupp-Dolberg.
N.V. Locospoor.
Motor Rail Ltd.
Plymouth Locomotive Works.
Railway Mine & Plantation Equipment Ltd.
U.C.M.A.S.

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

Magnetic separators.
Electromagnets Ltd.
Huntington, Heberlein & Co. Ltd.
Industrial Magnets Ltd.
Permag Ltd.
Rapid Magnetic Ltd.
Unifloc Ltd.

Massecuite heat treating equipment.
Blairs Ltd.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Pott, Cassels & Williamson Ltd.
A. & W. Smith & Co. Ltd.
Société Française des Constructions Babcock & Wilcox.
Stork-Werkspoor (V.M.F.)
The Western States Machine Co. (*Stevens System*).

Mechanical crop thinning machines.
Catchpole Engineering Co. Ltd.
Salopian-Kenneth Hudson Ltd.

Metal detectors.
Automa Engineering Ltd.
Metal Detection Ltd.

Meters, Integrating, for liquids.
Cleveland Meters Ltd.

Mill hydraulics.
Edwards Engineering Corp.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor (V.M.F.)

Mill rolls.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Farrel Corporation.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
G. M. Hay & Co. Ltd.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Southern Cross Engineering & Foundry Works.
Stork-Werkspoor (V.M.F.).

Mill roll movement indicators and recorders.
Edwards Engineering Corp.

Milling plant.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Farrel Corporation.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
G. H. Hay & Co. Ltd.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Southern Cross Engineering & Foundry Works.
Stork-Werkspoor (V.M.F.).
Technoexport Czechoslovakia.
Toyo Chemical Engineering Co. Ltd.
Western Gear Corporation.
see also Knives, Milling *and* Shredders.

Milling plant—complete electrical equipment.
Siemens-Schuckertwerke A.G.

Molasses addition plants for beet pulp.
Amandus Kahl Nachf.

Molasses tanks.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinfabrik Buckau R. Wolf A.G.
Clayton, Son & Co. Ltd.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
Harvey Fabrication Ltd.
Kingston Industrial Works Ltd.
Krupp-Dolberg.
Port Engineering Works Ltd.
Salzgitter Maschinen A.G.
Société Française des Constructions Babcock & Wilcox.
Stork-Werkspoor (V.M.F.)
Towler & Son Ltd.

Mud removal chemicals for water cooling systems.
Houseman & Thompson Ltd.

Oil, Sugar-dissolving.
Clifford Coupe Ltd.

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

Packings and gaskets.
British Belting & Asbestos Ltd.
Johns-Manville International Corp.

Pallets.
Wellington Engineering Works Ltd.

Pallet loaders.
The Lawrence Engineering Co. Ltd.

Pans, Vacuum.
A.P.V. Co. Ltd.
Blairs Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.

Pans, Vacuum—*continued.*
Burnett & Rolfe Ltd.
Clayton, Son & Co. Ltd.
A. F. Craig & Co. Ltd.
John Dore & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Harvey Fabrication Ltd.
Honolulu Iron Works Co.
Robert Jenkins & Co. Ltd.
Kingston Industrial Works Ltd.
AB. Landsverk.
The Mirrlees Watson Co. Ltd.
Port Engineering Works Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Société Française des Constructions Babcock & Wilcox.
Southern Cross Engineering & Foundry Works.
Stork-Werkspoor (V.M.F.)
Technoexport Czechoslovakia.
Towler & Son Ltd.
U.C.M.A.S.

Paper and board from bagasse—Manufacturing equipment.
Parsons & Whittemore Lyddon Ltd.

Parcelling machines.
Fr. Hesser Maschinenfabrik A.G.
SIG Swiss Industrial Company.

Pelleting presses for dried pulp.
Amandus Kahl Nachf.
Richard Sizer Ltd.

Perforated metals.
Harvey Perforators and Weavers Ltd.
Ets. Krieg et Zivy.
Locker Industries (Sales) Ltd.

Pipes, Steam.
Babcock & Wilcox Ltd.
T.I. Stainless Tubes Ltd.
Wellington Engineering Works Ltd.

Pipe fittings.
see Tube fittings

Pipewrap, Protective fabric.
Fothergill & Harvey Ltd.

Ploughs—Disc.
Martin-Markham Ltd.
F. W. Pettit Ltd.
Salopian-Kenneth Hudson Ltd.

Ploughs—Reversible.
Salopian-Kenneth Hudson Ltd.

Ploughs—Ridging and draining.
James A. Cuthbertson Ltd.

Polythene bag sealers.
The Thames Packaging Equipment Co.

Power plants.
Siemens-Schuckertwerke A.G.

Power transmission equipment.
Thomas Broadbent & Sons Ltd.
Crofts (Engineers) Ltd.
Farrel Corporation.
Heenan & Froude Ltd.
Renold Chains Ltd.
Western Gear Corporation.

Preliming equipment.
A/S De danske Sukkerfabrikker.

Scaffold boards.
Grill Floors Ltd.

Scale removal and prevention.
Diamond Alkali Company.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
H. Williams & Son Ltd.
see also Tube Cleaners.

Screens, Centrifugal, *see* Centrifugal Screens.

Screens, Filter, *see* Filter screens.

Screens, Vibrating.
Frederick Braby &Co. Ltd.
Büttner-Werke A.G.
Chain Belt Company.
Cocksedge & Co. Ltd.
The Deister Concentrator Co. Inc.
Electromagnets Ltd.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Harvey Perforators and Weavers Ltd.
Hein, Lehmann & Co. A.G.
Locker Industries (Sales) Ltd.
Multi-Metal Wire Cloth Co. Inc.
Sinex Engineering Co. Ltd.
Spencer (Melksham) Ltd.
The Sugar Manufactorers' Supply Co. Ltd.
Unifloc Ltd.
see also Juice Strainers and Screens.

Self-regulating alternators.
Heemaf N.V.

Ship loading installations.
Babcock & Wilcox Ltd.
Fletcher and Stewart Ltd.
Simon Handling Engineers Ltd.
Spencer (Melksham) Ltd.

Shredders.
BMA Braunschweigische Maschinenbauanstalt.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gruendler Crusher & Pulverizer Co.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
Stork-Werkspoor (V.M.F.)

Shredder drives.
Siemens–Schuckertwerke A.G.
Western Gear Corporation.

Silos—Pre-stressed concrete.
A/S De danske Sukkerfabrikker.

Skip hoists.
Babcock & Wilcox Ltd.
New Conveyor Co. Ltd.
Strachan & Henshaw Ltd.

Spectrophotometers.
Metrimpex, Budapest.

Spray nozzles.
Chain Belt Company.
Elfa-Apparate-Vertriebs G.m.b.H.
Korting Brothers (1917) Ltd.
The Lunkenheimer Company.
New Conveyor Co. Ltd.

Spraying and dusting machinery.
Cooper, Pegler & Co. Ltd.

Stainless steel buckets and utensils.
Clifford Coupe Ltd.

Steam accumulators.
Babcock & Wilcox Ltd.
Centrifix Corporation.
Cochran & Co., Annan, Ltd.
Fletcher and Stewart Ltd.
Harvey Fabrication Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Steam storage equipment.
see Steam accumulators.

Steam superheaters.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Foster Wheeler Ltd.

Steam traps.
von Arnim'she Werke G.m.b.H., Werk Schneider & Helmecke.
The British Steam Specialties Ltd.
J. H. Carruthers & Co. Ltd.

Steam turbines for mill drives, etc.
Belliss & Morcom Ltd.
A. F. Craig & Co. Ltd.
The English Electric Co. Ltd., Steam Turbine Divn.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
A.G. Kühnle, Kopp & Kausch.
The Mirrlees Watson Co. Ltd.
Murray Iron Works Company.
Richardsons, Westgarth & Co. Ltd.
A. & W. Smith & Co. Ltd.
Stal-Laval Turbin AB.
Stork-Werkspoor (V.M.F.)
G. & J. Weir Ltd.
Stal-Laval Turbine Co.
Worthington Corporation.

Steam turbo-alternator sets.
The English Electric Co. Ltd. Steam Turbine Divn.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
A.G. Kühnle, Kopp & Kausch.
Murray Iron Works Company.
Richardsons, Westgarth & Co. Ltd.
Siemens–Schuckertwerke A.G.
Stal-Laval Turbin AB.
Worthington Corporation.

Steel flooring and handrailing.
Grill Floors Ltd.

Stokers—Bagasse burning spreader type.
Babcock & Wilcox Ltd.

Storage vessels, Stainless steel.
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Burnett & Rolfe Ltd.
Harvey Fabrication Ltd.
Robert Jenkins & Co. Ltd.
Towler & Son Ltd.

Strainers, Self-cleaning.
Walmsleys (Bury) Ltd.

Sugar cane screw presses.
Rose, Downs & Thompson Ltd.

Sugar factory (beet) molasses-free process.
BMA Braunschweigische Maschinenbauanstalt.

Sugar factory design and erection (Cane and Beet).
BMA Braunschweigische Maschinenbauanstalt.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
Honolulu Iron Works Co.
Invest Export.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor (V.M.F.)
Toyo Chemical Engineering Co. Ltd.
U.C.M.A.S.

Sugar machinery, General.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. &. W. Smith & Co. Ltd.
Southern Cross Engineering & Foundry Works.
Stork-Werkspoor (V.M.F.)
Technoexport Czechoslovakia.
U.C.M.A.S.

Sugar tabletting machinery.
Goka N.V. Machine Works.
Standard Steel Corporation.

Sugar throwers and trimmers.
Cocksedge & Co. Ltd.
Fletcher and Stewart Ltd.
Spencer (Melksham) Ltd.

Sulphur furnaces, Continuous.
Maschinenfabrik H. Eberhardt.
Kestner Evaporator & Engineering Co. Ltd.
Port Engineering Works Ltd.

Switchgear.
The English Electric Co. Ltd., Electrical Plant Divn.
Heemaf N.V.
Siemens–Schuckertwerke A.G.

Switchgear, Ironclad.
Heemaf N.V.
Siemens–Schuckertwerke A.G.

Temperature conductive plastics.
Pac-O-Power Inc., Tempcon Divn.

Temperature recorders and controllers.
The British Rototherm Co. Ltd.
Evershed & Vignoles Ltd.
Fielden Electronics Ltd.
Honeywell Controls Ltd.
Negretti & Zambra Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
G. H. Zeal Ltd.

Test sieves, B.S. and A.S.T.M.
Endecotts (Filters) Ltd.

Test sieve shakers.
Endecotts (Filters) Ltd.

Thermometers.
The British Rototherm Co. Ltd.
Negretti & Zambra Ltd.
Taylor Controls Ltd.
Tomey Industries Ltd.
G. H. Zeal Ltd.

Thickeners, Tray-type.
The Eimco Corporation.

Track and track accessories.
Robert Hudson (Raletrux) Ltd.
Krupp-Dolberg.
N.V. Locospoor.
Railway Mine & Plantation Equipment Ltd.

Tractors.
F. C. Hibberd & Co. Ltd.

Trailers.
Cary Iron Works.
Robert Hudson (Raletrux) Ltd.
Lufkin Foundry & Machine Co.
Martin-Markham Ltd.
Salopian-Kenneth Hudson Ltd.
Whitlock Bros. Ltd.

Transformers.
The English Electric Co. Ltd., Electrical Plant Divn.
Siemens-Schuckertwerke A.G.

Trench gratings.
Grill Floors Ltd.

Tubes, Bi-metal.
T.I. Stainless Tubes Ltd.
Yorkshire Imperial Metals Ltd.

Tubes for boilers, evaporators, juice heaters, vacuum pans, etc.
Babcock & Wilcox Ltd.
Hudson & Wright Ltd.
T.I. Stainless Tubes Ltd.
Yorkshire Imperial Metals Ltd.

Tube cleaners, Rotary (Electric and air).
Babcock & Wilcox Ltd.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.
H. Williams & Son Ltd.
see also Scale removal and prevention.

Tube fittings.
A.P.V. Co. Ltd. (*stainless steel*).
Blakey's Boot Protectors Ltd. (*malleable iron*).
The Lunkenheimer Company.
T.I. Stainless Tubes Ltd.
Yorkshire Imperial Metals Ltd. (*copper, brass and plastic*).

Tyres.
Firestone International Company.
Firestone Tyre & Rubber Co. Ltd.

Vacuum pans, *see* Pans.

Vacuum pumps.
Alley Compressors Ltd.
Belliss & Morcom Ltd.
Blairs Ltd.
Comet Pump & Engineering Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Korting Brothers (1917) Ltd.
The Mirrlees Watson Co. Ltd.
Neyrpic.
Siemens-Schuckertwerke A.G.
A. &. W. Smith & Co. Ltd.
Spencer (Melksham) Ltd.
Stork-Werkspoor (V.M.F.)
Stothert & Pitt Ltd.
U.C.M.A.S.
Worthington Corporation.

Valves.
A.P.V. Co. Ltd.
von Arnim'sche Werke G.m.b.H., Werke Schneider & Helmecke.
Blundell & Crompton Ltd.
The British Steam Specialties Ltd.
The Lunkenheimer Company.
The Magnetic Valve Co. Ltd.
Saunders Valve Co. Ltd.
Taylor Controls Ltd.

Valves, Check-plate type.
Pac-O-Power Inc., Valve Divn.

Valves, Relief.
Blundell & Crompton Ltd.
G. Hopkins & Sons Ltd.
The Lunkenheimer Company.

Variable speed controls.
Crofts (Engineers) Ltd.
The English Electric Co. Ltd., Electric Plant Divn.
Heenan & Froude Ltd.

Vehicle washes.
Grill Floors Ltd.

Water cooling towers.
Film Cooling Towers (1925) Ltd.
Foster Wheeler Ltd.
AB. Svenska Flaktfabriken.

Weighing machines.
Adequate Weighers Ltd.
Automa Engineering Ltd.
Electroweighers Ltd.
Fletcher and Stewart Ltd.
Garvens-Waagen-Fabrik G.m.b.H.
Fr. Hesser Maschinenfabrik A.G.
Howe Richardson Scale Co. Ltd.
Librawerk Pelz & Nagel K.G.
N.V. Servo-Balans.
Richard Simon & Sons Ltd.
Stork-Werkspoor (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.
see also Juice Scales.

Wire brushes, Rotary and manual.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

Wire cloth.
Endecotts (Filters) Ltd.
Ferguson Perforating & Wire Company.
Fontaine & Co. G.m.b.H.
Harvey Perforators and Weavers Ltd.
Locker Industries (Sales) Ltd.
Multi-Metal Wire Cloth Co. Inc.
Sankey Green Wire Weaving Co. Ltd.
Unifloc Ltd.
Otto H. York Co. Inc.

Woven wire.
Endecotts (Filters) Ltd.
Harvey Perforators and Weavers Ltd.
Locker Industries (Sales) 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.
Burnett & Rolfe Ltd.
Harvey Fabrication Ltd.
G. Hopkins & Sons Ltd.

BUYERS' GUIDE—ADDRESS LIST

Adequate Weighers Ltd.,
Bridge Works, Bridge Road, Sutton, Surrey, England.
Tel.: Vigilant 6666/7/8. *Cable:* Adegrate, London.

The Albany Engineering Co. Ltd.,
Church Road, Lydney, Glos., England.
Tel.: Lydney 275/276/425. *Cable:* Bolthead, Lydney.

Aldersley Engineers Ltd.,
Upper Church Lane, Tipton, Staffs., England.
Tel.: Tipton 3446. *Cable:* Ubique, Tipton.

Alfa-Laval AB.,
Fack 2, Stockholm Tull, Sweden.
Tel.: 540220. *Cable:* Alfalaval, Stockholm.
Telex: 1550.

Alley Compressors Ltd.,
Cathcart, Glasgow, S.4, Scotland.
Tel.: Merrylee 7141. *Cable:* Giweir, Glasgow, Telex.
Telex: 77161/2.

Jeremiah Ambler Ltd.,
Midland Mills, Bradford 2, Yorks., England.
Tel.: Bradford 28456/9. *Cable:* Ambler, Bradford.
Telex: 51195.

American Plant Equipment Co., Pronto Filters Division,
441 York Street, P.O. Box 292, Elizabeth, New Jersey 07207, U.S.A.
Tel.: Area Code 201, 354 7770.

The A.P.V. Co. Ltd.,
Manor Royal, Crawley, Sussex.
Tel.: Crawley 27777. *Cable:* Anaclastic, Crawley
Telex: 87237.

von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke,
Offenbach/Main, Germany.
Tel.: Offenbach 82054/56. *Cable:* Kondenstopf, Offenbachmain.
Telex: 4152899 arnimwerk ofbh.

ASEA,
Västeras, Sweden.
Tel.: 10000. *Cable:* Asea, Västeras.
Telex: 4720.

Associated Chemical Companies (Sales) Limited.,
Beckwith Knowle, Ottley Road, Harrogate, Yorks., England.
Tel.: Harrogate 68911. *Cable:* Aschem, Harrogate.
Telex: 5741.

Auto Diesels Ltd.,
Braby House, Smithfield Street, London E, England.
Tel.: Central 2388. *Cable:* Xenophon, London E.C.1.

Automa Engineering Ltd.,
see Dunford & Elliott Process Engineering Ltd.

Babcock & Wilcox Ltd.,
Babcock House, 209 Euston Road, London, N.W.1, England.
Tel.: Euston 4321. *Cable:* Babcock, London.
Telex: 23256.

Balco-Filtertechnik G.m.b.H.,
Elektro-Chemishe Fabrik, 29 Oldenburg/Oldenburg, Bürgereschstr. 5/7, Germany.
Tel.: 0441/82221.
Telex: 02–5896.

W. & R. Balston Ltd.,
see H. Reeve Angel & Co. Ltd.

Andrew Barclay, Sons & Co. Ltd.,
Caledonia Works, Kilmarnock, Scotland.
Tel.: 1366/7. *Cable:* Barclayson, Kilmarnock.

Bellingham & Stanley Ltd.,
71 Hornsey Rise, London, N.19, England.
Tel.: Archway 2270. *Cable:* Polyfract, London, N.19.

Belliss & Morcom Ltd.,
Icknield Square, Birmingham 16, England.
Tel.: Edgbaston 3531. *Cable:* Belliss, Birmingham 16.

Bendix Ericsson U.K. Ltd.,
High Church Street, New Basford, Nottingham, England.
Tel.: Nottingham 75115. *Cable:* Benderic, Nottingham.

James Beresford & Son Ltd.,
Ace Works, Kitts Green, Birmingham 33, England.
Tel.: Stechford 3081. *Cable:* Beresford, Birmingham.

Birtley Engineering Ltd.,
Birtley, Co. Durham, England.
Tel.: Birtley 248

Blairs Ltd.,
Glasgow Engineering Works, Woodville Street, Govan, Glasgow, S.W.1, Scotland.
Tel.: Govan 1261. *Cable:* Blazon, Glasgow.

Blakey's Boot Protectors Ltd.,
see Pennine Chainbelt Co. Ltd.

Blundell & Crompton Ltd.,
West India Dock Road, London, E.14, England.
Tel.: East 6001/3838. *Cable:* Blundell, London, E.14.

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

Frederick Braby & Co. Ltd.,
Braby House, Smithfield Street, London E, England.
Tel.: Central 2388. *Cable:* Xenophon, London E.C.1.

Brecknell, Dolman & Rogers Ltd.,
Pennywell Road, Bristol 5, England.
Tel.: Bristol 58222. *Cable:* Bremaners, Phone, Bristol.

British Belting & Asbestos Ltd.,
Cleckheaton, Yorkshire, England.
Tel.: Cleckheaton 3222. *Cable:* Belting, Cleckheaton.
Telex: 51106.

British Charcoals & Macdonalds Ltd.,
51 Biggar Street, Glasgow, E.1, Scotland.
Tel.: Bridgeton 1274–5. *Cable:* Poynter, Glasgow.

British Overhead Irrigation Ltd.,
Upper Halliford, Shepperton, Middx., England.
Tel.: Sunbury 5177/8 *Cable:* Irrigation, Shepperton.

The British Rototherm Co. Ltd.,
Merton Abbey, London, S.W.19, England.
Tel.: Liberty 7661. *Cable:* Rototherm, London S.W.19.

The British Steam Specialties Ltd.,
Fleet Street, Leicester, England.
Tel.: Leicester 23232. *Cable:* Boss, Phone, Leicester.
Telex: 34589

Thomas Broadbent & Sons Ltd.,
Central Ironworks, Huddersfield, England.
Tel.: Huddersfield 5520. *Cable:* Broadbent, Huddersfield.

Broussard Machine Company,
see Logan Perkins.

James Buchanan & Son (Liverpool) Ltd.,
105 Brasenose Road, Liverpool 20, England.
Tel.: Bootle 2117. *Cable:* Buchanan, Liverpool.

Maschinenfabrik Buckau R. Wolf A.G.,
Grevenbroich/Ndrrh., Germany.
Tel.: Grevenbroich 421. *Cable:* Maschinenbau, Grevenbroich.
Telex: 08517111.

Buell Ltd.,
3 St. James's Square, London, S.W.1, England.
Tel.: Trafalgar 5381. *Cable:* Allentare, Piccy, London.

Burnett & Rolfe Ltd.,
Off Commissioners Road, Strood, Rochester, Kent, England.
Tel.: Strood 78702. *Cable:* Fullyquip, Rochester.

Butters Bros. & Co. Ltd.,
McLellan Street, Glasgow S.1, Scotland.
Tel.: Ibrox 1141. *Cable:* Butters, Glasgow.
Telex: 77660.

Büttner-Werke A.G.,
Postfach 4 and 6, Krefeld-Uerdingen 1, Germany.
Tel.: Krefeld 43511. *Cable:* Büttner, Krefeld-Uerdingen.

Buttner Works, Inc.,
78 Main Street, P.O. Box 57, Madison, N.J., U.S.A.
Cable: Buttnerusa, Madison.

Cape Insulation and Asbestos Products Ltd.,
114 & 116 Park Street, London, W.1, England.
Tel.: Grosvenor 6022. *Cable:* CIAP, London, Telex.
Telex: Incorrupt Ldn. 23759.

Carlson-Ford Sales Ltd.,
Newman Street, Ashton-under-Lyne, Lancs., England.
Tel.: Ashton-under-Lyne 3611.
Cable: Carlsfords, Ashton-under-Lyne.
Telex: 66796.

Carmichael & Sons (Worcs.) Ltd.,
Gregory Mill Street, Barbourne, Worcester, England.
Tel.: Worcester 21383. *Cable:* Carmichael, Worcester.

Carrier Engineering Co. Ltd.,
Carrier House. Warwick Row, London S.W.1, England.
Tel.: Victoria 6858. *Cable:* Drysys, London, Telex.
Telex: 23581.

J. H. Carruthers & Co. Ltd.,
College Milton, East Kilbride, Glasgow, Scotland.
Tel.: East Kilbride 20591. *Cable:* Hoisting, East Kilbride.
Telex: 77782.

Cary Iron Works,
see **Logan Perkins.**

Catchpole Engineering Co. Ltd.,
78 Risbygate Street, Bury St. Edmunds, Suffolk, England.
Tel.: Bury St. Edmunds 2591. *Cable:* Beslift, Bury St. Edmunds.

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

Centrifix Corporation,
1017 Le Hall, Houston 25, Texas, U.S.A.
Tel.: Riverside 7–3620. *Cable:* Centrifix, Houston.

Chain Belt Company,
P.O. Box 2022, Milwaukee 1, Wisconsin, U.S.A.
Tel.: Evergreen 4–3000. *Cable:* Beltchain.
Telex: 414 671–5622.

Chambon Ltd.,
Riverside Works, Standish Road, Hammersmith, London W.6, England.
Tel.: Riverside 6086. *Cable:* Chambonted.

Choquenet L. Fonderies et Ateliers—Sté. Ame,
Chauny (Aisne), France.
Tel.: Chauny 734.

Clayton, Son & Co. Ltd.,
Moor End Works, Hunslet, Leeds 10, Yorkshire, England.
Tel.: Leeds 75226/9. *Cable:* Gas, Leeds.

Cleveland Meters Ltd.,
Subsidiary of Neptune Meters Ltd.,
Redcar, Yorkshire, England.
Tel.: Redcar 2205. *Cable:* Meters, Redcar.

The Clydesdale Chemical Co. Ltd.,
142 Queen Street, Glasgow, C.1.
Tel.: Central 5247/8. *Cable:* Cactus, Glasgow.

Cochran & Co., Annan, Ltd.,
Annan, Dumfriesshire, Scotland.
Tel.: Annan 111. *Cable:* Multitube, Annan.

Cocksedge & Co. Ltd.,
Grey Friars Road, Ipswich, Suffolk, England.
Tel.: Ipswich 56161. *Cable:* Cocksedge, Ipswich.

Comet Pump & Engineering Co. Ltd.,
Johnson Road, West Croydon, Surrey, England.
Tel.: Thornton Heath 3816. *Cable:* Comet, Croydon.

Cooper, Pegler & Co. Ltd.,
P.O. Box 9–98, Burgess Hill, Sussex, England.
Tel.: Burgess Hill 2525. *Cable:* Stomata, Burgess Hill.

Cotterell & Pither Ltd.,
Lower High Street, Watford, Herts., England.
Tel.: Watford 27724/5.

Clifford Coupe Ltd.,
25/27 Hammersmith Broadway, London, W.6. England.
Tel.: Riverside 8731. *Cable:* Clifcoupe, London.

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

Crofts (Engineers) Ltd.,
Thornbury, Bradford 3, Yorkshire, England.
Tel.: Bradford 65251. *Cable:* Crofters, Bradford.
Telex: 51–186, Bradford.

Crone & Taylor (Engineering) Ltd.,
Sutton Oak, St. Helens, Lancashire, England.
Tel.: St. Helens 23283/5. *Cable:* Crontaylor, Phone, St. Helens.

James A. Cuthbertson Ltd.,
Station Road, Biggar, Lanarkshire, Scotland.
Tel.: Biggar 20 and 4. *Cable:* Mechadrain, Biggar.

A/S De danske Sukkerfabrikker,
Langebrogade 5, Kobenhavn K, Denmark.
Tel.: Central 9030. *Cable:* Sukkerfabrikker, Copenhagen.
Telex: 5530 Sukker KH.

Darrold Engineering Co. Ltd.,
Conveyor Works, Balds Lane, Lye, Stourbridge, Worcs., Engand.
Tel.: Lye 2168.

Davey, Paxman & Co. Ltd.,
Standard Ironworks, Colchester, Essex, England.
Tel.: Colchester 5151. *Cable:* Paxman, Colchester, Telex.
Telex: 1851.

Deco Engineering Co. Ltd.,
West Row, North Kensington, London, W.10, England.
Tel.: Ladbroke 3066/7. *Cable:* Etyladec, Wesphone, London.

The Deister Concentrator Co. Inc.,
901–935 Glasgow Avenue, Fort Wayne, Ind., U.S.A.
Tel.: Anthony 7213/4. *Cable:* Retsied, Fort Wayne.

Diamond Alkali Company,
99 Park Avenue, New York 16, N.Y., U.S.A.
Cable: Diamalki, New York.

Diamond Alkali Company, Western Division,
1901 Spring Street, Redwood City, Calif., U.S.A.
Tel.: EM 9–0071. *Cable:* DACO-West, Redwood City, Calif.

John Dore & Co. Ltd.,
29/31 Bromley High Street, Bow, London, E.3, England.
Tel.: Advance 2136, 3421. *Cable:* Cuivre, Bochurch, London.

Dorr-Oliver Inc., Cane Sugar Division,
Stamford, Conn., U.S.A.

Dreibholz & Floering Ltd.,
Dereham, Norfolk, England.
Tel.: Dereham 145. *Cable:* Slicing, Dereham.

Dunford & Elliott Process Engineering Ltd.,
143 Maple Road, Surbiton, Surrey.
Tel.: Kingston 7799. *Cable:* Lindaresco, Telex, London.
Telex: 22413.

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

The Eagle-Picher Company,
American Building, Cincinnati 1, Ohio, U.S.A.
Tel.: 721–7010. *Cable:* Eaglepich, Cincinnati.

Maschinenfabrik H. Eberhardt,
3340 Wolfenbüttel, Frankfurterstr, 14/17, P.O. Box 266. Germany.
Tel.: 2002/3263. *Cable:* Eberhardt, Wolfenbüttel.
Telex: 09 52620 Eberhardt Wfbtl.

Edwards Engineering Corp.,
1170 Constance Street, New Orleans 13, La., U.S.A.
Tel.: 524–0175. *Cable:* Joedco, New Orleans.

The Eimco Corporation,
P.O. Box 300, Salt Lake City 10, Utah, U.S.A.,
Tel.: Davis 8–8831. *Cable:* Eimco, Salt Lake City.

Eimco (Great Britain) Ltd.,
Earlsway, Team Valley, Gateshead 11, Co. Durham, England.
Tel.: Low Fell 7–7241. *Cable:* Eimco, Gateshead 11.

Eisenwerk Wülfel,
Eichelkampstr. 4–10, Hannover-Wülfel, Germany.
Tel.: 3 81 81 (from April 1964: 868181).
Cable: Eisenwerk, Hannover.
Telex: 09–22730.

Electromagnets Ltd.,
Boxmag Works, Bond Street, Hockley, Birmingham 19, England.
Tel.: Central 9071. *Cable:* Boxmag, Birmingham.

Electroweighers Ltd.,
41a Summer Row, Birmingham 3, England.
Tel.: Central 0362. *Cable:* Elecweigh, Birmingham.

Elfa-Apparate-Vertriebs G.m.b.H.,
Friedrichstr. 52a, Mülheim-Ruhr, Germany.
Tel.: 46565. *Cable:* Elfaapparate, Mülheimruhr.
Telex: 0856724.

Endecotts (Filters) Ltd.,
Lombard Road, London S.W.19, England.
Tel.: Liberty 8121/2/3. *Cable:* Endfilt, Wimble, London.

The English Electric Co. Ltd.,
English Electric House, Strand, London, W.C.2, England.
Tel.: Covent Garden 1234. *Cable:* Enelectico, London.

The English Electric Co. Ltd., Electrical Plant Division,
see The English Electric Co. Ltd.

The English Electric Co. Ltd., Steam Turbine Division,
see The English Electric Co. Ltd.

Escher Wyss (U.K.) Ltd.,
35 New Bridge Street, London, E.C.4, England.
Tel.: Central 7166. *Cable:* Escherwyss, London Telex.
Telex: 23920.

Evershed & Vignoles Ltd., Instrumentation & Controls Divn.,
Acton Lane Works, Chiswick, London, W.4, England.
Tel.: Chiswick 3670. *Cable:* Megger, London, W.4.
Telex: 22–583.

Ewart Chainbelt Co. Ltd.,
Colombo Street, Derby, England.
Tel.: Derby 45451. *Cable:* Chainbelt, Derby.
Telex: 37575.

Extraction De Smet S.A.,
265 Ave. Prince Baudouin, Edegem-Antwerp, Belgium.
Tel.: 49 42 40. *Cable:* Extraxsmet, Antwerp.
Telex: 3/824.

Farnell Carbons,
Divn. of Forestal Industries (U.K.) Ltd.,
The Adelphi, John Adam Street, London W.C.2, England.
Tel.: Whitehall 6777. *Cable:* Scofar, London W.C.2.
Telex: 22817/22818.

Farrel Corporation,
Ansonia, Conn., U.S.A.
Tel.: Regent 4–3331. *Cable:* Farrelmech, Ansonia.

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

Ferguson Perforating & Wire Co.,
130–140 Ernest Street, Providence, R.I., U.S.A.
Tel.: Williams 1–8876 *Cable:* Ferguson, Providence.

Fielden Electronics Ltd.,
Paston Road, Wythenshawe, Manchester 22, England.
Tel.: Wythenshawe 3251. *Cable:* Humidity, Manchester.

Film Cooling Towers (1925) Ltd.,
Chancery House, Parkshot, Richmond, Surrey, England.
Tel.: Richmond 6494/8. *Cable:* Aloof, Richmond.

Firestone International Company,
1200 Firestone Parkway, Akron, Ohio, U.S.A.
Tel.: Hemlock 4-1671. *Cable:* Firestone, Akron.
Telex: 0985711.

Firestone Tyre & Rubber Co. Ltd.,
Brentford, Middlesex, England.
Tel.: Isleworth 4141. *Cable:* Firestone, Brentford.
Telex: 23456.

Société de Fives Lille–Cail,
7 Rue Montalivet, Paris 7e, France.
Tel.: Anjou 22–01. *Cable:* Fivcail, Paris.

Société Fives-Penhoet,
see Soc. Fives Lille–Cail.

George Fletcher & Co. Ltd.,
Masson Works, Litchurch Lane, Derby, England.
Tel.: Derby 45817. *Cable:* Amarilla, Derby, Telex.
Telex: 37514.

Fletcher and Stewart Ltd., *see* George Fletcher & Co. Ltd. *and* Duncan Stewart & Co. Ltd.

Flexible Drives (Gilmans) Ltd.,
Skatoskalo Works, Millers Road, Warwick, England.
Tel.: Warwick 42693/5. *Cable:* Skatoskalo, Warwick.

Flexotube (Liverpool) Ltd.,
25 Hope Street, Liverpool 1, England.
Tel.: Royal 3345. *Cable:* Flexotube, Liverpool.

Fontaine & Co. G.m.b.H.,
Aachen, Germany.
Tel.: 31340. *Cable:* Fontaineco, Aachen.

Foster Wheeler Ltd.,
Foster Wheeler House, Chapel Street, London, N.W.1, England.
Tel.: Paddington 1221. *Cable:* Rewop, London, N.W.1.
Telex: London 23442.

Fothergill & Harvey Ltd.,
Summit, Littleborough, Lancs., England.
Tel.: Littleborough 88831. *Cable:* Harvester, Littleborough.

Fourways (Engineers) Ltd.,
268–270 Vauxhall Bridge Road, Westminster, London, S.W.1, England.
Tel.: Victoria 0640. *Cable:* Allenflex, London.

Garvens-Waagen-Fabrik G.m.b.H.,
Eichelkampstr. 4–10, Hannover-Wülfel, Germany.
Tel.: 3 81 81. (from April 1964: 868181). *Cable:* Eisenwerk, Hannover. *Telex:* 09–22730.

General Refractories Ltd.,
Genefax House, Tapton Park Road, Sheffield 10, Yorkshire. England.
Tel.: Sheffield 31113. *Cable:* Genefax, Sheffield. *Telex:* 54–128.

Goka N.V. Machine Works,
Postbus 130, Koestraat 2a, Amsterdam C, Holland.
Tel.: 222255/6. *Cable:* Kagodam, Amsterdam. *Telex:* 14173.

Graver Water Conditioning Co.,
(Division of Union Tank Car Company),
216 West 14th Street, New York 11, N.Y., U.S.A.
Tel.: WAtkins 4–2321. *Cable:* Gravex, New York.

J. Barcham Green Ltd.,
Hayle Mill, Tovil, Maidstone, Kent, England.
Tel.: Maidstone 2040. *Cable:* Green, Tovil, Maidstone.

E. Green & Sons Ltd.,
Economiser Works, Wakefield, England.
Tel.: Wakefield 2706. *Cable:* Economiser, Wakefield.

Grill Floors Ltd.,
West Row, North Kensington, London, W.10, England.
Tel.: Ladbroke 3066/7. *Cable:* Etyladec, London.

Gruendler Crusher & Pulverizer Co.,
2915 North Market Street, St. Louis 6, Mo., U.S.A.
Tel.: Jefferson 1–1220. *Cable:* Grupulco, St. Louis.

Gutehoffnungshütte Sterkrade A.G.,
Werk Düsseldorf, Düsseldorf, Germany.

Haller & Phillips Ltd.,
68–70 Goswell Road, London, E.C.1, England.
Tel.: Clerkenwell 0956/7/8. *Cable:* Haloid, London, E.C.1.

The Harland Engineering Co. Ltd.,
Harland House, 20 Park Street, London, W.1, England.
Tel.: Grosvenor 1221/3. *Cable:* Rhoemetric, London. *Telex:* 22881.

Harvey Fabrications Ltd.,
Greenwich Metal Works, Woolwich Road, London S.E.7, England.
Tel.: Greenwich 3232. *Cable:* Gaharvey, London. *Telex:* 25113

Harvey Perforators and Weavers Ltd.,
see Harvey Fabrication Ltd.

G. M. Hay & Co. Ltd.,
Strathclyde Foundry, 42 Fore Street, Whiteinch, Glasgow, W.4, Scotland.
Tel.: Scotstoun 3396/7. *Cable:* Castiron, Glasgow.

Heemaf N.V.,
Postbox 4, Hengelo, Holland.
Tel.: 05400–5839. *Cable:* Heemaf, Hengelo. *Telex:* 31307.

Heenan & Froude Ltd.,
Worcester, England.
Tel.: Worcester 23461. *Cable:* Heenan, Worcester. *Telex:* 33699.

Hein, Lehmann & Co. A.G.,
Abt. Massentrennung, P.O. Box 4109, Fichtenstr. 75, 4 Dusseldorf, Germany.
Tel.: 780201. *Cable:* Herrmannsieb, Dusseldorf. *Telex:* 0858 2740.

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

F. C. Hibberd & Co. Ltd.,
56, Victoria St., London S.W.1, England.
Tel.: Victoria 9517/8 *Cable:* Planetloco, London.

Samuel Hill Ltd.,
Balderstone Mill, Oldham Rd., Rochdale, Lancashire, England.
Tel.: Rochdale 2271. *Cable:* Filtering, Rochdale.

Hinz Elektromaschinen und Apparatebau,
33 Braunschweig, Hansestrasse 30, P.O. Box 103, Germany.
Tel.: 3 32 91. *Cable:* Hinzmotoren, Braunschweig. *Telex:* 0952 753.

Honolulu Iron Works Co.,
165 Broadway, New York 6, N.Y., U.S.A.
Cable: Honiron, New York.

G. Hopkins & Sons Ltd.,
United House, North Road, London, N.7, England.
Tel.: North 3321. *Cable:* Seamanlike, London, N.7. *Telex:* 23407.

Houseman & Thompson Ltd.,
The Priory, Burnham, Bucks., England.
Tel.: Burnham 1704. *Cable:* Houseman, Burnham, Slough. *Telex:* 84252.

Howe Richardson Scale Co. Ltd.,
Bulwell, Nottingham, England.
Tel.: Nottingham 27–1441. *Cable:* Richscalco, Nottingham. *Telex:* 37625.

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

Hudson & Wright Ltd.,
Abberley Street, Birmingham 18, England.
Tel.: Smethwick 1831. *Cable:* Desac, Birmingham.

Huntington, Heberlein & Co. Ltd.,
Aldwych House, Aldwych, London W.C.2, England.
Tel.: Holborn 1953. *Cable:* Innovation, London W.C.2. *Telex:* 25692.

Industrial Magnets Ltd.,
28 Station Road, Acocks Green, Birmingham 27, England.
Tel.: ACO 0706. *Cable:* Indmag, Birmingham.

Invest Export,
Deutscher Innen- und Aussen-handel,
Berlin W8, Taubenstrasse 7/9, Germany.
Tel.: 22 04 71. *Cable:* Diainvesta, Berlin. *Telex:* 011 461

Isopad Ltd.,
Barnet By-Pass, Boreham Wood, Herts., England.
Tel.: Elstree 2817/9. *Cable:* Isopad, Boreham Wood.

Robert Jenkins & Co. Ltd.,
Ivanhoe Works, Wortley Road, Rotherham, Yorks., England.
Tel.: Rotherham 4201/6.

Johns-Manville International Corp.,
22 East 40th Street, New York 16, N.Y., U.S.A.
Tel.: Lexington 2–7600. *Cable:* Johnmanvil, New York.

S. H. Johnson & Co. Ltd.,
Carpenters Road, Stratford, London, E.15, England.
Tel.: Maryland 7431. *Cable:* Filtrum, London.

Amandus Kahl Nachf.,
Hamburg 26, Eiffestrasse 432, Germany.
Tel.: 250914. *Cable:* Kahladus, Hamburg. *Telex:* 0212775.

Thomas C. Keay Ltd.,
P.O. Box 30, Baltic Street, Dundee, Scotland.
Tel.: Dundee 26031/4. *Cable:* Keay, Dundee.

James Kenyon & Son Ltd.,
Roach Bank Mills, Bury, Lancs., England.
Tel.: Bury 5121/2. *Cable:* Camellia, Bury. *Telex:* 66440.

Kestner Evaporator & Engineering Co. Ltd.,
Greenhithe, Kent, England.
Tel.: GR9 3281. *Cable:* Kestnerato, Dartford.

Kingston Industrial Works Ltd.,
138 Spanish Town Road, P.O. Box 72, Kingston 11, Jamaica, West Indies.
Tel.: 36121. *Cable:* Industrial, Kingston.

Chas. P. Kinnell & Co. Ltd.,
Albion Foundry, Cambridge Street, Wellingborough, Northants, England.
Tel.: Wellingborough 4186.

Köllmann & Gruhn,
Postfach 1480, Wuppertal-Barmen 7, Germany.
Tel.: Wuppertal 64211. *Cable:* Koellmannwerk, Wuppertal.
Telex: 08512–774.

Korting Brothers (1917) Ltd.,
Western Avenue, Sheepbridge Lane, Mansfield, Notts., England.
Tel.: Mansfield 5947. *Cable:* Korting, Mansfield.

Ets Krieg et Zivy,
9 Rue Louis-Lejeune, Montrouge (Seine), France.
Tel.: ALEsia 40–80. *Cable:* Krieg Zivy, Montrouge.

Krupp-Dolberg,
Essen, Ostfeldstr. 7, Postfach 12, Germany.
Tel.: 2 13 61. *Cable:* Kruppdolberg.
Telex: 08 57 732.

Aktiengesellschaft Kühnle, Kopp & Kausch,
671 Frankenthal/Pfalz, Germany.
Tel.: Frankenthal 2111.
Cable: Maschinenkessel, Frankenthal/Pfalz.
Telex: 04 65221.

Lafarge Aluminous Cement Co. Ltd.,
73 Brook Street, London, W.1, England.
Tel.: Mayfair 8546. *Cable:* Cimenfondu, London.

AB. Landsverk,
Landskrona, Sweden.
Tel.: 16200. *Cable:* Landsverk, Landskrona.
Telex: 4285.

The Lawrence Engineering Co. Ltd.,
268 Vauxhall Bridge Road, London S.W.1, England.
Tel.: Victoria 0640. *Cable:* Allenflex, London.

Lee, Howl & Co. Ltd.,
Alexandra Road, Tipton, Staffs., England.
Tel.: Tipton 1878/9. *Cable:* Howl, Tipton.

Lennig Chemicals Ltd.,
26-28 Bedford Row, London W.C.1, England.
Tel.: Chancery 6631. *Cable:* Lennig, London.
Telex: 24139.

Lepage, Urbain & Cie.,
5 Rue René Robin, Ivry-sur-Seine, France.
Tel.: Italie 27–13. *Cable:* Alepage, Paris.

Librawerk Pelz & Nagel K.G.,
33 Braunschweig Germany.
Tel.: 3 08 51. *Cable:* Librawerk, Braunschweig.
Telex: 0952866.

Link-Belt Company,
2680 Woolworth Building, New York 7, N.Y., U.S.A.
Tel.: Digby 9–4210. *Cable:* Linkbelt, New York.

Locker Industries (Sales) Ltd.,
Church Street, Warrington, Lancs., England.
Tel.: Warrington 34111. *Cable:* Lockers, Warrington.
Telex: 62508.

N.V. Locospoor.,
78 Bezuidenhout, The Hague, Holland.
Tel.: 720737. *Cable:* Locospoor, The Hague.

Lufkin Foundry & Machine Company,
P.O. Box 849, Lufkin, Texas, U.S.A.,
Tel.: NE 4–4421. *Cable:* Luffo, Lufkin.
Telex: 713–632–3103.

The Lunkenheimer Company,
Beekman St. at Waverly Ave, Cincinnati, Ohio 45214, U.S.A.
Tel.: WA 1–3400. *Cable:* Lunken, Cincinnati.

The Magnetic Valve Co. Ltd.,
7 Kendall Place, Baker Street, London, W.1, England.
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