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NOTES AND COMMENTS

The International Sugar Council.

The Seventeenth Session of the International Sugar Council was held at the Seat of the Council in London on 17th and 18th June 1964. The Session was presided over by Señor FEDERICO PATIÑO (Mexico), the Chairman of the Council for 1964. It was attended by representatives of forty-one countries and an observer from the F.A.O. This Session was also attended by observers from the Malagasy Republic and the United Arab Republic and by an observer from the E.E.C.

At this first meeting after the death of its Executive Director, Dr. RALPH E. STEDMAN, the Council reiterated its condolences to Mrs. STEDMAN and her family, and expressed its deep appreciation for all the messages of sympathy received by the Council from all parts of the world on its sudden and tragic loss.

The appointment of a new Executive Director will be considered by the Council at its next Session.

The Council noted that, since the last Session, the Republic of Upper Volta had become party to the 1963 Protocol. Having been informed that some Governments signatories of the 1963 Protocol had experienced difficulties in completing their constitutional procedures, the Council agreed to extend to 31st December 1964 the time limit provided under Article 6(2) of that Protocol for the deposit of instruments of ratification, acceptance, approval or accession. The Council also approved an application by the Republic of Tchad for accession to the 1963 Protocol.

In accordance with the established practice, the Statistical Committee reviewed the estimate of the quantity of sugar likely to be required to meet the maximum needs of importing countries in 1964. In making their assessment the Committee had the benefit of many official figures. Where these were not forthcoming the Committee had, as in the past, to make its own assumptions based on the best information available. The Council adopted the Committee's revised estimate of the net import requirements of the free market for 1964 amounting to 11,857,000 metric tons, raw value and noted that the import requirements of the United States of America from foreign sources were estimated at 3,266,000 metric tons, raw value, making a total for the requirements of the world market of 15,123,000 metric tons, raw value (details of which will appear later). The Council considered this new estimate against its revised forecast of supplies available for world destinations in 1964 and noted that, taking the year as a whole, it would appear that requirements would again be in excess of supplies. Thus the Council envisaged a continuation of a tight supply/demand situation.

The Council received a report by its Preparatory Committee regarding the bases and framework of a new International Sugar Agreement and agreed that it was appropriate for circulation to member Governments for study and early comment. It also agreed that the report should be available to other interested Governments. This discharges the Council's obligation under Article 2(1) of the Protocol.

The next Session will open on Monday, 2nd November, 1964.

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F.A.O. views on world sugar production.

World production of sugar in 1963/64 is expected by the Food and Agriculture Organization of the United Nations to exceed last season's by 2·5 to 3 million tons. However, a reduction of four million tons in stocks in 1962/63 means less sugar for the third successive season. Consumption is beginning to level off, according to their recent Commodity Review[1] based on information available as at mid-February, but stocks will be further reduced before sugar from the 1964/65 beet crops comes forward. The average prices during 1964 were expected to remain variable and "very high," in the first half, though in the second half of 1964 they are expected to fall in view of increased production in the coming season.

According to the review, production for 1963/64 is estimated at about 53 million tons, compared with 54·9 million tons in the record 1960/61 season, and 50·4 million tons respectively in 1961/62 and 1962/63.

During the current season, Cuban production, because of hurricane Flora and other problems, is estimated at no more than 3·3 million tons, about

[1] Monthly Bull. Agric. Econ. Stat., 1964, **13**, (3), 18–22.

one half of production in 1960/61. Prolonged drought in the Soviet Union reduced yield in spite of increased areas under beet; production in 1963/64 is estimated at about six million tons raw value, 500,000 tons less than in 1962/63.

On the other hand production in Western Europe is estimated at more than eight million tons, about one million tons more than in 1962/63 despite reduced production in Italy, Spain and the Netherlands. The main increases are in West Germany where production recovered to its record two million ton level and in France which expected a similar output. Denmark and Yugoslavia have planted much larger areas to sugar beet for the current season. In the United States production of both beet and cane sugar was at record levels.

In other sugar cane growing areas, according to the review, "there are indications of increases in output in a number of countries including Argentina, Mexico, the Philippines, Mauritius and South Africa. . . ." India also expected to produce more.

Although full information on trade in sugar in 1963 was not available "there was a further substantial decline in world trade in raw and refined sugar . . . which largely reflected the further fall in Cuban output." In particular Cuban exports to the Soviet Union and Mainland China were severely reduced. Total imports into the developed countries were larger in 1963 than in 1962; imports into the United Kingdom increased from 2·15 to 2·52 million tons. In other West European countries, especially Italy, the Netherlands and West Germany, imports were higher. "But there is as yet little indication as to whether or not importing countries in Asia, Africa and the Near East maintained their 1962 import levels."

Regarding consumption, the review says a "tentative estimate for 1963 for the world, excluding the centrally-planned economies, is put at 41·5 million tons, raw value, two per cent higher than in 1962." This, says the review "implies no increase in average per caput consumption."

The outlook for coming years is for increased production in a number of major cane sugar producing countries, including Australia, South Africa, Southern Rhodesia, Mexico and India. Increased plantings for the 1964/65 sugar beet harvest are expected in Europe this spring, encouraged in several countries by higher prices to growers. But in all cases weather will play a major rôle in the final output.

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U.K. surcharge on sugar.

The Sugar Board's distribution payments on sugar, which had been at the level of ½d per lb (4s 8d per cwt), were abolished on the 27th May, and a surcharge imposed from the 29th May. Initially this was ½d per lb but was raised quickly on the 2nd June and then the 5th June, to 1½d and then 2d per lb (18s 8d per cwt). These four changes brought the total to 21 changes in surcharge and distribution payments since the beginning of 1963.

The changes reflect the variations in the world price of sugar which, on the London Terminal Market, fell to £46 per ton on the 12th June, breaking through the "low" limit of 1963. At this price, the cost of sugar has fallen to its lowest level for 17 months, two peaks of £101 and £105 having been achieved in the meantime—on 23rd May and 31st October 1963, respectively.

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Cuban harvest ended[1].

Heavy rains throughout Cuba during the second week of June appear to have virtually ended cane cutting for the year and work is now going ahead with cleaning up the fields for the next crop. Hundreds of thousands of tons of cane are being left in the fields uncut, especially in Oriente and Camagüey Provinces which have experienced particularly heavy rains. Cane cutting has been completed in some areas, including Havana Province.

There is no definite information on how serious the effect of the widespread rains have been, but the Cuban Minister of Agriculture warned some weeks ago that large quantities of cane were threatened by the approach of the rainy season. Western diplomatic observers in Havana are still inclined to stick to their previous estimates that the crop will be less than the 3,800,000 tons produced last year.

Some think it will not be more than about 3,500,000 tons while a few believe it might go a little higher. The exact figure might not be known for a long time since the Prime Minister, Dr. FIDEL CASTRO, has proclaimed a policy of "discretion" about the sugar crop and warned that he does not intend to publish figures for this year or next.

* * *

Caroni Ltd. 1962/63 report.

Sugar production totalled 203,580 tons compared with 179,974 tons in the previous season, and included 91,490 tons of sugar made by Ste. Madeleine sugar factory—a record for that factory. Ste. Madeleine crushed a certain amount of cane for the Brechin Castle factory where it would have been expensive to process, an example of the benefit possible from integration of the operations of the two plants. Steps are to be taken to increase factory capacity at Ste. Madeleine so as to be able to get the crop harvested during good weather, before the onset of the wet season.

The crop was somewhat disappointing at Brechin Castle, where there was some damage by froghopper, and also labour difficulties. From the 1st July 1963, Caroni Ltd. and Ste. Madeleine Sugar Co. Ltd. were amalgamated, the former parts now being known as the Brechin Castle Division and the Ste. Madeleine Division of Caroni Ltd.

[1] *Public Ledger*, 6th and 13th June 1964.

BIOLOGICAL CONTROL OF SUGAR CANE PESTS

IN an article on the biological control of pests in the tropics, i.e. insect pests and weeds, the writer (F. J. SIMMONDS) who is Director of the Commonwealth Institute of Biological Control, Trinidad, refers to some of the major insect pests of sugar cane where biological control has been applied or tried[1]. He states "interest in biological methods of controlling insect pests and weeds is increasing as the problems arising from an indiscriminate use of modern powerful insecticides are becoming more widely appreciated. The expense involved in the extensive use of chemical pesticides may also be prohibitive in tropical countries and the knowledge required to use them efficiently is often lacking. The paper surveys the biological control of pests by introducing their natural enemies into the environment or by altering the environment in such a way as to make it more favourable to the species antagonistic to the pest. Examples of attempts at the biological control of both insect pests and weeds and the varying results of these experiments, ranging from spectacular success to total failure, are discussed."

Leaf-hopper Control

Reference is made to the control of the sugar cane leaf-hopper in Hawaii, one of the examples of very successful biological control of an insect pest in the tropics. The leaf-hopper (*Perkinsiella saccharicida*) "had been accidentally introduced into the islands and very seriously threatened the entire sugar industry. Search for natural enemies produced the Mirid egg-predator *Tytthus* (*Cyrtorhinus*) *mundulus*, which was successfully established in Hawaii and has, since 1923, given very adequate control of the leaf-hopper."

Cane Borers

Biological control of cane borers has been attempted or practised in many parts of the world with varying results. The losses of cane or sugar due to borers are enormous and one of the worst offenders is *Diatraea saccharalis*. Biological control has been attempted using a number of different natural enemies, such as "the egg-parasite *Trichogramma minutum*, which destroys the eggs, the larval parasites *Lixophaga diatraeae*, *Metagonistylum minense*, and *Paratheresia claripalpis*, and also several braconid (wasp) parasites which also attack the larvae.

The results of attempts against *Diatraea* spp. illustrate the variation in success obtained with biological control of the same (or closely related) pests in different areas. *Trichogramma* has been utilized in the form of annual mass liberations of adult parasites following very large-scale laboratory breeding, at times in the season when natural parasitism of *Diatraea* in the field has been low. This method has been used against *Diatraea* particularly in British Guiana, Barbados and Louisiana, and there has been much controversy as to its value, some claiming that there is an economic reduction in sugar losses following mass releases, others that the releases are valueless because of the generally enormous number of *Trichogramma* already in the field when releases are made. The question has not as yet been finally settled but in the New World tropics this method has been largely discarded."

Larval parasites have proved successful in some areas. "*Lixophaga*, a native of Cuba and Jamaica, has given excellent control of sugar cane moth borer in St. Kitts and Antigua (on the latter island annual releases are made) reducing joint infestation from about 25% in 1930 to about 5% subsequent to the introduction of the parasite. This species, together with *Paratheresia* from Trinidad, has been successfully introduced into Dominica; *Metogonistylum*, from the Amazon valley, has given good control of *Diatraea saccharalis* in St. Lucia and British Guiana and partial control in Martinique, while in Guadeloupe all three species have become established and have considerably reduced *Diatraea* infestation. *Lixophaga* has been successfully introduced into Peru, and *Metagonistylum* has given excellent control of *Diatraea* spp. in some parts of Venezuela." However in other areas where conditions appear favourable for these parasites little or no success has been obtained.

Biological Control Organizations

Various organizations have been developed to further advances in biological control, some of a specialized nature. Specialized national organizations have been developed, as in the U.S.A., U.S.S.R., Canada, Australia, New Zealand, Hawaii, etc. "In many areas other institutions carry out biological control work on local problems. There are two international organizations: the Commission Internationale de la Lutte Biologique, which is a body co-ordinating the efforts in this field of national laboratories in Europe and the Mediterranean area, and the Commonwealth Institute of Biological Control which has been developed over the past 35 years to carry out investigations in this field, principally, though not exclusively, for British Commonwealth countries. This Institute has its headquarters and West Indian Station in Trinidad and has other stations in Europe, California, India, Pakistan and East Africa. From these stations entomologists can carry out a very widespread search for biological control agents in connexion with a number of pest problems. In 1962 work was carried out on 94 projects and 534 shipments of 82 beneficial species totalling 571,500 individuals, were sent to 27 different countries." This work is summarized in the annual report of the Institute.

F.N.H.

[1] Biological control of pests in the tropics. *Tropical Science*, 1963, **5**, 200–207.

SUGAR CANE AGRICULTURE IN QUEENSLAND

30th Conference, Queensland Society of Sugar Cane Technologists, 1963.

AT this conference held at Townsville from the 17th to the 23rd April, 1963, a number of papers on different problems facing the producer of sugar cane in Queensland were read.

Fertilizers and Manures

In a paper on the availability of citric-soluble phosphates to sugar cane, K. C. LEVERINGTON points out that with the newer methods of fertilizer manufacture now in use and the production of phosphatic fertilizers from rock phosphate there has been a replacement of some of the water-soluble phosphates by forms which are insoluble in water, although soluble in citric acid. A series of field experiments is described. Results showed that although there was a response to phosphate there were no significant differences in yields owing to the replacement of up to 70% of the water-soluble phosphate by citric-soluble phosphate.

In "An experiment with green manures" R. A. YATES reviews the pros and cons of green manuring and modern views in regard to it, especially in the tropics. The main benefits are considered to be the control of erosion and weeds (especially where the fallow period is wet) and the holding of nutrients in the plant on soils where they would otherwise be subject to leaching. Adverse effects are that green manures may compete for soil moisture and that they may prevent the beneficial weathering action normally obtained in a fallow. The experiment carried out is considered to illustrate the latter adverse effect. Figures are given showing how green manures depressed the subsequent cane crop yield by one third. It is suggested this was due to the prevention of the beneficial effect of a normal fallow on the heavy clay soil present.

Pests and Diseases

The advantages of utilizing electricity for heating with the hot water treatment of planting material in the control of ratoon stunting disease is forcibly put forward by G. F. O'HANLON and E. H. FOX. After nine years' experience with the electric plant described it is considered that although installation was expensive, subsequent running costs are negligible. Much manual labour is eliminated and the whole procedure may be operated by the Field Supervisor alone. Four treatments a day represent 13 hours of supervision but this does not mean constant attendance at the plant and allows time off for meals, office work, etc. The co-operation of farmers is essential in the timing and punctual delivery of cane for treatment.

C. L. TOOHEY indicates the nature of the pests and diseases of the Moreton area and their degree of virulence in each case. The major animal pests are rats and foxes; with the former the recent change of policy from large areas of standover cane has resulted in a loss of harbourages, and baiting with thallium wheat has been more successful. Where Q50, a soft variety of cane, has been replaced by the tougher skinned and trashier Pindar and N:Co 310, damage from rats and foxes has been less. Soldier Fly (*Altermetoponia rubiceps*) and cane grubs (*Rhopea*) constitute the two worst insect pests. The four major diseases are regarded as mosaic, chlorotic streak, ratoon stunting and leaf scald, while diseases of less significance are pineapple disease, Pokkah Boeng, red rot and *Scleropthora.*

Weed Control

The giant sensitive plant (*Mimosa invisa*) has proved to be one of the most troublesome weeds for Queensland cane growers and the article "Some practical aspects of giant sensitive plant control in cane fields" by P. E. THEODORE and E. H. FOX supplies much information of general interest. The date of the first record of the weed in Queensland has been stated in the past to be 1944 but the writers consider it was probably present in the country during the previous 15 years. Row-by-row roguing of plants has been successfully practised on some farms and it is considered that only complete annual elimination on infested farms can promise eventual freedom from the weed. Unnoticed seedlings are quite capable of setting innumerable viable seeds when only a few weeks old. It is believed seeds may remain dormant and viable in the soil for a long time. Various herbicides will kill the weed provided adequate contact is made but the danger is with odd plants in the rows that escape and their subsequent seeding. Spread by machinery is considered to be certain and the adoption of the mechanical harvester may set a new problem.

Another article on weed control in Queensland cane fields is contributed by R. A. YATES, who considers the effectiveness of various modern weedkillers on different weeds in some detail. Reasons are suggested for the failure of certain weedkillers under special conditions, e.g. unsatisfactory pre-emergent applications of 2,4-D may be due to too rapid a breakdown by micro-organisms, the failure of others to photochemical decomposition, and excessive absorption by clay and humus. Deeply buried seeds create a special problem.

Tests on aerial spraying were carried out in 1962 with two types of aircraft with a view to obtaining information on penetration of sugar cane foliage of various densities. The tests, described by N. McD. SMITH, emphasized the importance of cross stripping the ends to complete the spraying of a field and of maintaining a volume mean diameter of between 220 and 250μ for droplet size. The hazard of drift from fine droplets during fall-out or descent into a field can be considerable.

F.N.H.

WEED CONTROL IN CANE FIELDS

IN an article in *World Crops*[1], J. W. ROBSON and G. C. PROCTER explain the chemical nature and mode of action of two modern weedkillers, "Paraquat" and "Diquat", and their wide range of uses with such tropical crops as sugar cane, rubber, citrus, coffee, oil palms and bananas. The writers hold the view that in the course of the next few years there is little doubt that many of the uses of these extraordinary chemicals will become normal practice and that new and modified weed-killing techniques and programmes using "Paraquat" will be evolved by estate and plantation managers.

It is pointed out that in recent years research workers have been intensifying their research "on a group of diquaternary salts generally known as bipyridyls, which have novel and unique properties and are of considerable interest, particularly in tropical agriculture. Briefly, the action of the bipyridylium herbicides is that they are absorbed very rapidly into the green parts of plants and are to some extent translocated. They interfere with the photosynthetic process in such a way that the green aerial parts of the plant are rapidly desiccated and killed. Further, when the chemical comes in contact with the soil it is adsorbed on to the clay particles and is immediately inactivated.

"At present two bipyridylium herbicides are in wide-scale use. The first of these, "Diquat", affects mainly broad-leaved plants and is widely used in Europe for potato haulm destruction, clover desiccation and pre-crop emergence weedkilling. The second related compound, "Paraquat", which controls grasses as well as broad-leaved weeds, is likely to have far wider uses in tropical and subtropical areas. The chemical composition of "Paraquat" is 1:1′ dimethyl-4:4′bipyridylium cation and it is marketed as an aqueous solution of its salt under the name "Gramoxone". Some of its characteristics which are of particular interest are as follows:

(1) It is so rapidly absorbed that the effect, which is most rapid in bright sunlight, can be seen within a few hours. The kill is spectacular and quick.

(2) It kills a very wide range of weeds.

(3) Absorption is so rapid that rain falling shortly after application has no adverse effect on the result. Application can thus be made in almost any kind of weather.

(4) Because it is inactivated on contact with the soil there is no chance of a build-up of toxic chemicals in the soil.

(5) It is of low mammalian toxicity and at normal rates of use is harmless to fish.

(6) It can be applied safely around the bases of all trees provided the bark is brown.

(7) It is soluble in water, active at low concentrations and rates of use are low.

(8) It can be applied through all types of conventional spray machinery and is compatible with many other agricultural chemicals."

In the case of sugar cane "Paraquat" is claimed to have "three major uses: weed control in the cane, pre-harvest desiccation, and weed control in irrigation canals and ditches".

Post emergence weed control

"Paraquat" may be used to clear existing weeds before crop emergence or before the cane is planted. However, its main use at present appears to be for post-emergence work. In the past, total chemical control of grass weeds during the early period of cane growth has been difficult, as it usually caused serious damage to the crop. Growth-regulating weedkillers followed by contact weedkillers have been used with varying degrees of success.

Special no-drift applicators are now being developed to allow accurate inter-row weed killing with "Gramoxone." In the meantime, provided that application can be made without spraying the crop or that the cane is not less than 3 ft high, "Paraquat" applied by ordinary knapsack sprayer gives excellent weed control without crop damage. The growing point and leaves are well above the level of the spray and the hardened leaf sheath protects the lower stem from the chemical. Under Caribbean conditions a rate of 2 pints of product in 40 gallons of water per acre (2·8 l in 450 l/ha) has given good control of weeds.

Pre-harvest desiccation

In many areas of the Caribbean and South America "Paraquat" has been shown to be outstanding for desiccation of sugar cane prior to burning. This is particularly important where mechanical harvesting is practised. "Paraquat" treatment ensures an almost perfect burn of the green tops and sets in motion a long chain of economic savings, terminating in less trash going to the factory and a significant increase in sugar recovery.

Aquatic weed control

While still discussing sugar cane, it is appropriate to consider the control of weeds in waterways. Since "Paraquat" is inactivated in the soil, treated water can be used safely for furrow irrigation. For overhead irrigation an interval of seven days should be allowed between treatment and irrigation. At the rates used, "Paraquat" is harmless to fish. It can be used as a direct treatment on the banks and also on the surface of the water.

Good control has been obtained of floating and emergent species, such as *Eichhornia crassipes* (water hyacinth), *Pistia stratiotes* (water lettuce) and *Salvinia auriculata* (water fern), at rates as low as 2 pints per acre (2·8 litres/ha). Spraying can be done by knapsack or high-pressure hoses directed from the banks or from boats. Because of its broad spectrum of activity "Paraquat" can, of course, be used against single weed species or against an aquatic weed complex of broad-leaved weeds, ferns and grasses.

[1] *World Crops*, 1963, **15**, 264–268.

Submerged species can also be controlled by injecting the chemical below the water level. By this method many species of weeds and algae are controlled at concentrations of 5 p.p.m. of "Gramoxone" in the water. There is evidence that even lower concentrations are effective.

Some graphic colour photographs are reproduced, one of post-emergence control in young sugar cane, another of cane desiccated and burned five days later (at 2 pints in 5 gal/acre or 2·8 l in 450 l/ha). Another photograph shown the catastrophic effect on the troublesome aquatic plant or irrigation weed *Pistia stratiotes* (water lettuce) at a concentration of only 2 pints in 100 gal/acre or 2·8 l in 1100 l/ha).

F.N.H.

AGRICULTURAL ABSTRACTS

A new Philippine sugar cane variety, Phil. 54-60. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1963, **10**, (10), 1.—A description (with photograph) is given of this promising locally produced hybrid cane, a cross between CP 50-11 and H 44-3098.

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Post-emergence weed control in sugar beets under California conditions. D. E. BAYER *et al.* *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 564–570.—Annual weeds, notably the grasses *Echinochloa crusgalli* and *E. colonum*, which develop after the effects of pre-emergence weed killers has worn off, are serious problems in sugar beet cultivation in California. "Dalapon" is effective but may harm beet if the spray settles on the leaves. Tests with other weed killers are here reported. "Diuron" showed promise as a directed spray.

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Sugar beet root aphid resistance in sugar beet. R. L. WALLIS and J. O. GASKILL. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 571–572.—Some varieties or clones of sugar beet, grown in small plots, showed much more resistance to sugar beet root aphid than others. Whether this would hold in large scale cultivation is not known.

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Variety crosses in sugar beet. R. H. HELMERICK, R. F. FINKNER and C. W. DOXTATOR. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 573–596.—This consists of three separate papers, viz. (1) Expression of heterosis and combining ability, (2) Estimation of environmental and genetic variances for weight per root and sucrose per cent, and (3) Estimating the number and proportion of genetic deviates by the partitioning method of genetic analysis.

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Ecological characteristics of nematode-trapping Hyphomycetes. 1. Preliminary Studies. R. C. COOKE. *Ann. Appl. Biol.*, 1963, **52**, 431–437.—This is a study of thirteen species of nematode-trapping fungi and demonstrates the wide differences in growth rate, competitive saprophytic ability, effect on free living nematode populations and ability to produce traps spontaneously. Species with adhesive reticulated traps tended to have more rapid growth rates and higher saprophytic ability ratings than the ring-formers. Results are tabulated.

The effect of method and rate of phosphate application on yield and quality of sugar beets. S. D. ROMSDAL and W. R. SCHMEHL. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 603–607.—In Colorado the frequent need for phosphatic fertilizer for sugar beet is recognised, the usual rate being about 100 lb P_2O_5 (44 lb P) per acre. Trials on a calcareous sandy loam containing 37 lb of available P_2O_5 per acre showed that phosphate applications (50 or 200 lb P_2O_5 rates) substantially increased yield, but there were no appreciable differences in yield or sucrose content with the different methods of phosphate application employed.

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Influence of inhibitors in sugar beet fruits on speed of germination at 50° and 70°F. F. W. SNYDER and S. T. DEXTER. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 608–613.—In most sugar beet areas planting as early as possible is considered to be the most profitable. It is concluded that strains of sugar beet which emerge rapidly at 70° as well as 50°F can be selected.

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A technique for obtaining identical pairs of seedling beets. A. M. HARPER and J. B. TENNANT. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 614–616.—Sugar beet plants normally show much genetic variation because of cross pollination. A method of splitting seedlings (at the two leaf stage) and growing these on to form two identical plants is described, such plants being often needed or useful in experimental work.

* * *

Pests of sugar beet. C. E. E. RUNGS. *Al Awamia* (Rabat), 1962, **3**, 161–174; through *Rev. Appl. Ent.*, 1964, **52**, Ser. A, 17–18.—The author gives an annotated list of about 50 species of invertebrates that attack sugar beet in Morocco. This includes flea-beetles, cutworms, aphids, species of *Pegomyia*, *Lixus*, *Cleonus*, *Cassida*, and *Scrobipalpa*.

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Susceptibility of rice to a strain of the sugar cane mosaic virus. L. ANZALONE. *Plant Dis. Reptr.*, 1963, **47**, 583–584; through *Rev. Appl. Mycol.*, 1964, **43**, 38.—Four cultivated varieties of rice proved susceptible to strain H of the virus when inoculated by the air blast method. Sorghum was easier to infect than rice.

Treating sugar beet seed. W. J. BYFORD. *Ann. Appl. Biol.*, 1963, **51**, 41–49.—This deals with experiments on the use of ethyl mercury phosphate and other materials for treating sugar beet seed. Steeping sugar beet seeds in ethyl mercury phosphate solution controlled *Pleospora betae* and increased the emergence of seedlings in the field more than did "short-wet" fungicide treatments, spraying EMP solution on to the seed, or steeping in other fungicides.

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Selection for speed of germination in sugar beet. F. W. SNYDER. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 617–622.—Seedlings of sugar beet variety U.S. 401 were selected on the basis of speed of germination, fast and slow germinators, and grown on in separate plots. Their progeny did not show any significant pattern of germination. It was concluded that speed of germination is largely controlled by the maternal tissues of the seed-ball (fruit) itself.

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Comparison of fluorescent and incandescent lamps for promotion of flowering in sugar beet seedlings. J. O. GASKILL. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 623–634.—A wide range of fluorescent lamps, as well as the incandescent type serving as standard, were highly effective in the low-temperature induction process. But during the post-induction period the fluorescent lamps used were wholly ineffective in promoting flowering.

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The effect of yeasts on growth and sugar content of sugar beet. W. DREIFUSS and N. TSCHISCHOW. *Zeitsch. Zuckerind.*, 1963, **88**, 566–568.—Tests have shown that treating beet seed with a 0·2% aqueous yeast suspension and drying by addition of hyperphosphate (less than 1% on weight of beet seed) increases the root weight and the sugar content, the maximum increase occurring at between 3½ and 4½ months of growth, after which it falls. Large-scale tests have also shown that growth acceleration is also obtainable. Beet seeds are very sensitive to conventional drying processes.

* * *

A correlation study on crop-weather relationships in sugar cane. M. GANGOPADHYAYA and R. P. SARKAR. *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, 1–12.—Under the All-India Co-ordinated Crop-Weather Scheme on sugar cane systematic observations on growth and yield and on meteorological conditions are recorded. An analysis is made of the data so far accumulated from each of the stations co-operating, each growing two varieties of sugar cane in 12 plots.

Studies on the relation between soil environment and incidence of sugar cane wilt disease. A. GANGULY, T. N. JHA and B. V. SONI. *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 13–17.—A survey of the disease (caused by *Cephalosporium sacchari*) in various kinds of soil in the white sugar belt of Bihar was carried out. Maximum incidence was in non-calcareous soils of pH 7·0 to 8·06.

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Artificially synthesized forms as an indication of the probable origin of certain naturally occurring forms of *Saccharum spontaneum*. P. A. KANDASAMI and K. S. SUBBA RAO. *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 25–31.—The geographical range of *Saccharum spontaneum* is outlined, also its diversity of forms and varieties and the complexity of their chromosome "make-up". The origin of $2n = 52$ forms was inferred to have been through hybridization between a form with $2n = 64$ and one with $2n = 40$.

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Additional findings on the use of gamma BHC against termites and shoot borers in sugar cane in Uttar Pradesh. T. P. S. TEOTIA *et al.* *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 33–38.—Heavy losses from termites destroying the buds of planting setts and from shoot borers (*Chilotraea infuscatellus*) are experienced in Uttar Pradesh. The advantages of using gamma-benzene hexachloride for both pests on the spring-sown crop are stressed. Dipping setts in a 1% solution was effective against termites, but soaking overnight was harmful to the buds or eyes.

* * *

Effect of gibberellic acid on pollen germination and growth in sugar cane. A. S. ETHIRAJAN *et al.* *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 39–43.—Most of the 34 clones or varieties of sugar cane tested showed an increased rate but some did not; 500 p.p.m. was the most favourable concentration. Hybrid varieties and variants of *Saccharum spontaneum* showed remarkable tolerance to heavy doses.

* * *

Studies on the incidence of sugar cane diseases in Punjab. S. S. SANDHU *et al.* *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 44–49.—An account of a disease survey carried out in 1960–61 and 1961–62 is given. Red rot (*Colletotrichum falcatum*) was the most damaging disease. Other diseases recorded are smut, red stripe, pokkah-boeng, wilt, stinking rot, albino (cause unknown), eye spot, ring spot, mosaic and banded sclerotial disease. Sugar cane rust and pineapple disease were not recorded.

On the effects of gibberellic acid on sugar cane. P. S. GILL. *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 63–72.—A detailed account is given of work so far carried out at the Institute of Sugar Cane Research, Lucknow, on this subject.

* * *

Occurrence of some new pests of sugar cane. K. C. CHANDY *et al. Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 73.—Insects noted as pests on sugar cane for the first time in Madras State are briefly described (with plate). They are—*Orchesma marginepunctata*, *O. serendiba*, *Cletus bipunctatus*, *Agronosceles nubila*, *Menida histrio* and *Rhadinosa* sp.

* * *

Preliminary trials with a bacterial spore powder for the control of the stalk borer and internode borer of sugar cane. A. N. KABRA and S. KUMAR. *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 75.—A pathogenic bacterium caused considerable mortality with lab-lab bean pod-boring caterpillars in Mysore. Laboratory and field trials with the spore powder at Lucknow showed no indication of efficiency with cane borers.

* * *

Use of black polyethylene film as mulch for sugar cane. C. N. BABU *et al. Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 76–77.—A small reduction in weeding costs resulted but insufficient to cover the cost of polyethylene. There were no other advantages and soil was not enriched as with trash and leaf mulches. The blades of nut grass (*Cyperus rotundus*) were inclined to pierce through the film.

* * *

Observations on the flowering behaviour of sugar cane varieties at Coimbatore and Taliparamba. U. VIJAYALAKSHMI and J. THULJARAM RAO. *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 78–80.—At Taliparamba, where one of the world collections of sugar cane varieties (over 2000) is maintained, flowering with many varieties is better than at Coimbatore. Flowering may be influenced greatly by rainfall. A table depicts percentage flowering of varieties, from different parts of the world, at the two stations from 1960-1962.

* * *

Leaf sheath red-rot in Maharashtra State. P. A. SHINDEE. *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 84.—It is pointed out that two different fungi may be responsible for leaf sheath red-rot, now a disease of major importance in Maharashtra. They are *Sclerotium rolfsii* and *Ozonium texanum* var. *parasiticum*. Details are given.

* * *

New tilling technique for tropical cultivation. ANON. *Trop. Sci.*, 1963, **5**, 193.—A new method of tilling, known as the "tied-ridge" system, which helps to conserve moisture, is described. It was evolved at the National Institute of Agricultural Engineering in England and has been successfully demonstrated with maize in Tanganyika. To produce the ridge structure, a bridge of soil is formed at regular intervals to join the ridge made by a special ridge plough. For this a tool was evolved which breaks up the soil on the floor of the trench and scoops up loose earth to form a tie. Tie forming is done by a circular disc trailed behind the plough and lifted at intervals. The system is well suited for regions where a period of heavy rainfall, followed by long dry spells, prevails.

* * *

The occurrence of *Goryphus* (= *Melcha*) *ornatipennis* **on** *Proceras indicus* **at Pugalur (Madras State).** S. A. R. RAO. *Indian J. Sugar Cane Res. Dev.*, 1963, **8**, (1), 87.—This is the first record in India of this apparently rare parasite on the internode borer. Further work and observation are in progress.

* * *

The effect of Coccinellids on aphids infesting insecticide-treated sugar beet. G. D. HEATHCOTE. *Plant Pathology*, 1963, **12**, 80–83.—Insecticides tested on sugar beet crops affected aphid predators (Coccinellids or "lady-birds") only temporarily. When insecticides were no longer used, aphid populations sometimes increased more than on unsprayed crops, but Coccinellids recolonized the sprayed crops and populations of aphids and predators were soon similar on sprayed and unsprayed crops. The insecticides affected the Coccinellid population on beet more by destroying its source of food than by directly killing the beetles.

* * *

Studies on sugar cane smut caused by *Ustilago scitaminea*. **I.** S. K. SAXENA and A. M. KHAN. *J. Indian Botanical Soc.*, 1963, **42**, 195–203.—This is an investigation into the effect of temperature on the percentage and rate of germination of spores (chlamydospores) of this fungus from seven different localities in India. Spores germinated between 15° and 40°C while the optimum temperature for all the collections ranged between 25° and 30°C. Aligarh and Punjab collections were fast germinators, Coimbatore and Cuddalore slow germinators, while Bihar, Bengal and Poona spores germinated at a medium rate.

* * *

Leaf-spot disease of sugar cane in Sarawak. G. J. TURNER. *The Gardens Bulletin, Singapore*, 1963, **20**, 287.—In an article on new records of plant diseases in Sarawak for the years 1960 and 1961 the presence of leaf-spot (*Cercospora koepkei* Krüger) is recorded in Sarawak for the first time.

* * *

Sugary endosperm in Sorghum. R. E. HARPER and J. R. QUINBY. *J. Heredity*, 1963, **54**, (3), 121–126. The existence of a little known form of *Sorghum* in India, which corresponds to sweet corn in maize, and its genetical significance, is dealt with. Seeds wrinkle as they mature and are used for parching. Some forms have sugary or juicy stems.

THE ISOLATION OF PLANTEOSE FROM BEET FINAL MOLASSES

By W. W. BINKLEY and W. F. ALTENBURG
(New York Sugar Trade Laboratory, 37 Warren Street, New York, N.Y., 10007, U.S.A.)

TRANSGALACTOSYLASES are the most active transport enzymes in the sugar beet[1]. The addition of a galactosyl group to carbon-6 of the glucose moiety of sucrose yields raffinose, the principal trisaccharide of this plant. The appendage of this glycosyl group to carbon-6 of the fructose portion of sucrose produces planteose, a trisaccharide which is not attacked by yeast[2]. The marked transgalactosylase activity in the sugar beet suggests the probable formation of the latter 6-*O*-D-galactosylsucrose therein. This report describes the isolation of planteose from the final molasses of the production of sucrose from this plant.

EXPERIMENTAL

Materials.—The beet final molasses was produced by the Great Western Sugar Co., Billings, Mont., U.S.A. This molasses was found to contain 47·85% sucrose, 3·92% raffinose, 0·49% reducing sugars (as invert), 10·44% ash and a total of 80·26% solid substances.

Yeast Fermentation of Beet Final Molasses

One hundred grams of the above molasses in 300 ml of demineralized water were allowed to react with 25 g of baker's yeast (Fleischmann's Standard Brands, Inc., New York, N.Y., U.S.A.) for 48 hr at 25–27°C. A slight evolution of gas was noted at the end of this period. The yeast was removed then by filtration. The filtrate was concentrated under reduced pressure at 60°C to a volume of 100 ml.

Examination of the Non-Fermented Substances from Beet Final Molasses

(*a*) *Carbon Column Chromatography.*—A 15 ml aliquot of the above concentrate was diluted with demineralized water to a volume of 200 ml. The resulting solution was added at the top of a 30 cm high × 6 cm dia. column of granular carbon ("Nuchar", C-Unground grade, West Virginia Pulp and Paper Co., New York, N.Y., U.S.A.)[3]. The chromatogram was then developed with 3 litres of demineralized water. Two additional aliquots, 13 and 12 ml respectively, of the concentrate were chromatographed separately and successively on the same column in the manner just described. The chromatogram was then developed with 1 litre of 5% aqueous ethanol followed by 500 ml portions of each unit strength increasing from 6 to 20% aqueous ethanol. Assays on Whatman No. 1 filter paper developed with 7:1:2 v/v 1-propanol:ethyl acetate: water and sprayed with α-naphthol-phosphoric acid[4] revealed the probable presence of planteose in the effluent of the carbon column developed with 9 to 12% aqueous ethanol (Fig. 1). The yields of residual syrups from these effluents were 99, 67, 44 and 36 mg, respectively.

(*b*) *Thick Paper Chromatography and Isolation of Planteose.*—The residual syrup (99 mg) from the development of the carbon column with 9% aqueous ethanol was dissolved in 1 ml of water and was deposited with a streak applicator at a designated position on a 23 × 45 cm sheet of Whatman No. 17 filter paper. The descending chromatogram was developed at 20°C with 500 ml of 7:1:2 v/v 1-propanol: ethyl acetate:water, about 6 days being required. Utilizing guide strips cut from the lengthwise edge of the chromatogram and the α-naphthol-phosphoric acid spray reagent, the adsorbate with the mobility of planteose was located, 23·0–28·5 cm from the starting position.

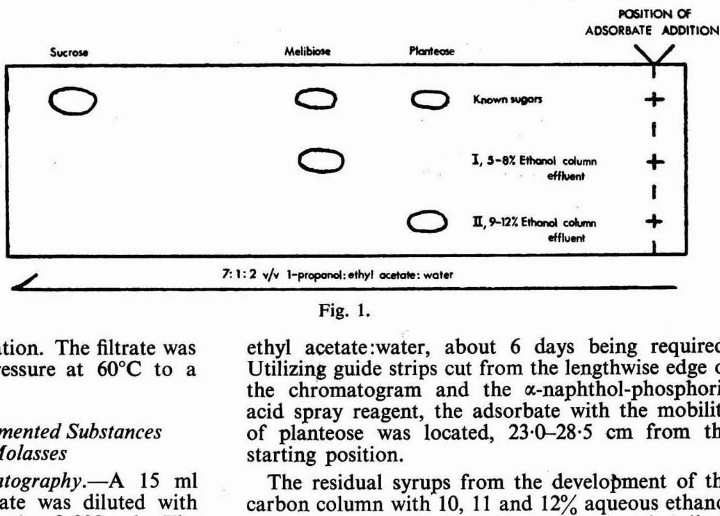

Fig. 1.

The residual syrups from the development of the carbon column with 10, 11 and 12% aqueous ethanol were chromatographed on this paper as just described. The adsorbate with the mobility of planteose was eluted with water and rechromatographed on thick paper, yield 25 mg. The electrophoretic mobility of

[1] Based on the analysis of beet final molasses by CARRUTHERS *et al.*: *I.S.J.*, 1963, **65**, 234–237, 266–270.
[2] WATTIEZ & HANS: *Bull. acad. roy. med. Belg.*, 1943, **8**, 386.
[3] See BINKLEY *et al.*: *I.S.J.*, 1963, **65**, 196 for conditioning procedure.
[4] ALBON & GROSS: *Analyst*, 1952, **77**, 410.

this re-chromatographed syrup at 12°C on paper after 4 hr at 2000 V in a 0·05 *M* borate buffer at pH 9·2[5] was identical to that for planteose (Fig. 2; $M_{sucrose}$, 1·90 for planteose, 1·60 for raffinose); raffinose was absent. This re-chromatographed syrup reacted as follows: Molisch-positive; Benedict, before acid hydrolysis-negative, after acid hydrolysis-positive; invertase-negative; emulsin-positive (yielding sucrose and galactose); acid hydrolysis producing glucose, fructose and galactose (Fig. 3). An aqueous methanol solution of this syrup was nucleated with planteose dihydrate; well-shaped cubes formed at 25–27°C over a period of 14 days, yield 4·2 mg. The X-ray powder diffractogram of these crystals was identical to that for planteose dihydrate[6]. The crystals isolated from the yeast fermentation residue of beet final molasses were thus properly identified as planteose dihydrate.

Discussion

Raffinose and stachyose are probably the most abundant oligosaccharides of the "raffinose family" in nature, the sugar beet being a well-known example[7]. A less known member of this family is planteose, a reserve sugar in the seeds of Plantago. Modern chromatographic techniques indicate that this trisaccharide may be widespread in nature, probably in no more than trace amount.

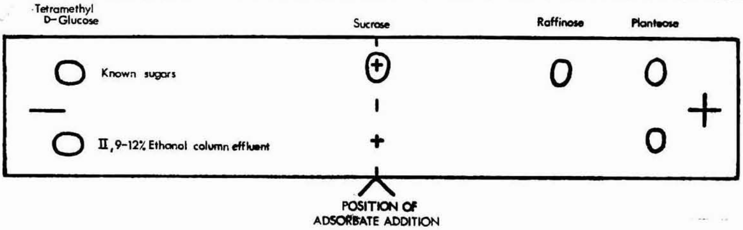

Fig. 2

A syrup with the $R_{sucrose}$ of planteose was isolated from this fraction by thick paper chromatography. The $M_{sucrose}$ value (paper electrophoresis) of this syrup was the same as that for planteose. Utilizing paper chromatography this syrup was found to react as follows: acid hydrolysis yielded fructose, glucose and galactose; emulsin produced sucrose and galactose; invertase did not react. Nucleation of this syrup with planteose dihydrate induced the formation of additional crystals. The X-ray powder diffractogram of these crystals was identical to that for planteose dihydrate. This is the first record of the direct isolation of planteose from beet final molasses. The concentration of this sugar was estimated to be 0·011% (based on the yield of crystalline material).

Summary

Planteose, a 6-*O*-D-galactosylsucrose, was isolated from beet final molasses; its minimum concentration was estimated to be 0·011% (based on the yield of crystalline sugar).

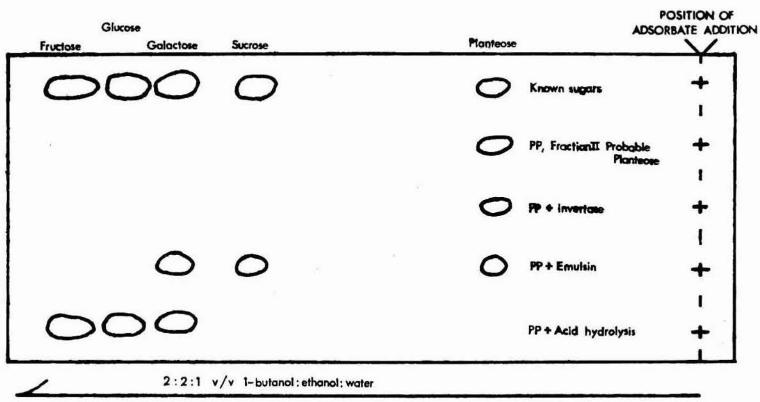

Fig. 3.

The residual syrup from the yeast fermentation of beet final molasses was adsorbed on a carbon column. The percolation of water through this column was undertaken to eliminate the very simple substances. Gradient elution with aqueous ethanol was utilized to remove the disaccharides (I, 5–8% ethanol) followed by a fraction of higher oligosaccharides (II, 9–12% ethanol). Paper chromatography and paper electrophoresis revealed the probable presence of planteose in fraction II (Figs. 1 and 2).

Acknowledgment

Thanks are due Mr. E. J. Roberts, Sugar Investigations, United States Department of Agriculture, for his assistance with the paper electrophoresis and Mr. H. Chanzy, State University College of Forestry at Syracuse University, for his assistance with the X-ray diffractograms.

[5] Gross: *Nature*, 1953, **172**, 908; 1954, **173**, 487.
[6] French *et al.*: *J. Amer. Chem. Soc.*, 1953, **75**, 709.
[7] French: *Advances in Carbohydrate Chem.*, 1954, **9**, 149.

THE R.T. ROTATING PRE-SCALDER

By G. TIBO and A. SMET
(Tirlemont Refinery, Belgium)

Paper presented to the 16th Tech. Conf., British Sugar Corporation Ltd., 1963.

PART II

The Pre-Scalder from an Economic Viewpoint

The returns to be expected from the money invested in a pre-scalder are peculiar to each installation, as the number of local factors is too large to allow any general rule. As usual in this kind of heat economy problem, the existing equipment and its possibilities must be considered.

We give here, however, a few comparative calorific balances of an R.T. diffusion station.

The following values are assumed:

Draught: 111 kg juice per 100 kg beets.

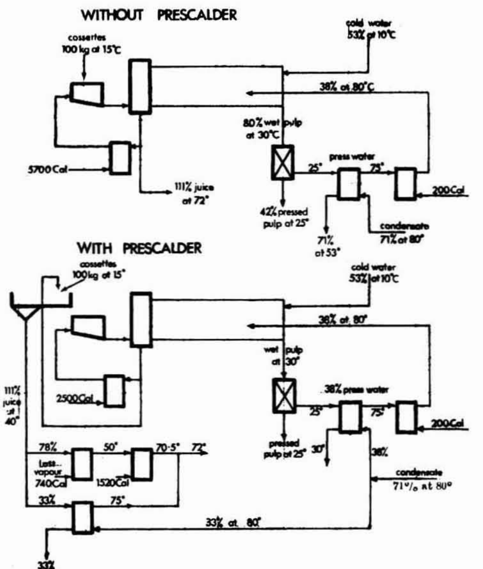

Fig. 4 Calorific balance of R.T. diffuser with cold pulp at 12% dry substance

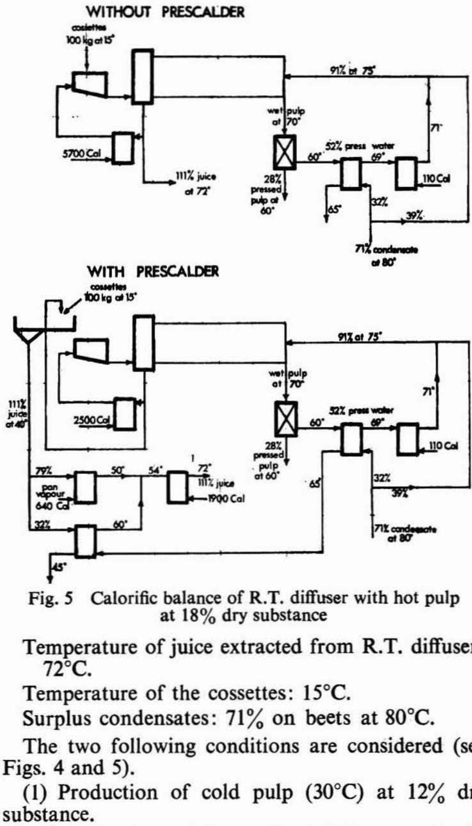

Fig. 5 Calorific balance of R.T. diffuser with hot pulp at 18% dry substance

Temperature of juice extracted from R.T. diffuser: 72°C.

Temperature of the cossettes: 15°C.

Surplus condensates: 71% on beets at 80°C.

The two following conditions are considered (see Figs. 4 and 5).

(1) Production of cold pulp (30°C) at 12% dry substance.

(2) Production of hot pulp (70°C) at 18% dry substance.

Heat fed into the loop as steam supplied by the evaporation station, is indicated by figures such as 5700 Cal, etc.

Table I

Estimation of the comparative coal costs for the schemes of Fig. 4 and 5
(Factory of 2400 tons per day—90 days)

	Cold pulp 12% dry substance		*Hot pulp 18% dry substance*	
	Without pre-scalder	*With pre-scalder*	*Without pre-scalder*	*With pre-scalder*
Calories to be furnished by vapour from the evaporators (per 100 kg beets)	5900	4220	5810	4510
Coal (7000 Cal per kg) per ton of beet	10·5	7·5	10·4	8·1
Cost per ton of beet (Belgian Francs)......	9·45	6·75	9·36	7·29
Total cost (90 days—2400 tons per day)..	2,041,000	1,459,000	2,020,000	1,575,000
Yearly economy by use of pre-scalder (Belgian Francs)	—	582,000	—	445,000

Table II

Estimates of the comparative investments necessary for the schemes of Fig. 4 and 5
(Factory capacity 2400 tons beet per day)

	Cold pulp at 12% *dry substance*		*Hot pulp at* 18% *dry substance*	
	Without Pre-scalder	*With Pre-scalder*	*Without Pre-scalder*	*With Pre-scalder*
Pre-scalder Cost (Belgian francs)	—	*600,000*	—	*600,000*
Circulation juice heaters (K = 800 Cal/sq.m./°C/hr)				
Temperature difference	15	18	15	18
Cal/hour	5,700,000	2,500,000	5,700,000	2,500,000
Heating surface (sq.m.)	475	175	475	175
Cost (Belgian francs)	*950,000*	*350,000*	*950,000*	*350,000*
Heat exchanger on press water (K = 700 Cal/sq.m./°C/hr)				
Temperature difference	16	5	8	8
Cal/hour	1,900,000	1,900,000	480,000	480,000
Heating surface (sq.m.)	170	540	85	85
Cost (Belgian francs)	*340,000*	*1,080,000*	*170,000*	*170,000*
Heater on press water (K = 800 Cal/sq.m./°C/hr)				
Temperature difference	15	15	15	15
Cal/hour	200,000	200,000	110,000	110,000
Heating surface (sq.m.)	17	17	10	10
Cost (Belgian francs)	*51,000*	*51,000*	*30,000*	*30,000*
Heater on pan vapours (K = 350 Cal/sq.m./°C/hr)				
Temperature difference		15		15
Cal/hour		740,000		750,000
Heating surface (sq.m.)		140		140
Cost (Belgian francs)		*280,000*		*280,000*
Heat exchanger on raw juice (K = 700 Cal/sq.m./°C/hr)				
Temperature difference		5		5
Cal/hour		1,150,000		640,000
Heating surface (sq. m.)		330		180
Cost (Belgian francs)		*660,000*		*360,000*
Heater on raw juice (K = 800 Cal/sq.m./°C/hr)				
Temperature difference		15		15
Cal/hour		1,520,000		1,900,000
Heating surface (sq.m.)		125		160
Cost (Belgian francs)		*250,000*		*320,000*
TOTAL COST (Belgian francs)	*1,341,000*	*3,271,000*	*1,150,000*	*2,110,000*
Extra cost for pre-scalder	—	*1,930,000*	—	*960,000*

CALCULATION OF THE RETURNS OF A ROTARY PRE-SCALDER INSTALLATION

1. Cold Pulp at 12% dry substance

	Belgian Francs
Yearly economy in coal	582,000
Cost of additional formaldehyde consumption	70,000
Yearly profit:	512,000
Cost of additional plant	1,930,000

The extra plant can thus be paid for in 4 years.

On the other hand, if one prefers to pay for the investment in 10 years, at an interest rate of 5%, the annual profit would be

$$512{,}000 - \frac{13}{100} \times 1{,}930{,}000 = 262{,}000 \text{ Francs.}$$

2. Hot Pulp at 18% dry substance

	Belgian Francs
Yearly economy in coal	445,000
Cost of additional formaldehyde consumption	70,000
Yearly profit:	375,000
Cost of additional plant	960,000

The extra plant is paid for in 3 years, or produces an annual profit of 250,000 Francs if the investment is paid for in 10 years.

CONCLUSION

The new type of rotary R.T. pre-scalder may now be considered as an industrial device which makes possible the recovery of otherwise waste heat, when using a diffuser plant equipped with the scalding process.

It is a fairly simple and cheap apparatus which can be built for capacities up to 4000 tons of beets per day.

The hot juice of the R.T. diffuser is cooled to 40°C in only one flow through the fresh cossettes.

The retention time of juice and cossettes in the pre-scalder is only about 40 seconds.

It would be possible to dimension the apparatus for a double juice circulation through the cossettes, in order to make possible a still higher recovery of pan vapours. But such a device does not seem interesting so far, since it cancels the benefit of the scalding process itself.

Although the problem of heat recovery is a specific one in each factory, it has been shown with two examples that the installation of a pre-scalder pays for itself.

EXPLOSIVE GAS FROM SUGAR SEEPAGE

By C. H. COUPER and I. R. SHERWOOD

(Government Chemical Laboratory, Brisbane, Australia, and C.S.R. Research Laboratories, Sydney, Australia)

ON the evening of 9th May 1963, a fire broke out in a stack of 77,000 tons of bulk raw sugar stored in the Townsville Sugar Terminal, Queensland. The fire assumed major proportions and was not extinguished until 84 hours later on the morning of 13th May.

The buildings of the sugar terminal are situated mainly on reclaimed land close to the wharves. The sugar storage shed is nearly 1000 feet long by 150 feet wide. Prior to the fire the water table in this area was 7 feet below ground surface. However, the volume of water used to fight the fire raised the level of the water table approximately 4½ feet and carried in with it some thousands of tons of sugar from the stack.

Following the fire three minor explosions took place. The first of these occurred on 16th May on a train track close to the burnt-out area. No damage was caused.

One day later a second explosion took place, this time in the switch room of the receiving station, some 30 yards from the main storage building. At the time, two windows in the switch room were open and an electrician was working in the room. The explosion appently resulted from an arc formed at the main switch when the power was turned off. The force of the explosion blew out two windows in the room, lifted a steel checker plate from the ground and pushed the electrician against the wall. No flame was observed.

On 18th May another minor explosion took place on the train track close to the burnt-out area. On this occasion a pale flame some 12 feet long was seen at ground level and this caused a length of steel rail to heat up considerably.

Immediately following the explosions an investigation into possible causes was carried out. Tests were made of gases in the switch room where the second explosion had occurred. For this purpose various portable instruments were used, including Davis "Vapotester" and Riken equipment.

In the electrical cable conduit in the floor of the switch room an explosive gas (probably hydrogen, on the basis of instrument readings) and concentrations of carbon dioxide were detected. Gases were found to be bubbling up through water in a foundation trench (about 3½ ft deep) some 100 ft from the switch room. These gases were sampled and found to be similar to those which had been tested in the conduit of the switch room.

Tests were made on gases emanating from crevices in the ground round the storage shed. In every case, carbon dioxide and a light explosive gas were detected. No traces of carbon monoxide, methane or hydrogen sulphide were detected. Two holes were drilled through the concrete floor of the storage shed, one on each side of the conveyor tunnel. In each case, explosive gas and carbon dioxide were found.

Tests were carried out in the covered drains near the building and there also gave positive reactions. The same gases were found being emitted from hairline cracks in the walls of the conveyor tunnel beneath the floor of the main storage shed.

The area over which these gases were detected was much greater than that occupied by the buildings and spread some 1500 × 500 ft.

Samples of explosive gases taken at several points were despatched to laboratories for chromatographic analysis. They were found to consist essentially of carbon dioxide and hydrogen in the approximate volume ratio of 2·4:1. Traces, only, of methane were found.

No explosive gas could be detected in the residual stack of raw sugar in the storage shed.

Samples of liquid and soil taken from areas in which explosive gas had been detected were examined microbiologically. Several types of yeasts and bacteria were observed but a high proportion of the population consisted of *Clostridium butyricum*. This organism was isolated readily following transference to potato dextrose agar, incubation in an anaerobic jar at 30°C and heat-shocking. It formed sporulating rods of typical shape and fragmented agar with gases which were shown to consist mainly of carbon dioxide and hydrogen. A strong butyric odour was noted and the acid was identified by paper chromatography. Potato starch was fermented. On the basis of morphology and biochemical tests the organism was identified as *Clostridium buytricum*.

Discussion

The results of this investigation show that carbon dioxide and hydrogen can be produced in large volumes through microbial attack on dilute sugar solutions in the soil. There is always the possibility of sugar spillage in the neighbourhood of sugar storage depots, and washing of this sugar into the ground by hosing or by rain provides a very suitable substrate for *clostridia* and other micro-organisms in the soil. If the sugar solutions penetrate the ground to any appreciable depth anaerobic conditions will be met which will favour proliferation of *clostridia*.

The production of explosive gas in this way provides a possible explanation for a phenomenon which occasionally has been reported from molasses storage areas, viz. the occurrence of minor explosions in the vicinity of molasses tanks. In the past these occurrences have been attributed to the ignition of small amounts of methane, although no identification of the gas has been reported and its origin, also, has been obscure.

The present investigation suggests that a more likely explanation for these explosions is the generation of hydrogen gas by soil *clostridia*, the substrate being dilute molasses which has found its way into the ground by seepage of spillage.

Acknowledgment

Grateful acknowledgment is made to Mr. K. Deasy for analyses of gas samples and to Miss M. R. McLean for assistance in classifying the organisms isolated.

The authors wish to express their thanks to the Director of the Government Chemical Laboratory, Brisbane, Australia and to the Management of The Colonial Sugar Refining Co. Ltd., for permission to publish this work.

SINGLE PASS *vs.* RECIRCULATION IN EVAPORATORS

By L. A. TROMP, A.M.I.Mech.E.

PART I

Definitions

Both single pass flow and recirculation systems are applied in evaporators in sugar factories. To avoid misunderstanding both are defined below, as applied in evaporators having vertical tubes no longer than, say, 2·40 metres (8 feet).

The recirculation type originated with the invention of the multiple-effect more than a century ago and may be described as follows: Juice is supplied from above the calandria or from below the bottom of the vessel, more or less distant from the outlet in this same bottom. When evaporation starts in the vertical tubes, the juice climbs upwards with film formation and is ejected, as a result of the velocity of the emerging vapour, from the upper tube end. Because of the ejection velocity of the juice and vapour mixture from the tubes, there is little or no possibility of the juice dropping to fall back into the tubes from above.

It may be observed visually that the emergent juice rolls over the imperforate area of the upper tube-sheet towards the downtake through which it falls to mix with the juice in the bottom of the evaporator.

On the right-hand side of Fig. 1 the performance is shown diagramatically, the equation $F = O + V$ (weight of feed of incoming juice = weight of outgoing juice + weight of vapour produced) applying, as for all evaporators.

Concerning recirculation, which is assumed to take place inside the evaporator, there arise a number of questions which obviously cannot be answered, viz.

(*a*) Is the mixture uniform or is a portion of the incoming juice short-circuited to the outlet without concentration?

(*b*) If recirculation takes place, what is the value of the proportion X in Fig. 1, since this cannot be measured?

Because the evaporating action is continuous, recirculation cannot be 100% of the incoming juice, since if this were so no juice would be discharged.

For these reasons the writer refers to this method of working as "problematic recirculation".

Single-pass flow is much easier to explain. Until the juice drops into the downtake there is no difference between this and "problematic recirculation"; however, with the single-pass flow system the bottom of the downtake is blocked and provided with a discharge tube for the concentrated juice. It may also therefore be called the "sealed downtake" system, and is illustrated on the left-hand side of Fig. 1.

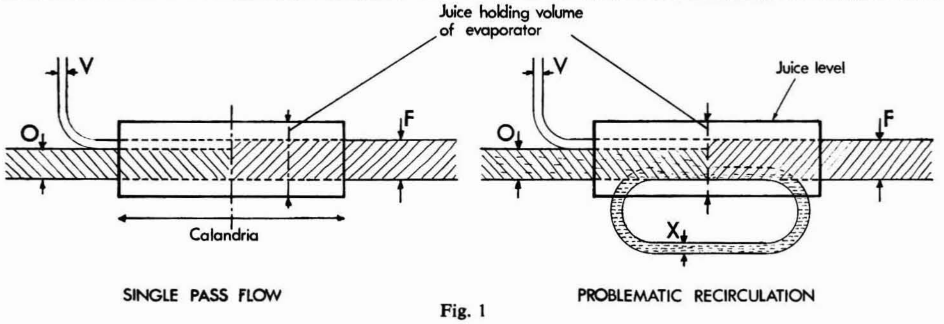

Fig. 1

Evaporator Designs with Problematic Recirculation

Fig. 2 illustrates a design made before 1920, where the juice enters through a bent pipe into the downtake. Since the concentrated juice leaves the apparatus through the bottom sump at *O*, there is little doubt that short-circuiting may occur.

Because of the strong objection of factory operators to the single-pass method, the writer could not get ready acceptance of it and therefore, as a disguise, proposed later to arrange the juice inlet from the

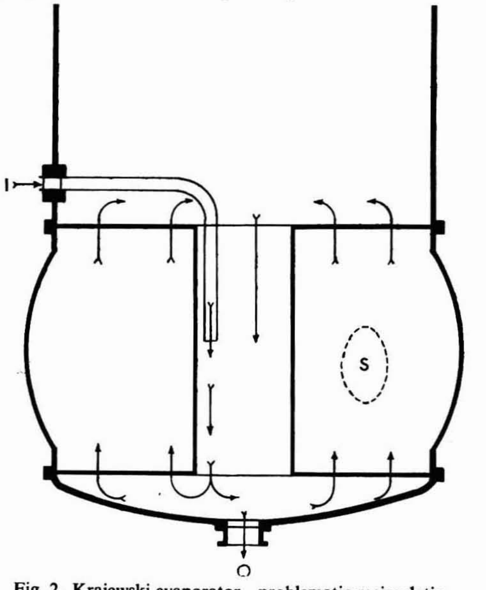

Fig. 2. Krajewski evaporator—problematic recirculation.
KEY: I = juice inlet, O = concentrated juice outlet,
S = steam inlet.

bottom through a perforated ring pipe provided in the bottom space of the evaporator, sufficiently distant from the outlet sump. This arrangement had a good reception and, in practically all cases, resulted in a 5–15% increase in evaporation, recirculation, if any[1], obviously being limited to a small fraction.

In Fig. 3 this design has been developed to the fullest degree, although the juice outlet has been located at some distance from the downtake centre, probably because there is some hesitation in respect of the sealed downtake. This may be explained by reason of the impossibility of juice level regulation in single-pass evaporators.

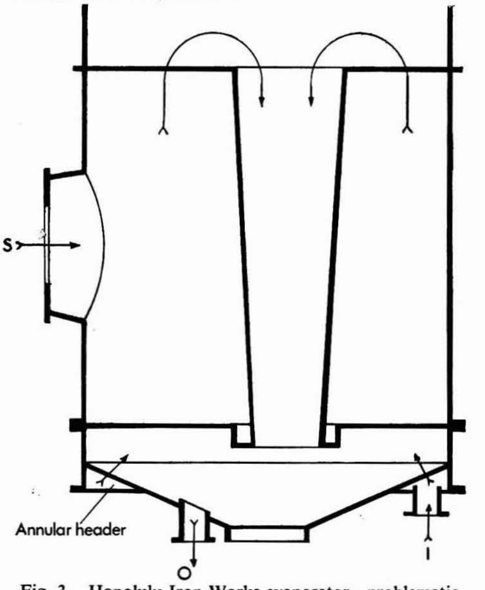

Fig. 3. Honolulu Iron Works evaporator—problematic recirculation.

Evaporator Designs with Sealed Downtake

Before 1927, the design illustrated in Fig. 4 was put on the market. This is very plain and lacks a good juice distributing device in the bottom space of the evaporator. The prejudice against single-pass flow has hampered its general introduction and only relatively few evaporators were equipped with sealed downtakes at that time.

The calandria was made of cast iron with brass tube sheets as mostly made and applied in the Western Hemisphere. Although originated for white sugar factories these were also found in raw sugar factories. On the European Continent, and also in Java, mild

[1] See also GONZÁLEZ MAÍZ: *I.S.J.*, 1954, **56**, 9–10.

steel was used almost exclusively. Nowadays, extensive use is made of copper-bearing steel as manufacturing material.

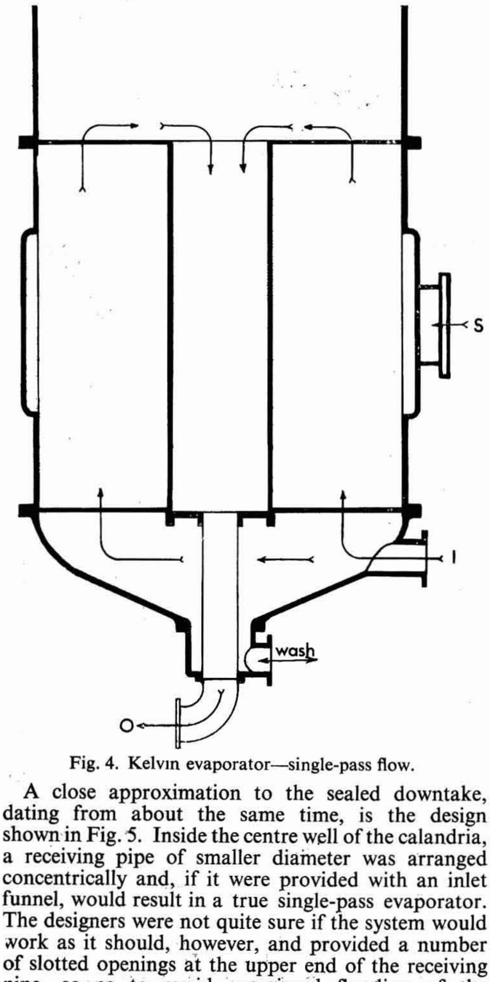

Fig. 4. Kelvin evaporator—single-pass flow.

A close approximation to the sealed downtake, dating from about the same time, is the design shown in Fig. 5. Inside the centre well of the calandria, a receiving pipe of smaller diameter was arranged concentrically and, if it were provided with an inlet funnel, would result in a true single-pass evaporator. The designers were not quite sure if the system would work as it should, however, and provided a number of slotted openings at the upper end of the receiving pipe, so as to avoid occasional flooding of the evaporator. More to the point would have been, in this case, to locate an overflow funnel at a lower height, as shown with broken lines. The writer has observed such an installation in actual operation, but the performance did not show any improvement over the conventional "old-timers".

The narrow vapour pipes between the bodies, strangulating catch-alls and inadequate juice distribution in the bottom space of the evaporator may have had a detrimental effect on the evaporating capacity and it may be that the receiving pipe had been taken out, owing to local "inventivity" which was not unusual at that place.

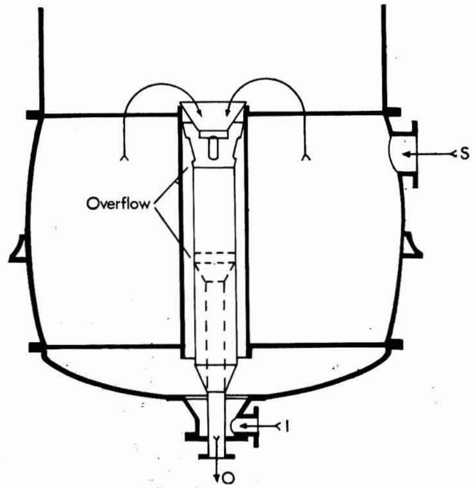

Fig. 5. Fives-Lille evaporator—single-pass flow.

In Fig. 6 is shown the calandria of a true sealed-downtake evaporator where there is no possibility of mixture of virgin and concentrated juice. The juice enters at the centre of the bottom and is distributed by a perforated deflector while the downtake is arranged to one side, being of segmental or sectional cross-section. The concentrated juice is withdrawn through a spout on this downtake, opposite the steam entrance.

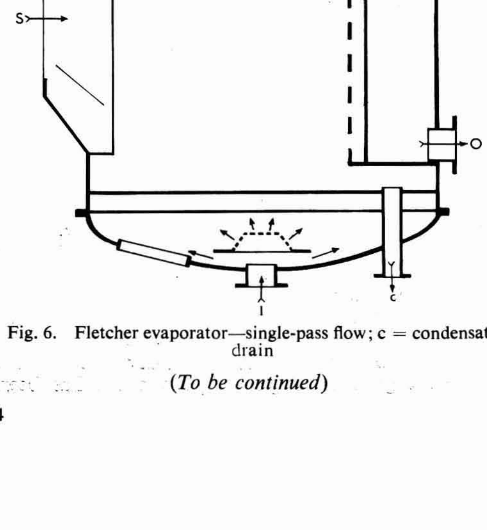

Fig. 6. Fletcher evaporator—single-pass flow; c = condensate drain

(To be continued)

SUGAR HOUSE PRACTICE

High undetermined losses. C. G. M. PERK. *S. African Sugar. J.*, 1963, **47**, 505–507.—In a continuation of a survey of undetermined losses[1], mention is made of sugar frequently found in tail water samples from vacuum condensers serving rotary vacuum filters. This is caused by entrainment from the filtrate receivers of the filters, as a result of either flooding or excessive frothing in the receivers. Two recommendations are made: (1) installing a save-all between receivers and condensers, and (2) providing a vacuum controller at the vacuum pump. Details and a diagram are given of a simple vacuum controller[2]. Most Stillman save-alls are considered to be of faulty design and a modified design as adopted at Big Bend sugar factory is described.

* * *

Pingtung sugar factory. T. Y. CHEN. *Sugar J.* (La.), 1963, **26**, (2), 32–36.—Details are given of Pingtung sugar factory, which is the largest and most up-to-date of the factories owned by Taiwan Sugar Corporation (the factory was built in 1909 but suffered extensive damage during World War II). The equipment includes two tandems each of five 36 × 78 inch 3-roller mills, two quadruple-effect evaporators, eight vacuum pans (for a 4-boiling scheme) and 28 crystallizers, plus Broadbent and Western States centrifugals. Annual production is 50,000 metric tons of plantation white sugar, the average pol in 1961–62 being 99·82.

* * *

Heat exchange in the cooling elements of disc-type horizontal crystallizers. S. ZAGRODZKI. *Ind. Alim. Agric.*, 1963, **80**, 723–732.—Static and dynamic tests carried out with a laboratory crystallizer trough at controlled rotary speeds of the discs and of circulation rates of the cooling water gave values for *k* (heat transfer coefficient) which were 100–200% higher than those given by conventional calculations, the smallest differences occurring at the lowest cooling water circulation rates. The values of *k* determined in the tests have been used to calculate values of α_1' and α_2' (the partial heat transfer coefficients for, respectively, water cooled in the trough and cooling water inside the disc elements); these in turn have been used to calculate values of *k* for increased cooling under flow conditions to within an error not exceeding 20%.

* * *

Sugar moisture—drying—preserving. P. DEVILLERS. *Sucr. Franç.*, 1963, **104**, 315–319.—The problem of sugar moisture is considered first in relation to the impurity in sugars and the degree of freedom (no chance of escape where the water is included in the crystal, progressive chance to escape where the water is in a highly supersaturated syrup, and the highest degree of freedom where the syrup is saturated at the crystal face). Two equilibria occur simultaneously: that between the crystallized sugar and the layer of molasses covering it, and that between the water in the molasses and the water in the air (the so-called equilibrium relative humidity or E.R.H.). The boiling, curing and drying of sugar is discussed in relation to the final moisture content of the sugar. Mechanical agitation in the pans is beneficial since fewer agglomerates, which may include water, are formed (a moisture content of 0·027% with agitation compared with 0·084% without). Centrifugals giving the dryest sugar are recommended. Horizontal drum dryers give the lowest yield of agglomerates. A secondary drying lasting two days in conditioning bins is recommended to crystallize the layer of supersaturated molasses. The sugar then sent to the main silos should be stored at relatively low R.H., e.g. 60. The conditions to be maintained in four different types of silo are discussed.

* * *

Imperial warehouse and bulk handling at Galveston. ANON. *Sugar y Azúcar*, 1963, **58**, (10), 34–35.—An illustrated account is given of the new bulk handling installation set up by Imperial Sugar Company at Galveston, Texas, which includes a warehouse with a capacity of 60 million lb of raw sugar. The sugar is unloaded from ships to a 400-foot dockside Stephens-Adamson conveyor system. From the warehouse the stored raw sugar is transferred to an underfloor conveyor system which moves it to rail cars for transport to the Sugar Land refinery.

* * *

Crystal sugar packing machine at Szolnok sugar factory. V. HIDASI. *Cukoripar*, 1963, **16**, 293–295. The semi-automatic sugar packing device described consists of a large cone suspended above an endless conveyor. Sugar is delivered to the apex of the cone and is distributed into smaller hoppers located at its lower perimeter. The conveyor, which is slightly inclined inwardly, is provided with levers which come into contact with the hinged lids at the bottom of the hoppers, opening these so that the sugar pours into a suitably placed 1-kg bag. The sugar is fed to the machine under gravity from the warehouse situated above the packing station, the amount fed being controlled by throttling valves.

* * *

Experience in processing cane raw sugar at Odessa refinery. V. PETRUNYAK and K. DEKHTYAREVA. *Sakhar. Prom.*, 1963, (11), 36–39.—Details are given of the modifications at Odessa refinery for processing cane raw sugar and producing an extra 170 metric tons of refined sugar per day (bringing the total to 700 metric tons). Raw sugar is affined and mingled with run-off from the first low-grade strike and with part of the affined sugar wash. It is then melted in active carbon wash water and filter sweet water, limed, carbonatated and sulphited. First low-grade sugar is melted in the liquor and this treated with active

[1] *See also I.S.J.*, 1962, **64**, 206.
[2] *British Chem. Eng.*, 1957, **2**, (3).

carbon. The fine liquor produced is boiled to three strikes, the first being used to produce granulated refined sugar, and the second and third to make tablet sugar. The third strike run-off is sent to the recovery house where it and affination syrup and re-melted 2nd low-grade sugar are boiled to the 1st low-grade strike; the run-off from this is boiled to the 2nd low-grade strike, the final run-off having a purity of 60–61. Some criticisms are made of the machinery used in the refinery.

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Producing powdered sugar at Shepetovsk sugar combine. I. SOROKIN. *Sakhar. Prom.*, 1963, (11), 54–55.—The waste from the cutting of pressed sugar is ground in a mill, whence the powder goes via an elevator to a rotary sieve, then via a hopper to a weigher. The larger pieces retained by sieve are passed back to the mill via another elevator. The powder is packed in paper bags.

* * *

Factory research in Hawaii. *Rpt. H.S.P.A. Expt. Sta.*, 1963, 34–38.—Plantation sugars from *A*, *B* and *C* strikes were analysed, re-melted and boiled to commerical grain size in a laboratory vacuum pan. The resultant sugars were analysed and found to have significant improvements in colour, filtrability and ash content as a result of the re-crystallization. The lower quality sugars generally exhibited greater improvements than higher quality sugars. The overall effect, however, is lower than is generally considered to result from re-crystallization. High M.W. compounds present as suspensoids were isolated from juice and syrups by high-speed centrifuging and the residual solution after centrifugal solids removal was fractionated by a series of methanol precipitations. Infra-red spectra show that a large part of both the centrifugal- and methanol-precipitated solids consisted of polysaccharides of a similar nature. Syrups from Hawaii contained more of these substances than samples from Oahu. Laboratory studies showed that when a sucrose concentration gradient develops around a growing or dissolving sucrose crystal, a shift in salt concentration may occur. At 30–50°C the salts investigated increased in the region of low sucrose concentration around growing crystals, but the opposite effect occurred around a dissolving crystal. New colour substances isolated from sucrose crystal solutions by cation-exchange paper chomatography were found to contain only carbon, hydrogen and oxygen, so that they are considered more probably thermal degradation products of reducing sugars. An infra-red spectrum of the substances had only two distinguishable peaks corresponding to carboxyl groups. Further fractionation by cellulose column chromatography indicated the presence of two substances similar in composition but of differing M.W. Laboratory experiments in which "Hodag CB-6" surface-active agent (methyl glucoside of coconut oil fatty acids) at 0·03–0·1% on syrup was added in boiling showed that it tends to improve circulation and lower molasses viscosity. It had little effect on syrups normally producing high quality crystal, although caused some improvements with poor quality crystal syrups. An adverse effect on filtrability occurred with 1·0% of the agent. Scum formation on the electric membrane pilot plant for partial demineralization of syrup was due to bacterial contamination. It has been reduced by periodically reversing the polarity of the current with a corresponding interchange of syrup and waste streams. With this procedure and new membranes, the electrical resistance has remained very low and the maximum operating current levels have remained high. Sugars boiled in the laboratory vacuum pan at 78°C gave a crystal colour averaging 10% higher than when boiled at 62°C. Reasons for this are given. The 85% methanol-insoluble material in sugar crystals studied earlier[1] was found to contain dextran, starch, xylan and araban with a predominance of the first two. Fractions of differing M.W. obtained by ultra-filtration were studied. Infra-red spectra of the high M.W. polysaccharides show that these are similar to a glucose polysaccharide α-1,4-glycosidically linked and highly branched by α-1,6 linkages. An Oliver rotary vacuum filter was modified by installing "EimcoBelt" and ancillary equipment for treatment of muds with "Separan AP-30", the belt discharge unit being made of polypropylene fabric. Factors favouring both the modified and the routine procedure are listed. Most of the moisture found in sucrose crystals was shown by nuclear magnetic resonance studies to exist in the "hindered" state. A specially designed cane core sampler which is illustrated was found to be reliable for field distribution use, approximately 75% of the pol theoretically available in field cane as weighed being available in mixed juice. Excellent correlation was found between field cane and mixed juice purities.

* * *

Division of mill technology. J. H. NICKLIN, B. G. ADKINS and A. D. DOOLAN. *Ann. Rpt. Bureau Sugar Expt. Sta.* (Queensland), 1963, 77–89.—Good agreement was found between cane samples taken from trucks in the factory yards and the prepared cane taken by a special cane sampler at Bingera sugar factory, and the sampler received the approval of the Central Sugar Cane Prices Board for the determination of individual fibre contents. Using a bagasse weigher at Pioneer, it was found that evaporation from a milling train causes a higher error than was anticipated in the determination of bagasse weight by mass balance. The fibre ratio method is therefore preferable, being considered sufficiently reliable for estimating bagasse weight for use in a system of cane analysis. Tests showed that up to 80°F superheat has no adverse effect on the coefficient of heat transfer based on saturation temperature. Beyond 80°F, the coefficient drops slowly to about 7·5% reduction at 180°F. The results are valid for 1st evaporator effects. Means of increasing evaporator capacity are discussed.

[1] *I.S.J.*, 1962, **64**, 207.

A simple demister has proved satisfactory in entrainment prevention. A single-tube evaporator has been constructed for studying the effect of various design and operational features on the heat transfer coefficient. Changes at many factories in the power generation and distribution systems are noted. Data are presented for the 1962 season and some for the 1956–1962 seasons, and these are discussed.

* * *

Successful process of treatment of sugar factory effluents developed by the National Sugar Institute. ANON. *Sharkara*, 1962, **5**, 132–134.—A chemical method developed for factory effluent treatment consists in neutralizing with slaked lime to pH 9·0–9·5 and adding a strong alum solution to adjust the pH to 7·0. The resultant flocculation reduces the BOD by 60%, but this is unsatisfactory and the process is both costly and leaves a large amount of foul-smelling soluble matter. A combination of the activated sludge process with the trickling filter technique, the latter being the first stage, reduces the BOD by 85–90%, which gives an effluent satisfying the state requirements. A pilot plant has been set up and results obtained show a BOD_5 of the treated effluent of 150–250 p.p.m. The effluent can be used for irrigation or discharged to rivers, etc.

* * *

Steam cleaning flushes dirt away. A. E. DAYTON. *Sugar News* (Philippines), 1963, **39**, 722–724.—Industrial application of steam cleaners to remove dirt and grime from factory plant are discussed. It is pointed out that the efficiency of a steam cleaning compound is directly related to the temperature at which it is applied and that some compounds which will remove dirt and grime at 100°C in a cold water solution could be used safely for brushing of teeth.

* * *

Bone chars for the decolorization of syrups in the sugar factory. G. MARTINI. *Ind. Alim.*, 1963, (5), 45–49.—A general account is given of bone char: its use in sugar refining, its preparation and composition (both as virgin char and after regeneration), theories of its mode of action, physical characteristics, regeneration and principal analytical measurements made on it.

* * *

Centrifugalling of sugar. I. BAZÁN B. *Bol. Azuc. Mex.*, 1963, (169), 16–20.—The meaning of centrifugal force is explained as is the calculation of the *g* factor of a centrifugal. Molasses in a massecuite is classified in three parts: the excess, which provides fluidity and is easily separated; the inter-crystalline molasses, which requires more force and time; and the film surrounding the crystals, which is hard to separate. The effect of grain size on the relative proportions of these is described, and the factors limiting the size of baskets are discussed, as is the relationship between grain size and sugar wall thickness. The use of a centrifugal in a refinery is discussed and the reasons for use of comparatively low-speed machines are explained, while recommendations are made whereby to achieve best results from a battery of refinery centrifugals. Similar discussions are given of the choice of machine for handling *A*-*B*-massecuites and *C*-massecuite, with corresponding recommendations for optimum performance.

* * *

By cane diffusion we assist the birth of a new technology in sucrose extraction. J. A. LÓPEZ H. *La Ind. Azuc.*, 1963, **69**, 221–226.—The Silver ring cane diffuser is briefly described and the De Smet diffuser for cane illustrated and described in much greater detail, together with an account of its advantages. Finally a brief mention is made of the DdS diffuser in operation in Tanganyika.

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The "Rapifloc" system—Improvements in the filtration of cane muds. L. ACONSKY and J. V. MILES. *Bol. Azuc. Mex.*, 1963, (170), 16–22.—An account is given of the "Rapifloc" system of mud treatment and filtration as applied in a number of cane sugar factories in Panama, Puerto Rico and the U.S.A.[1]

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Cane knives. ANON. *Rev. Agric. Sucr.* (Mauritius), 1963, **42**, 181–185.—The article is, as the introduction states, "an extract from notes issued by prominent British sugar machinery specialists." From investigations over many years, the manufacturers recommend two types of knife blades: the clamp and the four-edge type. These are described with diagrams and information is also given on bearings, shaft, drives, position of the knives, clearance adjustment, direction of rotation, power, hoods, and increase in mill capacity obtainable with knives.

* * *

The story of the Victorias Milling Company. ANON. *Sugar J.* (La.), 1963, **26**, (5), 20–28.—Details are given of the organization of this Philippines sugar factory with information on the equipment and processes used. Factory performance data are also reproduced.

* * *

Studies in ion-exchange phenomena and their application to (the) Indian sugar industry. P. C. NIGAM. *Agra Univ. J. Res.* (*Sci.*), 1962, **11**, (1), 259–262 (abstract of Ph.D. thesis, 1960); through *S.I.A.*, 1963, **25**, Abs. 835.—Laboratory and pilot-plant tests with the resins "Duolite C-25", "Amberlite IR-120", "Zeokarb 215" and "Zeokarb 225" (strongly acidic), "Zeokarb 226", "Amberlite IRC-50" (weakly acidic), "Amberlite IR-410", "Deacidite FF", "Duolite A-101" (strongly basic), "Duolite A-7", "Amberlite IR-45", "Deacidite E" (weakly basic) and "Duolite A-30" (basic) are described. A pilot plant was constructed for clarified cane juice demineralization and sugar boiling, using a mixed bed of "Duolite C-25" and "Duolite A-7". This recovered 10% more

[1] *Cf. I.S.J.*, 1963, **65**, 270.

sugar than the conventional process, and produced only one-third as much molasses, the latter being edible.

* * *

An evaluation of continuous centrifugals for *C*-massecuite. J. G. DAVIES. *Sugar J.* (La.), 1963, **26,** (5), 32–35, 44.—The performance of two types of continuous centrifugals, the mechanical features of which are not discussed, in the purging of *C*-massecuite was investigated. The data were compared on the basis of the so-called "cyclone purity", i.e. the purity of mother liquor a sample of which was obtained by induced drainage in a vacuum filter. The nearer the purity of the run-off approaches the "cyclone purity" the closer will the run-off conform to an "attainable" purity. The centrifugals were used as fore- and after-workers. The test data showed that continuous centrifugals may be readily used for single- or double-purging of *C*-massecuites.

* * *

Methods of boiling cane raw sugar. V. E. BAIKOW. *Sugar J.* (La.), 1963, **26,** (5), 36–39.—A general survey is given of various two-and three-boiling systems and some comparative data from one factory are presented showing that despite a lower purity syrup, less molasses was produced with a 3-boiling system than when a 2-boiling system was used. A 2-boiling system is considered inexpedient when the massecuite apparent purity is greater than 80. Details are given of a 3-boiling scheme developed by the author in which syrup or *A*-molasses of not less than 68 purity is seeded with fondant sugar and boiled to a footing of 88°Bx. Two-thirds of this is cut to a storage crystallizer for later use and the remaining one-third used as footing for the *C*-massecuite which is boiled on *B*-molasses. The *C*-sugar is cured and mingled with hot clarified juice or water to produce a magma which is used as footing for the *A*-massecuite, boiled on syrup, again cutting two-thirds of the full pan to a storage crystallizer for later treatment (in making *A*- or *B*-strikes) and building up the remaining third to a full pan. This may then be cut, half going to a further storage crystallizer and the remainder built up to a full pan, or may be brought together and purged as an *A*-strike, if the grain size is adequate. The *B*-massecuite uses either the built-up *C*-magma or material from the subsequent storage crystallizer as a footing which is built up on *A*-molasses to give the *B*-strike. Excess *C*-sugar magma is melted and used as *A*-strike feed.

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Control of cane sugar wastes in Puerto Rico. R. M. GUZMÁN. *Sugar y Azúcar*, 1963, **58,** (11), 62–64. The sources of pollution in sugar factory waste waters discharged into the Loíza River, Puerto Rico's largest river, have been investigated. The cooling and condenser waters were found to have a high BOD load as a result of evaporator and pan entrainment. The BOD was reduced by installing suitable separators. Chemical treatment of effluent is considered uneconomical. Microbial decomposition has been applied in a number of lagoons and a satisfactory reduction in the pollution has been obtained, with no foul odour. The lagoons hold the waste waters for the entire crop and can be discharged throughout the year at a rate controlled to maintain the level of dissolved oxygen in the receiving river at a satisfactory value.

* * *

Colour adsorption of sugar cane liquors. G. C. OLIVO and E. J. MORALES. *Sugar y Azúcar*, 1963, **58,** (11), 68–71.—Details are given of the Graver "Contraflux" decolorizing system at Western Sugar Refining Co., Mayagüez, Puerto Rico, where sugar liquor rises through a tower of Pittsburgh granular carbon (CAL) and freshly regenerated carbon is injected into the top of the tower to replace exhausted carbon withdrawn from the bottom. The exhausted carbon is sweetened-off in a column, recovering sweetwater of down to 1°Bx. A Nichols scheme with a Herreshoff kiln is used for carbon regeneration. Operating data are presented but are considered unrepresentative since the system operated for only 10 days during which time there were several shut-downs. The average colour removal shown was 69%, at a total throughput of 817,219 gal of 54·3°Bx on average.

* * *

Some notes on low grade boiling. J. C. CHOU. *Taiwan Sugar Quarterly*, 1963, **10,** (3), 9–13.—At Nanchow sugar factory, the overall apparent purity drop from final massecuite to molasses has been increased by 0·59 units to 27·18 by seeding molasses of 68–70 purity with a fondant mixture and building up the grain which is used as footing for 2 or 3 separate final massecuite strikes having a crystal size of 0·3 mm. The massecuite, of 98·5–99·5°Bx and 32–36% crystal content, is cooled from 70 to 40°C in the crystallizers and reheated to 50°C in the mixer before purging.

* * *

Operation of (a) gyratory screen. C. A. LEE and H. M. LIAW. *Taiwan Sugar Quarterly*, 1963, **10,** (3), 14–19.—The method of CULP[1] for evaluating screen efficiency whereby results are converted to "mesh of mean sieve" is explained mathematically. The results obtained for fine granulated sugar screened on gyratory sieves at Pingtung factory are discussed.

* * *

Introduction of a new clarification process. S. I. WANG. *Taiwan Sugar Quarterly*, 1963, **10,** (3), 20–22.—The so-called "defe-carbonatation" process described consists in heating the raw juice to 75–80°C and preliming to pH 7·2–7·8. The juice remains 40–60 min in the 1st carbonatation vessel, during which time the muds settle out. The supernatant juice is drawn off, screened to remove bagacillo, and passed to the 1st filtered juice tank. The muddy juice remaining in the tank is limed, gassed with CO_2 as

[1] *I.S.J.*, 1962, **64,** 181.

usual and filtered, the filtrate being mixed with the 1st filtered juice. This is then again carbonatated by the conventional method, syrup filtration being omitted. While sugar quality differed little from the conventional process, approximately 25% reduction in clarifying agents and 8% in fuel was obtained.

* * *

Comparison between various absorption systems according to their efficiency. J. M. DE LA PEZA. *Bol. Azuc. Mex.*, 1963, (171), 24–29.—The use of activated carbon is discussed both in fixed columns, using co- and counter-current absorption or a mixture of these, and also in fluid and expanded beds. Reactivation of adsorbents is referred to, the Nichols-Herreshoff type of kiln being discussed. Use of carbon in powder and granular forms is briefly compared.

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Techniques of sugar bulk transport. K. DOERING and E. ŚWIDER. *Gaz. Cukr.*, 1963, **71**, 271–275.—The various types of road tankers available for sugar, including a number of British types, are discussed as are systems of sugar loading and unloading. The article, written from the Polish viewpoint, considers the various factors involved in the choice of system, including, of course, the costs.

* * *

Production and packaging of cube sugar with a modern cube sugar plant. C. C. STELZIG. *Zucker*, 1963, **16**, 659–661.—Details and illustrations are given of the Chambon packaging plant installed in the Rain-am-Lech factory of Süddeutsche Zucker A.G. The plant has a capacity of 2 tons/hr of sugar in 1-kg packets or 1·8 tons/hr in ½-kg packets.

* * *

Does a clarified juice preheater reduce the cost of the evaporator? C. G. M. PERK. *S. African Sugar J.*, 1963, **47**, 765–771.—The heat balances and costs of a first vessel evaporating 50,000 lb/hr of water and receiving the feed un-preheated are compared with those of a preheater plus a smaller first vessel with the same evaporation capacity. The calculations show that the bigger vessel will cost less than the smaller one preceded by a heater of adequate size. It is also shown that if it became necessary to bleed more vapour from the first vessel, a juice heater of adequate capacity installed ahead of the vessel would "free", in the first vessel, about twice the heating surface of the preheater.

* * *

Capacity, efficiency and overall performance of cane milling plant. R. SUBRAHMANIAM. *Indian Sugar*, 1963, **13**, 311–313.—The formula for calculation of lost juice % fibre based on an imbibition of 200% on fibre[1] is modified to correspond to conditions in Indian sugar factories, i.e. imbibition of 100 and 150% fibre. Comparison of mill performance data shows that doubling the number of rollers in a tandem (from 9 to 18) will lead to a capacity increase of only 29%, whereas maintaining the same number but increasing their size from 24 × 48 in to 30 × 60 in will result in an increase of up to 50% in capacity.

* * *

Our trial of raw sugar manufacture in India—a critical review. K. G. HATHI and T. T. OOMMEN. *Indian Sugar*, 1963, **13**, 315–318.—The author criticizes the specification laid down by the Export Agency Division for export raw sugar. While a pol of 96·5 is specified, the maximum permissible limits of reducing sugar content and ash content are respectively 0·7% and 0·4%; these figures correspond, however, to a pol of 97·0–97·5 and reduction in the pol below these values increases the reducing sugar and ash contents beyond the upper specified limit. Among suggested modifications to the specifications are a pol of 96·5–98·0 and a moisture content corresponding to a safety factor no greater than 0·3. Caking of raw sugar is considered a normal phenomenon and carries with it no risks of sugar deterioration. Also criticized is the lack of price incentive to the sugar manufacturers.

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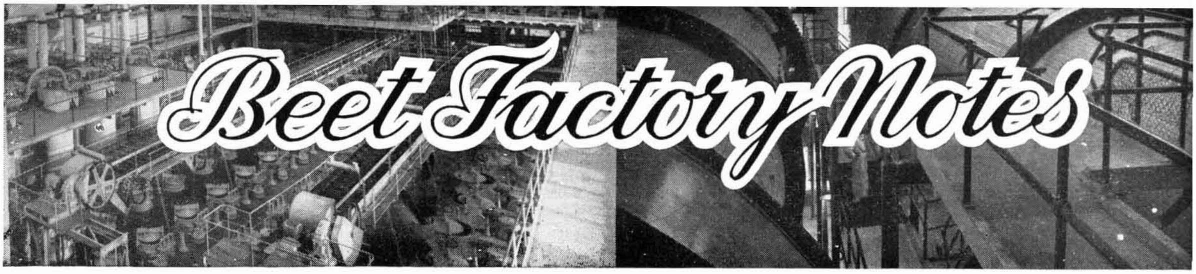
Application of synthetic resin for decolorization of refinery melter liquor. S. GAWRYCH and I. OGLAZA. *Prace Inst. Lab. Badawczych Przemyslu Spozywczego*, 1962, **12**, (3), 1–27; through *S.I.A.*, 1963, **25**, Abs. 917.—The resin decolorization station at Witaszyce refinery, its performance in the 1960/61 compaign, and the technical characteristics of "Asmit 259" (Imacti) decolorizing resin are reported in detail. The liquor was passed at 65°Bx and 80°C through two columns in series, each containing 1 cu.m. of wet resin in the Cl^- form. Two similar columns were in reserve. The liquor cycle was 24–40 hr (compared with a regeneration time of 10 hr) at a mean flow rate of 2·3 cu.m./hr. The liquor colour was reduced from 15–30° St. to 1·5–10°St. The decolorization capacity of new resin was 7·8 gF (= gram Fusc, a reduction of 1°St in 100 litres of solution) per litre of resin, and decreased to 50% of this value after five weeks; the capacity was increased to 60% by more intensive washing. Sugar losses in regeneration were 22·6 kg/cycle. Undetermined losses were small and the pH drop in treated liquor was 0·13 units. A mean decrease in conductimetric ash content of 0·05% (from an initial value of 0·59%) was obtained. Two-thirds of the ash and colour removal took place in the first column and one-third in the second. The moist and air-dry resins swelled in water to 168% and 227% of the original volume respectively. The specific gravity of the saturated resin in water and 56°Bx liquor is respectively 1·121 and 1·338 at 20°C. The following measures are recommended: affination of second and third product sugars; introduction of new resin at the bottom of the second column; and storage of unused resin in the moist state at low temperature, to avoid loss of capacity.

[1] Handbook of Cane Sugar Engineering. E. HUGOT. (Elsevier Publishing Co., Amsterdam.) 1960. p. 248.



The history of Mezohegyes sugar factory. A. SIPITZKY. *Cukoripar*, 1963, **16**, 243–245, 275–278.—The factory was set up in 1889 and its history is retold with information on the modifications that have been made and the equipment that has been installed.

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Experience in carrying out repairs at factories in the Cherkassy sugar trust. A. P. PARKHOD'KO. *Sakhar. Prom.*, 1963, (11), 14–17.—The repair and maintenance of sugar factory equipment is discussed in the light of Soviet practices, particularly in the Cherkassy (Ukraine) group of factories. While machinery has become more complex and the campaigns become longer, the number of days lost through shut-downs has been cut.

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Experimental study of the rate of cooling of beet roots. V. Z. ZHADAN and M. Z. KHELEMSKII. *Sakhar. Prom.*, 1963, (11), 21–24.—Values of τ, the length of time (hr) taken to reduce the temperature of a given root to a given value as determined by wind tunnel experiments, differed by less than 15% from values calculated using an empirical formula. The most significant factor affecting the cooling time was the final difference in temperature between the air and the centre of the beet, a decrease in this difference from 0·5 to 0·25°C causing a 24% increase in the period. As it was impossible to establish equilibrium between the air and beet temperatures, the cooling process was assumed complete when the temperature in the beet was 0·5–0·7°C higher than that of the air. The beet diameter, air flow rate and beet moisture loss were also significant, whereas changes in the beet dry solids content and the initial temperature of the root had little effect. A slightly simpler empirical formula is presented for calculation of τ.

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Equation for calculating the crystallization period in vacuum pans. I. S. SKRIPKO and V. D. POPOV. *Sakhar. Prom.*, 1963, (11), 24–28.—The time taken to boil a massecuite from graining to dropping of the strike (τ) is given by

$$Kr = Kr_m \left[1 - e^{-\left(\frac{\tau}{\theta}\right)^n}\right]$$

where Kr = crystal content by weight % massecuite after a given time; Kr_m = the theoretically maximum possible crystal content % weight of massecuite; e = base of natural log; n = an angular coefficient which is a function of massecuite purity (reducing with increase in the non-sugars content and having a value of 1 for pure sucrose); and θ = a time constant, given by $\frac{W_\theta r}{q_{av}}$ sec, where W_θ = specific quantity (by weight) of water evaporated in a given time from 1 sq.m. of heating surface, r = heat of evaporation (joules/kg) and q_{av} = average specific heat flow when $\tau = \theta$ (joules/sq.m./sec). τ may be calculated by substituting known values and a required value of Kr. Satisfactory agreement has been obtained between calculated and determined values. A worked example is given.

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Study of metal abrasion by massecuite. N. A. SOLOGUB. *Sakhar. Prom.*, 1963, (11), 29–30.—Investigations of wear of bushes and bearings in crystallizers showed that sugar crystals in the massecuite have an abrasive effect on sliding metal surfaces. The magnitude of the effect depends on the thickness of the layer of intercrystalline liquid between the metal surfaces which in turn is determined by pressure. At low pressures and low hardnesses of the abrasive substances, wear is largely a matter of corrosion, while at high pressure the effect is a mechanical one. The tests were carried out with various types and grades of Soviet metals and comparative durabilities are noted.

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Rational means of regulating hydraulic beet feed to a sugar factory. M. I. KULIK and A. A. ROKITSKII. *Sakhar. Prom.*, 1963, (11), 31–35.—A number of recommendations are made concerning beet fluming. These include installing stabilizing screens in the main flume to prevent water and beet spillage, a buffer beet store at the start of the main flume (fed directly from the clamps), slide gates in the main flume, and a storage tank for the extra water needed to clean a flume at changeover to another flume. The various capacities and optimum siting points can be calculated with equations that are presented and a simple flow diagram is given.

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Pre-liming in raw juice measuring tanks. W. PERETA. *Gaz. Cukr.*, 1963, **71**, 224–225.—The device described for pre-liming in raw juice tanks consists of a vertical rotating axis to which are fixed horizontal paddles and a tray from which are suspended a number of tubes of varying lengths, none reaching to the bottom of the tank. Raw juice is fed to the top of the tank and is mixed with limed juice fed from the tray through the vertical branch tubes.

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Air conditioning of sugar stores. R. TESI. *Ind. Sacc. Ital.*, 1963, **56**, 153–166.—Theoretical considerations are presented on the equilibrium between water and air and a graph is constructed of water content in air *vs.* temperature at relative humidities of 5% and

10–100% R.H. in steps of 10% R.H. The general scheme of operating an apparatus for air conditioning a sugar store is described.

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Automatic regulation of milk-of-lime density. O. BÖHM and S. BOUČEK. *Listy Cukr.*, 1963, **79**, 252–256. Details are given of a scheme for automatic control of milk-of-lime density (± 1·0°Bé) with continuous lime and sweet-water feeding to a slaking tank. The pneumatically-operated system includes differential pressure controls and measuring probes. A diagram is given.

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Winter protection of piled sugar beet roots. S. T. DEXTER, M. G. FRAKES and D. L. SUNDERLAND. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 455–461. Tests were conducted on beet piling during winter months in Michigan and Ohio. In one case, covering a pile of truncated pyramid shape with plastic sheeting maintained the beet at a fairly uniform "body" temperature, whereas an uncovered pile varied widely in temperature. A pile covered with straw was intermediate in body temperature and was readily affected by air temperature. The effectiveness of the plastic was considerably reduced when it did not reach the base of the pile. The plastic-covered beet did not freeze to the same extent as uncovered ones, and alternate freezing and thawing was similarly reduced. Plastic-covered beet in a similar test were analysed for sugar and shown to contain an extra 8 lb of recoverable sugar per ton. While the temperatures during the 47 days of the second test were not as low as generally in the first, the main observable difference between the beet was in the degree of wilting at the edges of the pile. Water collecting in pockets in the plastic sheeting should be prevented. Moulding was a minor problem, but had the temperature been higher ventilation might have been advisable.

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Experiments in vacuum pan control. J. G. ZIEGLER. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 462–467. White sugar yield per strike may be increased by boiling grain of more uniform size and with a minimum of conglomerates by means of full seeding rather than by shock seeding. Strikes of 60% yield with such grain purge better and require less wash liquor than poor strikes with yields below 40%. Pan boiling studies using pan microscopes disproved the existence of a supersaturation zone in which crystals form spontaneously only in the presence of other grain. Above a definite supersaturation (about 1·50) grain would form in syrup or at any stage of the strike, while maximum growth rate occurs at just below this upper limit. It was found that fine grain formed during a strike will not be washed out by a large drink of feed, but will dissolve in undersaturated liquor; the fine grain conglomerates, in fact, give the impression in the sight glasses of a clean strike. Since conventional supersaturation measuring methods proved inadequate, the temperature of the surface (which is the most highly supersaturated region) was measured and the absolute pressure controlled precisely to give a reliable supersaturation reading. At any given absolute pressure, the temperature corresponding to the supersaturation limit can be determined approximately from a chart based on the data of BROWN & NEES[1], or the precise value determined directly by gradually raising the pan temperature until the appearance of new grain shows that the limit has been exceeded, or by introducing some powdered sugar into the graining charge while it is being concentrated and noting the temperature at which crystals first show corners. It was found that the pan boiling time could be shortened by 10–20% by bringing the pan together as soon as possible and maintaining an optimum tightness during the feeding period, the tight strike being "looser" than a loose strike because of the resulting lower syrup concentration and hence viscosity. Factors contributing to conglomeration were studied. It appeared that the only cure was vigorous circulation during the conglomeration period; mechanical circulation needed to be supplemented by boiling. Without mechanical circulation, rapid boiling may help but the conglomeration period occurs when the crystal area is too small to absorb the sugar liberated by the boiling. Therefore, steam flow should be reduced and water fed to prevent a rise in supersaturation beyond the upper limit[2]. The water feed can be reduced as the crystal area increases. The Taylor semi-automatic pan control system devised on the basis of the above findings is described with details of the boiling process.

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Instrument maintenance on the sugar factory. H. L. MEMMOTT and P. GAUGH. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 468–471.—Hints are given on correct instrument maintenance, including the provision of clean air supply, thorough cleaning, checking and calibrating, and actuating motor and valve overhaul. The effect of chattering on valve wear is discussed and particular mention is made of butterfly valve inspection and alignment.

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Cost reduction through instrumentation improvement in steam balance, fuel savings and other material savings. H. C. DYER. *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 471–475.—A survey is made of the instrumentation of an evaporator, including vapour pressure controllers, absolute pressure controllers, density controllers, level measuring and regulating instruments and exhaust steam pressure controllers. The boiler controls discussed include those for steam pressure, fuel feed rate, fuel-air ratio, and draught. Also mentioned briefly are the controls at the various stations of the beet end.

[1] *Ind. Eng. Chem.*, 1933, **25**, 555–558; *I.S.J.*, 1933, **35**, 442.
[2] *Cf.* GENIE: *I.S.J.*, 1962, **64**, 232, 260, 298.

Werbkowice sugar factory. Z. KUNCEWICZ. *Gaz. Cukr.*, 1963, **71**, 241–246.—Details are given of this 3000-ton/day Polish beet sugar factory which is the first new one to be built for 30 years. The equipment includes two DdS diffusers (each with a capacity of 1700 tons of beet/day), Dorr-Oliver clarifiers, Abraham plate-and-frame filters (for 2nd carbonatation juice), Szarejko filters, a Robert quadruple-effect evaporator, Werkspoor crystallizers, Hesser automatic packaging plant, West German silos and a British pulp briquetting unit. Campaign output is planned at 45,000 tons of white sugar.

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Automation in the sugar industry. H. SCHINK. *Zucker*, 1963, **16**, 609–614.—The development of conventional control techniques in process engineering is discussed with reference to the efficiencies obtained and the economics. Automatic control of a pulp drying plant is used as an example in which the difference in CO_2 content of the waste gas entering and leaving the dryer is related to the moisture content of the pulp. A volume control for the incoming pulp controls the discharge screw and is fed with signals from the waste gas CO_2 control which also governs the waste gas temperature. A diagram of the proposed scheme is presented. The article closes with a section on computers, particularly simple analogue computers and a computer system for steam generator efficiency is described by way of example.

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Biological treatment of sugar factory waste water. H. SCHULZE-FALKENHAIN. *Zucker*, 1963, **16**, 615–617. A survey is presented of sugar factory waste water treatment, including both aerobic and anaerobic processes. The former comprises natural processes (discharge to streams, rivers, sea), semi-technical processes (sewage lagoons and land) and fully technical processes (trickling filter and activated sludge processes). The effects obtained with these processes are discussed with references to the literature.

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Notes on feed water for steam boilers. W. PERETA. *Gaz. Cukr.*, 1963, **71**, 268–271.—In the absence of water-softening plant, scale formation caused by hard water can be prevented by adding sodium carbonate for boilers of up to 15 atm pressure or sodium phosphate for higher pressures. Corrosion caused by CO_2 can be combated by maintaining the feed water at as high an alkalinity as possible without the occurrence of "spitting" in the boiler. Prevention of sludge formation is also discussed. Determining the density of the water in the boiler will enable steps to be taken to prevent this exceeding an upper limit, causing excessive scaling and heat losses.

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Liquor filtration with Funda filters. J. MANINA. *Zeitsch. Zuckerind.*, 1963, **16**, 622–628.—The theory of filtration is discussed with mention of the various types used and the requirements of a good filter-aid are listed. The characteristics of kieselguhr and perlite are compared. The Funda filter is described and details are given of its operating characteristics[1]. The phases in a cycle of remelt liquor treatment are described with the aid of diagrams also showing the auxiliary equipment, and an efficiency curve is presented for a remelt of 99 purity and 65°Bx showing viscosity *vs.* Brix. Throughput and pressure during 50 hours' running time are also depicted graphically. The advantages of the filter are discussed and various hints on its use are given.

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Practical experiences in the formation and prevention of low temperature corrosion in steam boiler plants. K. KÖHLER. *Zucker*, 1963, **16**, 650–659.—In oil-fired plants, low temperature corrosion caused by the formation of sulphuric acid can be prevented if the air supply is reduced almost to the proportions of a stoichiometric mixture, which considerably reduces the oxidation of SO_2 to SO_3. In addition, soot and coke dust in the flue gases can adsorb sulphuric acid and remove part of the acid from the gas phase. In coal-fired furnaces the ash plays an important rôle on account of its adsorption and neutralizing effects. Heating gas can be de-sulphured by adding basic oxides or carbonates. The relationship between acid dew point and the sulphur content of fuel is explained, and a dew point measuring device is described. Pulverised coal furnaces permit fuels of high sulphur content to be burnt without danger of low temperature corrosion. One exception to this (two identical boilers in a power station) has been studied and is discussed; no corrosion difficulties will arise with proper operation. Oxidation of SO_2 cannot be prevented in travelling grate furnaces when no additive is used. The combined burning of coal and blast furnace gas or coal and oil helps to reduce corrosion.

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Relationships between the residual calcium content and alkalinity under various working conditions and with different beet. W. KRÜGER. *Zucker*, 1963, **16**, 669–673.—The determination of residual lime content in carbonatation juice is discussed as are tests in this connexion conducted over 10 years to determine the optimum pH at carbonatation. It was found that in defecation the residual lime content decreased with increase in the amount of lime added as a result of the powerful adsorption capacity of $CaCO_3$. A difference between the theoretical natural residual alkalinity and the lower effective alkalinity was not affected by the amount of lime added. Thus by maintaining higher alkalinity and pH values in 1st carbonatation, the residual lime content was reduced while the effective, theoretical natural residual and optimum alkalinities rose. The differences were reduced to negligible values by slight adjustments to the alkalinity and pH. The same reducing residual lime content was found in 2nd carbonatation with

[1] *Cf. I.S.J.*, 1963, **65**, 173–178.

increase in the lime content. The alkalinities were some 10% higher with phosphoric acid addition than with CO_2, while the residual lime content was much lower (0·5 mg CaO/100 g juice) with phosphoric acid than with CO_2 (3·0 mg/100 g). The values of the various factors above varied from year to year as well as within the year. While the effective alkalinity[1] is a better guide to changes in the residual lime content than is the optimum alkalinity, effective alkalinity cannot be used for controlling the residual lime content, whereas the optimum alkalinity must always be known. However, effective alkalinity values are important in that examination of the 1st carbonatation juice will enable a forecast of the residual lime content of the 2nd carbonatation juice to be made without need for recourse to time-consuming de-liming.

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Waste waters from regeneration of ion exchange units. H. P. HOFFMANN-WALBECK. *Zucker*, 1963, **16**, 673–678.—The volume, $KMnO_4$ consumption and BOD_5 of waste water resulting from regeneration of a thin juice de-liming unit and an ion exchange unit used for the Quentin process (exchange of K and Na for Mg) were determined and the results expressed in graph form. The absolute values were greater with the Quentin process, the regeneration waste water from which had a higher pollution load per ton of beet than the other unit. Suggested treatment of the waste waters, which should not be discharged direct to a stream, includes mixing with the other factory waste water. This water is relatively nitrogen-poor, whereas the regeneration waste water is rich in nitrogen, so that it will help to accelerate biodegradation of the waste. Applying the regeneration waste water to land can help the growth of pasturage.

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Installations for removing adhering impurities from beet according to Soviet processes. M. GRIMBERG. *Zucker*, 1963, **16**, 678–680.—The designs of two Soviet beet cleaners are described. One (USSR Patent 117,549) consists of a cylindrical trap located below the flume and divided into two chambers, one above the other. Each chamber is provided with a conical hinged valve which can be opened and closed independent of each other and enable the dirt to be removed from the trap. The heavier particles fall through a hole in the flume into the trap, while the lighter ones settle onto a vibratory plate situated in the bottom of the flume and sloping towards the trap. The second apparatus (USSR Patent 118,006) is considered more efficient and consists of a chain conveyor part of which is placed horizontally on the floor of the flume and part slopes upwards out of the flume. The conveyor moves against the direction of the water. Where the beet enter the unit there is a grating for sand and gravel removal. Another chain conveyor slopes away from the grating with the flow of beet. Below this conveyor is a hollow shell which serves as support for the conveyor and through which drop the lighter impurities onto the other chain conveyor below. The heavier impurities and beet are carried to the end of the smaller chain conveyor and fall into the flume, using the hollow shell surface as a guide plate, the impurities continuing their downward passage to the larger chain conveyor. The hollow shell also contains a nozzle which sprays water to help remove the impurities and its lower surface has spring-mounted rake arms for trapping light impurities which are then removed by the bars on the larger chain conveyor.

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Corrosion of feed pumps in boiler units. H. ANDERS. *Zucker*, 1963, **16**, 680–682.—Corrosion of pumps has been observed at pH values of 7 and below and at water temperatures of 40–180°C independent of the amount of sulphite added to the feed water. Copper will cause corrosion only when it is present in ionic form in the water but not when present as complex compounds. At pH 7 and below the water should be treated with sodium bicarbonate, the quantities depending on the steam quality and requirements as regards boiler washing. At higher pH values (9·0–9·5) ammonium sulphate added to regulate the pH can also cause corrosion since any excess will be hydrolysed and sulphuric acid will form. Mechanical erosion (cavitation) of pumps is also discussed.

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A new method of demineralization of sugar juices. R. TESI. *Ind. Sacc. Ital.*, 1963, **56**, 217–223.—Demineralized juice which has no buffering power is subject to three harmful effects during evaporation: irreversible colour formation, sucrose destruction and corrosion of the evaporator tubes. In order to avoid this, a new system has been devised. Thin juice is delimed and sent to the evaporators, half of the middle juice (of 40°Bx) being withdrawn, cooled and demineralized. The remaining middle juice is treated by a 3-boiling process, the 1st, 2nd and double-cured low-grade products being added to the withdrawn middle juice, melted, decolorized and filtered and boiled to a refined sugar, the run-off from which is returned to the 1st product boiling.

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Mechanism of aggregation of $CaCO_3$ particles in sucrose solution by a synthetic polyelectrolyte. R. KOHN and P. MOJŽÍŠ. *Listy Cukr.*, 1963, **79**, 279–287. The effect of sodium polymethacrylate on the formation of $CaCO_3$ aggregates was studied. It was found that the ξ-potential of the particles affects aggregation only to a negligible extent because of the hydrophilic nature of their surfaces. In solutions containing Ca^{++} ions the polyelectrolyte has practically no effect on the positive ξ-potential as a result of the formation of Ca polymethacrylate, which is only slightly dissociated. Aggregation is largely a result of the formation of a bridge between the particles and the polyelectrolyte particles. Adsorption of the polyelectrolyte is not caused exclusively by the electro-

[1] BRIEGHEL-MÜLLER & BRÜNICHE-OLSEN: *I.S.J.*, 1954, **56**, 112.

static forces of attraction between $CaCO_3$ particles and the polyelectrolyte molecules, even where these forces increase the aggregating effect of the polyelectrolytes. In the presence of Ca^{++} ions coagulation of the polymeric chain of polyelectrolyte macromolecules is caused by a reduction in the electrostatic forces along the macromolecules. In this case, aggregation of the $CaCO_3$ particles is possible only when the polyelectrolyte solution is rapidly and completely mixed with the suspension in such a way as to permit formation of bonds between polyelectrolyte and $CaCO_3$ before the polymeric chains are broken, as otherwise the electrolyte completely loses its aggregating effect. Graphs of flow of the suspension show that the particles are bound in the aggregates only very weakly. Since intensive mechanical interference would cause irreversible destruction of aggregate structure, the method of mixing the polyelectrolyte with suspension is one of the basic factors determining its efficiency.

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Prospects of reducing material usage in the construction of sugar factory machinery. M. ŠKRÁBAL. *Listy Cukr.*, 1963, **79**, 287–290.—Information is given on latest developments in sugar machinery, particularly from the point of view of material usage and weight of the machinery.

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Scales speed sugar beet handling. ANON. *Sugar News* (Philippines), 1963, **39**, 566.—Information is given on the weighing system of Toledo-Copaba S.A., of Belgium, which has been installed at nine beet factories. The gross weight of the beet on a lorry is given by the difference between the weights given by one scale for the loaded lorry and another for the empty lorry. A "Rupro" device withdraws a 40 kg sample from the lorry and transfers it to the tare house, depositing the sample in a hopper scale whence the sample passes through a washing drum. After six revolutions the clean sample drains on a low-speed mesh or plate conveyor and is transferred to a heater to eliminate surface moisture. After passing to a second hopper scale, the beet passes by bucket elevator to a vibratory feeder which slowly dumps the sample in a rasping machine. A very small amount of the raspings is used for pol determination, the weight of the sample determining how much basic lead subacetate solution is poured into the container from a stainless steel tank above the special fan scales. All stages are interlocked so that if any stage fails, all the preceding steps are automatically stopped.

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Characteristics of sugar house technology with particular reference to material flow. A. BRIEGHEL-MÜLLER. *Zeitsch. Zuckerind.*, 1963, **88**, 613–622, 679–684. The concept of sugar house technology and of molasses is discussed and boiling schemes are described in which the dry solids content of a standard molasses is used as basis for comparison. The principles of each scheme are represented by a novel graph system, which facilitates discussion of the boiling schemes and permits easy comparison of the materials balances. The schemes include those for raw sugar, white sugar and refined sugar. It is shown that a compound scheme (the so-called CP method), in which excess sugar is removed from a low-grade massecuite by curing and the mother liquor and run-off mixed with another low-grade massecuite, has many advantages over other schemes in that it improves molasses exhaustion and provides a higher quality sugar.

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Filtration of juices using battery hydrocyclones. F. N. DOBRONRAVOV. *Sakhar. Prom.*, 1963, (12), 14–17. A GB-3 Soviet-made battery hydrocyclone, which consists of 48 plastic 20-mm dia. multicyclones, was used to filter 1st and 2nd carbonatation juice. With 1st carbonatation juice from deteriorated beet, the maximum purification efficiency was 95·5% at a feed pressure of 8 atm, the yields of clear juice and muddy suspension being respectively 90·89% and 9·11% on initial juice. The mud content of the juice was reduced from 21·46 g/litre to 1·35 g/litre. Increasing the pressure to 9–10 atm reduced the efficiency. At pressures up to 2 atm a lower quantity of colloidal matter passed into the treated juice so that the juice was clearer than at higher pressures. At a constant pressure of 5 atm the average purification efficiency with 2nd carbonatation juice was 69·34%. Automatic feed control is advised in order to maintain optimum pressure at a given feed juice quality. Since scale forms in the hydrocyclones after 5–6 days, they should be made easily dismantlable to clean all parts and treatment with HCl should be made possible. "Plexiglass" ("Perspex", polymethyl methacrylate) used for the walls of the juice compartment becomes deformed under the action of heat and should be reinforced.

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Flume-wash water settling tank with mechanized mud removal. A. V. POKANEVICH. *Sakhar. Prom.*, 1963, (12), 17–20.—The mud and foam are removed from rectangular settling tanks by a gantry that travels the length of the tank on rails at 2 cm/sec and which is provided with two scrapers, one for the surface and the other for the tank floor. These can be raised or lowered as required. The mud is pushed into a hopper and the foam is discharged to a gutter.

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Improving the performance of automatic controls for a carbonatation station. A. A. ZHIRNOV and V. V. SAFRONOV. *Sakhar. Prom.*, 1963, (12), 23–25.—A number of design defects in a "Sakhavtomat" control unit are noted. The unit is designed for automatic lime proportioning, level and pH control in 1st and 2nd carbonatation vessels and saturation gas pressure control in the collecting tank.

NEW BOOKS AND BULLETINS

The World Sugar Economy—Structure and Policies. Vol. II. The World Picture. E. F. TACKE, A. S. STEPANOV, L. ALI and M. G. W. HALLMANS. 351 pp.; 8 × 10½ in. (International Sugar Council, Haymarket House, Haymarket, London S.W.1.) 1963. Price: 42s 0d.

This companion book to Vol. I[1] is divided into four parts, the first three of which are presentations of the world picture in respect of production, consumption and trade. Each part is sub-divided into chapters showing the development and regional distribution, the major factors involved and, where appropriate, the outlook. Thus is provided, by description and statistics, a detailed historical picture of the development of the industry. It also provides a very great amount of background information which will be of considerable value in a study of the commodity. For detailed figures, Part IV will be invaluable, since it includes a total of 39 tables on production, consumption, trade, stocks and prices, on country, regional and world bases, including figures available up to mid-1963 and in some cases even more recent. The compilers are to be congratulated on assembling a fitting companion to the earlier volume, and one which will undoubtedly be sought after in the same way.

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Nomographs. (B. W. Dyer & Co., 120 Wall St., New York, N.Y. 10005, U.S.A.) 1964.

Two nomographs, obtainable from B. W. Dyer & Co., have been prepared by them for calculating the amount of sugar or water, respectively, needed to increase or decrease the Brix of liquid sugars. The nomographs are used by connecting the initial Brix on one scale with the required final Brix on a second scale and extending the line to a third scale. The point on this third scale is joined to the point on a fourth scale, which is also calibrated in initial Brix values. The line so formed cuts across a fifth scale at the point corresponding to the amount of sugar or water to be added to one gal of the original liquid sugar, and this is then read off.

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WISCO in Jamaica. 26 pp.; 8 × 10 in. (The West Indies Sugar Co. Ltd., Bucklersbury House, Walbrook, London E.C.4.) 1964.

This booklet is a companion volume to the similar "Caroni Ltd.. in Trinidad", both companies being members of the Tate & Lyle Group. It has been issued to mark the first 25 years of WISCO's operation in Jamaica and describes briefly the post-Columbus history of the island. There follows an account of the Monymusk and Frome estates with a table and graph of annual sugar production from 1938 to 1963. The 1938 riots at Frome are briefly described and the resultant formation of the Jamaican Trades Union movement. Collective bargaining, profit sharing, water conservation and other activities of the Company are described and its rôle in the future of independent Jamaica is assessed.

A brief account is given of the growing of sugar cane and its processing, illustrated by a selection of colour photographs taken at Frome and Monymusk. An attached folded insert provides a map of the island showing the parishes, towns, rivers, railways, roads, etc.

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Advances in Carbohydrate Chemistry. Vol. 18. M. L. WOLFROM and R. S. TIPSON. 456 pp.; 6 × 9 in. (Academic Press Inc., 111 Fifth Ave., New York 3, N.Y., U.S.A.; Academic Press Inc. (London) Ltd., Berkeley Square House, Berkeley Square, London W.1.) 1964. Price: $16.50; 118s 0d.

The latest edition of "Advances" contains a tribute to E. E. BOURQUELOT (1851–1921), a pioneer carbohydrate chemist. Succeeding monographs are presented on the photochemistry of carbohydrates, chemistry of osotriazoles and of thio-sugars, trehaloses, naturally occurring C-glycosyl compounds, and of amino sugars derived from antibiotic substances. The biosynthesis of saccharides from glycopyranosyl esters of nucleotides are also covered, as is the determination of polymer homogeneity and of molecular dimensions in solutions of polysaccharides. But the most important chapter for our readers will be that concerned with the paper electrophoresis of carbohydrates which provides information on specificity of electrolytes, electrolytes not forming ionic complexes, and a series of tables of comparative mobilities. As usual, indexes to Volume 18 and cumulative indexes for Volumes 1–18 are included.

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Que es UNPASA? (What is UNPASA?) 27 pp; 5½ × 7¾ in. (Unión Nacional de Productores de Azúcar S.A. de C.V., Mexico 1, D.F.) 1964.

This little booklet, produced by the Mexican sugar producers' association, is an account (in Spanish) of its formation, organization and functions, the way in which it operates, its relations with other institutions, and the beneficiaries of its existence.

UNPASA was formed in 1938 on the basis of the former Azúcar S.A. which was the association formed by sugar factory operators in 1931. It organizes the distribution of sugar within Mexico and effects sales at prices established by the Government, maintaining adequate stocks and promoting sugar consumption. It handles exports and, when necessary, imports of sugar, provides credit facilities for members, and runs its own sugar cane research institute, etc. Benefits resulting for the general economy of the country, for consumers, for the sugar industry, cane farmers and workers are listed.

[1] *I.S.J.*, 1963, **65**, 306.

Sucrose crystallization studies in the presence of betaine. G. MANTOVANI. *Zeitsch. Zuckerind.*, 1963, **88,** 559–563.—Sucrose was dissolved in the presence of 0·5, 10, 15 and 20 g of betaine per 100 g water at 25°C ± 0·01°C. The solubility measurements were in good agreement with the values obtained by WISE & NICHOLSON[1], although the betaine was found to have a slight salting-out effect on sucrose. The effect of betaine on the crystallization rate at 1·1 supersaturation was also studied. The apparatus and test conditions were identical with those used in studies of the effect of KCl[2], single crystals weighing 10–20 g being grown from a solution of known density. The results for pure sucrose agree with those obtained in the KCl studies, with a reproducibility of ± 5%. At 10 g betaine the sucrose crystallization rate was practically unaltered, whereas at 20 g betaine the rate fell markedly. The phosphotungstic acid method for betaine determination described earlier[3] was modified to give greater accuracy[4], and betaine measured in the sucrose crystals. This showed that betaine is not included in sucrose crystals, but may be found on the surface or between two single crystals which have agglomerated during boiling or curing. The presence of betaine in factory sugar crystals is attributed to incomplete washing.

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Quality and composition of non-sugars in molasses during a long campaign. M. Z. KHELEMSKII, E. A. VOROB'EVA, N. T. POEDINOK and M. L. PEL'TS. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1963, **11,** 45–57.—Investigations over two campaigns at Makovsk sugar factory showed that the amount and composition of the molasses non-sugars vary with the length of campaign and depend on harvesting methods, beet physiology, storage period, etc. Comparison of molasses from beet harvested in November and February showed that, with both, even after 3 months' storage, the only significant change in the molasses composition was in the increased proportion of organic non-sugars, which rose at a greater rate than the ash. Consequently, the molasses composition may vary to a greater extent after short-term storage of sub-standard beet harvested in September than after long-term storage of healthy beet lifted in October. The rate of accumulation of molasses non-sugars was reduced by mechanical ventilation. Molasses obtained from mechanically harvested beet (which carried more soil) was of lower purity and tended to have higher non-sugars contents and more trisaccharides than did manually harvested beet. The trisaccharide content also increased with the length of the campaign, but even with a molasses trisaccharide content greater than 3%, the raffinose content in white sugar was negligible. The molasses nitrogen content remained approximately the same (% on weight of beet) throughout the campaign, but tended to fall in February-March.

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Clarification of filtrates in the analysis of highly coloured products. V. M. KATS and T. P. KHVALKOVSKII. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1963, **11,** 121–126.—The difficulty of polarizing highly coloured low-grade massecuite and molasses solution after clarifying with lead salts is discussed. While excess lead can be precipitated with ammonium phosphate and secondary clarification with hydrosulphite used to give lighter solutions, the method is time-consuming and the effects may still be inadequate for a pol accuracy of ± 0·1%. Herles' reagent was found to have a higher decolorizing effect than lead acetate, but the solution may still be too dark; however, supplementary decolorizing with active carbon is recommended. A brief survey is given of results obtained by various authors using carbon. Tests by the present authors have shown that "Norit" was more effective than "Carboraffin" in the decolorizing of molasses solution. However, an increase in the pol value resulted; this is attributed to the sorption of laevo-rotatory non-sugars together with sucrose. In tests with pure sugar solutions of approximately the same sugar content as the test molasses, "Carboraffin" caused a drop in the pol. Artificial molasses containing known non-optically active impurities behaved as pure sugar solutions. Increase in the pol ceased from the moment of complete decolorization. The procedure recommended is as follows: 13 g of the sample is placed in a 100 ml flask clarified with Herles' reagent (4–5 doses at 1·5–2 min intervals), cooled to 20°C and made up with distilled water, shaken, and filtered. Then 0·5 g of dry active carbon is added, the solution mixed, filtered and polarized in a 400 mm tube. A correction of —0·2°S is made with "Norit" and of —0·1°S with "Carboraffin".

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Experiment in storing preparations and working solutions of invertase. V. M. KATS, V. Z. NAKHODKINA and L. A. KOROBEINIKOVA. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1963, **11,** 127–132.—Tests have shown that working solutions and preparations of invertase (particularly undiluted preparations) are still suitable for use in the double-enzyme method of raffinose and sucrose determination after long storage. Optimum keeping conditions are given, but deviation

[1] *I.S.J.*, 1956, **58,** 329–332.
[2] MANTOVANI: *I.S.J.*, 1961, **63,** 351.
[3] *idem ibid.*, 1962, **64,** 246.
[4] *Analyst*, 1962, **87,** 313.

from these is claimed to cause only a negligible change in the fermentation activity over a whole campaign.

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Determination of pH in sugar factory products. T. P. KHVALKOVSKII. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1963, **11**, 132–154.—In an effort to improve electrometric and colorimetric methods of pH determination, the buffering capacities of sugar products were studied and found to increase with decrease in the purity of the products. The degree of buffering of molasses increases with fall in pH and buffering graphs for molasses from different factories in the pH range 7·0–5·5 agree, while in the range 7·0–10·0 they diverge considerably. The buffering capacity of molasses at the same factory undergoes only slight change over the range 5·5–10·0. Dilution recommendations for electrometric pH measurement are given on the basis of the findings. A colorimetric method is proposed for pH determination in undiluted products, whereby 5–6 drops of an indicator solution are added to one drop of the product and mixed. The indicator should be soluble in water or in water-alcohol mixtures (preferably with a low alchohol:water ratio). The pH values given by the colour change have been compared with data from the literature and the intervals between the colours corresponding to the pH values shown to be shorter in most cases than intervals cited in the literature. The accuracy is equal to the rated accuracy of an IM-2M pH meter. Better results are obtained if one of the indicators gives a yellow or colourless reaction. Tables of colour, corresponding pH range, concentration of indicator and type of solvent are given.

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Complexometric titration of sugar factory products. V. A. TSIRUL'. *Trudy Tsentr. Nauch.-Issled. Inst. Sakhar. Prom.*, 1963, **11**, 154–157.—To overcome difficulties in detecting the end-point in determination of calcium by titrating with "Complexon III" using murexide indicator, a procedure has been developed which is suitable under all lighting conditions. An electric lamp ("daylight" or normal) is suspended at a distance of 110–120 mm over a porcelain dish (160–170 mm dia.) and a paper hood draped over it. Carbonatation juice (10 ml) is pipetted into the dish together with 40 ml distilled water and 2·5 ml 1N NaOH solution. Sufficient murexide is added to give a rose colour in penetrating light (in non-penetrating light this colour will be much more intense). After the initial colour change some further murexide is added (a few grains) with NaCl (1:99) and titration continued dropwise with thorough mixing. The end-point occurs when a drop of "Complexon III" immediately merges with the colour of the solution and does not form a blue "haze". Comparison with the classic oxalate method gave a relative error of 3·98–5·35% with 2nd carbonatation juice, which is permissible for sugar product analyses. The method is therefore recommended for laboratories even where there is completely adequate daylight.

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Laboratory comparative study of active carbons. O. TISZAVÁRY. *Cukoripar*, 1963, **16**, 204–206.—Comparison of two Hungarian active carbons, "Ipagit 480" and "Decolor" with seven non-Hungarian carbons, including one Chinese, "Carboraffin" and three carbons produced by Norit N.V., showed that in molasses solution decolorization "Decolor" was among the best of those tested, whereas "Impagit 480" was among the poorest, being better only than the Chinese carbon. Both Hungarian carbons had high filtration rates.

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Determination of the white sugar and molasses sugar yield from sugar beet. K. VUKOV and L. BÁRÁNY. *Cukoripar*, 1963, **16**, 217–219.—With normal beet, good correlation has been found between molasses sugar content and the conductimetric ash of beet and this relationship is expressed in the form of an equation. For poor quality beet, a modified equation is used which takes into account the invert sugar content. However, both equations have limited application. For more accurate calculation of molasses yield, the almost linear relationship between the melassigenic coefficient (*m*) and the alkali ash proportion of non-sugars, established by SILIN, is used. The resultant expression is $m = 0{\cdot}028\,a + 0{\cdot}80$, where $a = \frac{h - 1{\cdot}8\ \text{CaO}}{100\ q}$, *h* being the conductimetric ash content of purified juice (g/100 Bx) and *q* is the juice purity. The CaO content of the juice is given as g CaO/100 Bx. The error is ± 0·09%. A modified form of the laboratory carbonatation method of Silin for press juice or raw juice is described.

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Optimum molasses concentration. I. N. KAGANOV. *Sakhar. Prom.*, 1963, (11), 18–21.—By optimum concentration is meant that value corresponding to the minimum required massecuite water content for ease of dropping, crystallization and curing, since the lower the molasses concentration the higher will be the purity, dissolved sugar being retained by the water. Equations are developed for calculating the molasses saturation coefficient (from the non-sugars composition and concentration) and the standard molasses purity, from which the exhaustion variables may be derived and a target run-off Brix determined. Empirical constants *a* and b[1] are determined from the solubility of sugar at a given temperature for two molasses concentrations.

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Determination of reducing substances in sugar products. I. M. FRIML and D. VČELÁKOVÁ. *Listy Cukr.*, 1963, **79**, 241–245.—The relationship between the composition of the Ofner copper reagent and the reducing

[1] *Sakhar. Prom.*, 1956, (3), 53.

capacity of sucrose was studied in the determination of invert sugar. It was found that at pH 9–10 the reducing effect of sucrose depends mainly on the concentration of the Rochelle salt, increase in which retards the reduction of Cu_2O. The effect of the Rochelle salt on the copper reduction by invert sugar was also studied, but the differences caused by the increased concentration proved less marked than with the sucrose. This is attributed to invert sugar degradation during reduction and the reducing effect of the degradation products on the copper reagent. However, their reducing capacities are not as clearly defined as with invert sugar and are therefore mainly confined to copper reagents with low concentrations of Rochelle salt, where reduction takes place most readily. The effect of time was studied with sucrose alone and in the presence of invert sugar. During 5–20 minutes' heating in a hot water bath the amount of Cu_2O reduced by sucrose was directly proportional to the heating time. The correction to be made for 10 g sucrose during 5 min moderate heating of the Ofner reagent was equal to the correction for 11 min heating in a water bath. The amount of Cu_2O reduced by invert sugar increased with reduction in the Rochelle salt concentration. Differences with a short heating period were more pronounced than with long heating periods. Fifteen min heating at 90–95°C in a water bath was required for complete reduction of invert sugar in the presence of sucrose. A correction of 0·85 ml of a solution of 0·0323N iodine is applied for 10 g sucrose, being 0·21 ml higher than with the standard 5 min heating on a wire gauze. Both methods gave the same results in a series of tests.

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Decolorizing juices with sodium hypochlorite. B. TICHÁ and M. FRIML. *Listy Cukr.*, 1963, **79**, 246–249. Sodium hypochlorite was added to sugar solutions (45, 90 and 135 mg/100 ml) and after 10, 30 and 120 min at 20°C or 70°C and filtration the colour of the treated solutions was determined photocolorimetrically. While the decolorizing effect depends on the amount of hypochlorite added, it was greater at the lower temperature and was more permanent. After 4 hours' heating on a water bath the solution became considerably dark, although with 90 mg of hypochlorite the colour obtained was still weaker than without hypochlorite. A small amount of sodium sulphite added after 10 min decolorization is sufficient to remove unreacted hypochlorite, and the sulphite also has a further decolorizing effect. Decolorization of cane sugar solutions proceeds in the same way as with beet sugar solutions, although the coloration during heating is greater. During 4 hours' heating, coloration with an untreated cane sugar solution was lower than with the addition of hypochlorite. The effects of hypochlorite plus sodium sulphite were greater than without the sulphite. The results of the tests indicated the possibility of experimental decolorization with 0·05% hypochlorite combined with sulphitation.

The effect of interfacial active bodies on the hygroscopicity of refined sugar. K. ČÍŽ. *Listy Cukr.*, 1963, **79**, 249–251.—Polarographic studies showed that the hygroscopicity of refined sugar increased with increase in the content of interfacial active substances (colloids, sucrose degradation products, saponins and colour bodies) and thus required storage at lower R.H. From the results a simple nomogram has been drawn showing the relationship between sugar moisture and the relative humidity of the surrounding medium at different ratios of interfacial substances and ash content. Refined sugar obtained from resin-decolorized syrups contained 30% less interfacial active substances.

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Studies in the chemical composition of molasses of Mysore and Hyderabad. S. L. MUKHERJEE and P. C. GOSWAMI. *Sci. Culture*, 1963, **29**, 200–201; through *S.I.A.*, 1963, **25**, Abs. 838.—Analyses of Brix, sugars and ash and chromatographic tests for individual amino acids were carried out on two cane molasses samples from white sugar factories. The only amino acids detected were aspartic acid and asparagine, together with smaller amounts of glutamic acid and glutamine. It is concluded that a major proportion of the amino acids are eliminated in the white sugar process.

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Observations on sugar losses during storage of sugar beet. E. STANCU. *Lucrarile Stiint. Inst. Agron. "N. Balcescu", Ser. B, Romin.*, 1960, **4**, 55–58; through *S.I.A.*, 1963, **25**, Abs. 851.—The determination of the sucrose content of stored beet was investigated for the purpose of decreasing "undetermined losses" in manufacture. Roumanian beets of varying duration of storage were extracted by both aqueous and alcoholic digestion and the extracts were analysed polarimetrically (pol) and chemically by Bertrand's method (sucrose) in each case. The results, including invert sugar determinations, are tabulated. The pol values of the alcoholic digest were close to the sucrose values of the aqueous digest, particularly in deteriorated beets, and these two procedures are recommended for routine control. The pol of the aqueous digest and the sucrose of the alcoholic digest were (in general) respectively higher and lower than the preceding values, presumably owing to precipitation of dextrorotatory substances by alcohol.

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Quantitative determination of sucrose with triphenyltetrazolium chloride by means of paper chromatography. F. FRIČ and O. KUBÁNIOVÁ. *J. Chromatogr.*, 1963, **11**, 127–130; through *S.I.A.*, 1963, **25**, Abs. 852.—A more rapid method for determining sucrose after chromatographic separation (e.g. with butanol-acetic acid-water, 4:1:5) is described. The chromatogram is sprayed with a clear centrifuged solution of invertase (0·1 g in 50 ml of 0·5% KH_2PO_4), stored at 18–20° for 40 min, and dried at 60–70°C. The paper is then dipped into a mixture of 1 part of 4%

TTC in methanol and 1 part of 1N NaOH by red light and dried at 70°C for 30 min. The red spots corresponding to sucrose can then be detected, cut out and eluted in methanol-acetic acid (10:1) mixture for 10 min. The extinction is measured with a blue filter and compared with that of standards (20–100 μg) from the same chromatogram.

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Determination of fermentable sugars in beet molasses. B. M. NAKHMANOVICH. *Spirt. Prom.*, 1963, **29,** (2), 29–31; through *S.I.A.*, 1963, **25,** Abs. 853.—Errors liable to arise in the analysis of molasses by the official method (in the U.S.S.R.) of double polarization are discussed. It is recommended that the invert sugar content be first determined (e.g. by Ofner's method). The direct and invert polarization values are then corrected by respectively adding and subtracting the optical rotation of the invert sugar (0·3184 × % invert sugar). The sucrose and raffinose contents are then calculated from the respective equations $(0{\cdot}512\ P + I)/0{\cdot}874$ and $(P - \%\ \text{sucrose})/1{\cdot}852$, where P and I are the numerical values of the corrected direct and invert polarizations respectively. Worked examples are given.

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Viscometric study of crystal formation in supersaturated aqueous sucrose solutions. N. TIKHOMIROFF, G. PIDOUX and R. FILIPPI. *Zucker*, 1963, **16,** 617–619. Examination of aqueous sucrose solutions which were colourless and free of reducing sugars at supersaturations of 1·1–1·6 showed that at a supersaturation of 1·2 or below there is no change in viscosity with time, whereas above 1·2 supersaturation the viscosity first rises then remains constant. The point at which constancy starts lies further along the time axis, the lower is the supersaturation. The phenomenon is attributed to rearrangement of molecules and results of a theoretical study of the subject are to be given later.

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Phase equilibria in sugar solutions. XI. The ternary system sucrose-butanol-water. F. H. C. KELLY and J. M. ROLLS. *J. Appl. Chem.*, 1963, **13,** 496–498. Equilibrium studies have been made of sucrose-butanol-water systems, with both *n*- and *iso*-butanol at 60°, and results with *iso*-butanol at 30° are illustrated by a triangular diagram showing equilibrium phase relationships. Tie-lines are plotted to show equilibria in the two liquid-phase concentration ranges. At 30° an acicular crystalline solid phase was sometimes observed at high butanol concentrations but was of low stability and was difficult to reproduce. That it was not possible to make positive identification of these crystals is considered unimportant as regards liquid-liquid extraction studies, although suggested origins are given. The overall effect of temperature increase from 30 to 60° was small but consistent with known data for the two-component water-butanol systems.

"Brix-free" water in cane fibre. J. BRUYN. *S. African Sugar J.*, 1963, **47,** 759–765.—A review is given of the literature on the determination of the amount of Brix-free water in cane fibre and the three methods used are described. In an attempt to determine the water absorption by fibre as a function of relative humidity, experiments were conducted on cane stalks which were chopped and shredded, washed until the wash water was free of dissolved solids, dried at 105°C and milled to a very fine powder. A small amount of this was placed on the pan of a special torsion balance constructed in a specially shaped glass vessel. Weighing was regulated electrically and a linear relationship established between weight and voltage in the range 0–500 mg. Air was blown through two bottles with a sintered glass plate and filled with a mixture of H_2SO_4 and water of such concentration as to give a desired relative humidity. The equilibrated stream of air then passed through a glass wool filter to remove droplets and entered the glass vessel containing the balance. The device was installed in an incubator to maintain constant temperature. The results of the tests showed that the device is not sufficiently accurate and that the amount of water associated with cane fibre lies between 20 and 30% on fibre. It is suggested that the amount of water may not be always identical for samples of cane fibre of different origin.

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Studying sucrose crystal growth with the microscope. H. E. C. POWERS. *J. Royal Microscop. Soc.*, 1963, **82,** 23–28.—The techniques applicable to microscopic studies of sucrose crystals are described with mention of the jacketed growth or dissolution cell for observing and recording the growth mechanism of crystal surfaces when the crystals are immersed in a suitable solution (static or flowing through the inner cell). Means of overcoming the problems caused by abrasion and surface imperfections, which prevent a clear picture of the interior in the dry, are described. Variation in crystal growth efficiency is discussed and the "Humidator" (controlled humidity container) is described. This is a hermetically-sealed container divided into two connected compartments, one containing a salt of required equilibrium relative humidity and the other a sub-saturated sucrose solution. The vapour pressure differential causes water molecules to migrate from the sucrose solution to the salt until equilibrium is attained. Some multi-coloured time-lapse cinemicrographs are presented showing examples of sucrose crystal forms in "Humidators" taken with polarized light using a quartz filter.

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Experimental checking of the Baloh enthalpy diagram for sugar-water solutions. C. LANGNER. *Zeitsch. Zuckerind.*, 1963, **88,** 676–678.—Known amounts of sucrose were added to distilled water and the temperature fall during the period up to final dissolution of the sucrose was determined, temperature measurements being taken once a min. From the specific enthalpies of the sugar and water, the specific enthalpies of the solutions were calculated using an equation which is presented[1]. The values thus calculated were compared with values obtained from an enthalpy diagram plotted by BALOH[2]. Agreement was good and the validity of the diagram for heat calculations thus established.

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Crystallization diagram. I. N. KAGANOV and R. I. LEVINA. *Sakhar. Prom.*, 1963, (12), 11–14.—A graphical method is presented for calculating the saturation Brix of a solution of known purity. The ordinates are values of α (non-sugars:water ratio) and abscissae are values of β (sucrose:water ratio). Lines radiating from the origin are of equal $\alpha:\beta$ ratios, i.e. correspond to constant purities. Lines drawn between points along the axes equidistant from the origin are such that at points along them $\alpha + \beta$ is constant, i.e. the lines correspond to constant Brix but changing purity. The saturation Brix of two samples of widely differing purity is determined at the same temperature and the corresponding points located on the graph (at the intercepts of the corresponding purity and Brix lines). Joining these two points gives a saturation line for the temperature in question; similar lines are drawn for a range of temperatures. Having done this, the saturation purity of a solution of given Brix at a particular temperature can be read from the graph, or the saturation temperature of a solution of given Brix and purity, or the saturation Brix of a solution of given purity at a given temperature.

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Modernized optico-acoustic gas analyser for determining CO_2 in saturation gas. V. I. MIKHAILENKO. *Sakhar. Prom.*, 1963, (12), 20–23.—The Soviet unit described measures the CO_2 concentration as a function of infra-red absorption by the CO_2. Its operation is based on equilibrium between the two halves of a radiation stream, i.e. between the CO_2 concentration in the gas sample and the constant CO_2 content in a corresponding gas-filled chamber. Adjustment is automatically effected by means of a microphone receiving reflected radiation from both streams and transmitting a signal to a motor regulating the thickness of the gas layer in the compensating chamber. The range is 0–50% CO_2 at a basic accuracy of $\pm$ 2·5% from the upper measuring limit.

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Determination of laevulic acid in bagasse hydrolysates. J. R. TORRES, S. GOODMAN, F. ROMAN and N. F. DE CARBALLO. *Rev. Col. Quím.* (Puerto Rico), 1962, **20,** (2), 38–43; through *Anal. Abs.*, 1963, **10,** 5379. A spectrophotometric procedure is described. The reagent is prepared by dissolving 5·95 g of 2,4-dinitrophenylhydrazine in 50 ml of concentrated HCl and diluting the solution to 1 litre with methanol. A 10-ml portion of the sample is mixed with 10 ml of the reagent, the mixture is maintained at 25° to 30° for 30 min, then 25 ml of ethyl acetate and 10 ml of H_2O are added, and the mixture is shaken. The separated ethyl acetate layer is extracted with four 20-ml portions of 3% aqueous $NaHCO_3$, the extract is diluted to 100 ml with H_2O, and the extinction is measured at 490 mμ. The concentration (p.p.m.) of laevulic acid is calculated by multiplying the extinction by 84·82. The effects on the precision of the method of other solvents, alkaline extractants, the time of reaction, acids, heat, excess of reagent, and concentration of $NaHCO_3$ solution were studied. A similar procedure was described by JIANG and GROTH[3].

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Sucrose: Precise determination of crystal and molecular structure by neutron diffraction. G. M. BROWN and H. A. LEVY. *Science*, 1963, **141,** 921–923.—An analysis is described which provides the first precise molecular parameters for sucrose. All hydrogen atoms are included. Carbon-carbon distances are 1·51 to 1·53 Angströms; carbon-oxygen 1·40–1·44A; carbon-hydrogen 1·08 to 1·11 A; and oxygen-hydrogen 0·94–0·99A. The furanose ring conformation differs from that in sucrose sodium bromide dihydrate. Hydrogen bonds (two of them intramolecular) utilize every hydroxyl group except one. (See also POWERS: *I.S.J.*, 1964, **66,** 117–118.)

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Origin of microbial contamination of sugars. II. P. DEVILLERS. *Ind. Alim. Agric.*, 1963, **80,** 919–923. Tabulated data showing the thermophilic and mesophilic counts in sugar stored in a silo indicate that there is hardly any development of bacteria even in the case of one year's storage. On the other hand, tables of yeast and mould populations show that these can multiply under certain (moist) conditions. If the sugar is too dry (relative humidity of 50), however, osmophilic yeasts and moulds die rapidly.

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Quantitative determination of sucrose and raffinose in the presence of certain reducing sugars. M. TRONJA and J. HUBACEK. *Kvasny Prum.*, 1963, **9,** 147–149; through *Rev. Intern. Ind. Agric.*, 1963, **24,** Abs. 1510. A paper chromatographic method of determining reducing and non-reducing sugars (sucrose and raffinose) is described. Non-reducing oligosaccharides were isolated and fermentatively hydrolysed on paper with β-fructosidase. The reducing effect of the hydrolysate on 2,3,5-triphenyltetrazolium chloride was studied and the product thus obtained was determined colorimetrically after elution.

[1] BOSNJAKOVIC: Technische Thermodynamik. Part II. (Dresden.) 1960. p. 84.

[2] *Zucker*, 1962, **15,** 444–451; *I.S.J.*, 1963, **65,** 88.

[3] *Anal. Abs.*, 1961, **8,** 238.

TRADE NOTICES

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

Pneumatic conveyor system. F. W. Berk & Co. Ltd., Engineering Division, 75 Uxbridge Rd., London W.5.

In the Berk-Gattys patent pneumatic conveyor system compressed air is used for fluidization and propulsion by means of a perforated hose laid inside the conveyor pipe. Low conveying speeds result, with consequent less attrition, minimum wear of pipes and bends and lower power requirements. The line can be stopped and started without blowing out and any number of take-off points can be provided.

The inner perforated tube, of rubber or PVC hose, is within the whole length of the conveyor pipe, air being introduced at regular intervals. The perforations are so arranged that they are open only when there is a pressure difference; they cannot be blocked, therefore. Conveying speed can be controlled over a wide range, and the system is successfully handling sugar.

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Eimco clarifiers for beet waste water. Eimco (Great Britain) Ltd., Team Valley, Gateshead, Co. Durham.

Clarifier installations recently completed by Eimco (G.B.) Ltd. include a unit at the British Sugar Corporation's Bury St. Edmunds factory which handles almost 15 million gallons each day. The clarifier separates mud from water used in beet fluming. Mud was originally separated from the flume water by settling in lagoons; expansion of the

factory rendered these inadequate and led to the decision to replace them by the Eimco clarifier. The unit installed is 200 ft in diameter and is capable of handling 10,000 gallons per minute. This capacity is in excess of that required for fluming alone, surplus clarified water being returned to a 14-acre artificial reserve and cooling pond which acts as a water reserve for the factory.

About 800 tons of mud is separated each day by the clarifier. The residual mud is pumped from the bottom of the unit and is dumped at the edge of the reserve pond. Sludge raking arms make one rotation every 25 minutes and are driven through a balanced drive-head assembly, in which the drive is taken to the main gearwheel at two points to provide an even torque distribution. This is particularly advantageous in view of the high torque loadings imposed by the large amounts of mud settling out. A torque cutout protects the drivehead in the event of overloading.

The new clarifier cuts water losses and converts the original batch clarifying process using lagoons to a more efficient continuous system. It occupies substantially less ground than was required using the original system, making space available for other purposes. Hand labour for digging out is eliminated as is the delay in waiting for mud to dry out sufficiently for removal.

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Compact remote control for Saunders valves. Saunders Valve Company Ltd., Cwmbran, Monmouthshire.

The double-acting method of pressure operation of Saunders valves, in which both the opening and closing movements are performed by the operating pressure, is noteworthy owing to the absence of springs. This eliminates possible spring malfunctioning and consequent maintenance. The compact design can be important where space is at a premium. The versatility of the diaphragm-operated double-acting (D.O.D.A.) topworks is displayed by its availability for both diaphragm and ball plug types of Saunders valve.

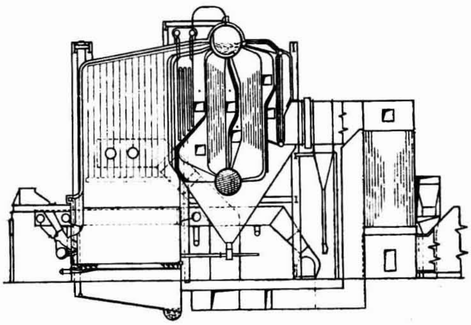
In the case of the diaphragm valves the actuator imparts axial thrust directly to the valve spindle but when fitted to the ball plug valves, with their on-off action, the drive is taken through 90° via a cam and peg mechanism.

* * *

Bagasse spreader-fired boiler in Peru. Babcock & Wilcox Ltd., 209 Euston Rd., London N.W.1.

In bagasse furnaces, a widely used alternative to the travelling grate with spreader firing is a dumping grate. The grate is divided into sections, the individual grate bars being arranged to turn through 90° so that all the ash on that section will fall into the ash hopper. Each section is operated by either power or (on smaller types of grate) hand-operated mechanism. One boiler of 88,000 lb/hr with firing of this type is operating at the Lima mill of Negociación Tuman S.A., in Peru. This boiler, designed for outlet steam conditions of 450 p.s.i. and 675°F, was designed by Babcock & Wilcox Ltd.

The actual grinding rate at the mill is 133 tons/hr. Immediate expansion will increase this to 163 tons/hr, although all equipment being obtained for this expansion is suitable for a future output of up to 200 tons/hr. Steam is used to drive three multi-stage turbines, one of 750 h.p. for the crusher, and the

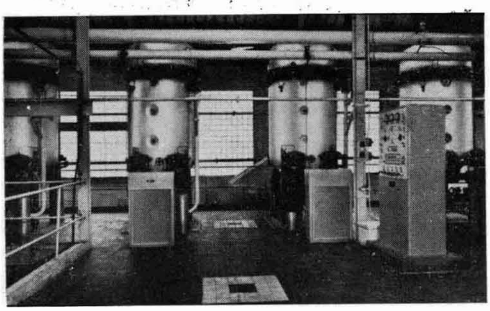


two others of 1600 h.p. for the mills. Turbine steam pressure is, at present, 300 p.s.i. but is to be increased to 450 p.s.i. in the future. The exhaust pressure is 15 p.s.i.

* * *

Stellar precoat-type pressure filter modifications. The Paterson Engineering Company Ltd., 129 Kingsway, London W.C.2.

The most important of a number of new developments is the introduction of new types of rigid filter elements for the Stellar filter which are cheaper and very much lighter than the existing types. The new elements are made entirely from plastic materials such as polyvinyl chloride and polypropylene and are applied principally to the filtration of liquids which are corrosive to the standard stainless steel filter elements.



A further development is the use of seamless woven filter sleeves made of modern synthetic fibres. Sleeves cover each element in the filter and can be used in some cases without the precoat, which is normally retained on the filter elements. The sleeves are effectively cleaned without any dismantling, by means of the proven "Autopact" cleaning system, thus eliminating external back-washing arrangements. Stellar elements with sleeves are being applied to advantage to the filtration of water, sugar liquors and other liquids including effluents. Where filter aid is not required the sleeves show a considerable saving in running costs and facilitate the recovery of solids or sludge without contamination.

Another significant development is the introduction of a full system of automation for Stellar filters. It is based on electro-pneumatic principles and provides any required combination of manual and automatic control ranging from the simple operation of individual filters by means of hand switches on a distant control panel, to complete pre-planned repetitive automation for batteries of several filters. Such systems are becoming indispensable in modern production processes and automatic Stellar stations are being installed in plants in the chemical, food and metal industries in addition to installations for the treatment of water supplies.

The photograph shows a fully automatic Stellar filtration plant at a British Sugar Corporation factory processing 5000 tons of beet per day. The plant filters second carbonatation juice and runs continuously during the campaign.

* * *

PUBLICATIONS RECEIVED

DUST CONTROL UNITS. Dust Control Equipment Ltd., Thurmaston, Leicester.

Folder 123 is a new brochure describing and illustrating the applications of the "Unimaster" Series UMA 70, 100, 150 and 250 dust control units and 100V, 150V and 250V venting units. These have air filtering surfaces ranging from 50 to 250 square feet and are selected with reference to the varying combinations of fan capacity, filter area and dust container size which are required by the particular application.

* * *

CWMBRAN 1939-1964. THE FIRST 25 YEARS. Saunders Valve Co. Ltd., Cwmbran, Monmouthshire.

In 1939 the Saunders Valve Co. Ltd. came to Cwmbran, Monmouthshire, establishing its headquarters in the town and providing a rapidly-expanding light engineering industry where none existed and where unemployment was high. Since then the labour force has increased five-fold as also has productivity per head. This development has been described in a new booklet produced to mark "the first 25 years" which provides information on the Company, management, progress in output and exports, etc., and also illustrates a number of applications for the valves made in Cwmbran.

* * *

MATERIALS HANDLING EQUIPMENT. Lansing Bagnall Ltd., Kingsclere Rd., Basingstoke, Hants.

New booklets have been prepared on the Lansing-Bagnall "Spacemaker 4" and "Tow-tractor 4·1" equipment, the first providing specifications, dimensions, illustrations and applications of this electric fork-lift reach truck, and the second providing similar information on the range of towing tractors. A general booklet provides information on all the Lansing-Bagnall range, including two tractors, fork-lifts of various types, and transloaders.

* * *

Sankey lump sugar.—Sankey Sugar Co. Ltd. has introduced a 1-lb packet for retail sale of its new lump sugar. This is slightly larger than the cube sugar generally available and measures 120 lumps to the pound. The lumps are formed by pressing in a Dutch machine and can be "custom-wrapped" for individual customers—restaurants, hotels, etc.—using a Swiss SAPAL wrapping machine.

* * *

Smith cane milling tandem for Hawaii.—A. & W. Smith & Co. Ltd., a subsidiary of Tate & Lyle Ltd., have received an order from the Laupahoehoe Sugar Company of Hawaii for the supply of cane crushing equipment, comprising a tandem of five 84-inch mills with associated gearing, to the value of approximately £295,000. This is the first British sugar cane crushing equipment of this size to be delivered to Hawaii since before 1939.

French Sugar Imports and Exports[1]

(*metric tons*)

	1963		1962	
	Unrefined	*Refined*	*Unrefined*	*Refined*
Imports				
Belgium/Luxembourg	48	583	88	1,629
Brazil	4,212	—	—	—
Bulgaria	3,000	—	—	—
Dominican Republic	—	—	99	18
Germany (East)	1,105	—	—	—
Guadeloupe	85,125	—	112,895	—
Holland	38	58	66	310
Hungary	998	—	—	—
Malagache Republic	33,659	300	29,678	—
Martinique	74,807	—	73,992	—
Poland	2,375	126	20,522	7,318
Réunion	177,963	—	181,923	—
Roumania	710	—	—	—
Surinam	400	—	—	—
Other Countries	1	—	26	11
	384,441	1,067	419,289	9,286
Exports				
Algeria	129,892	57,273	116,880	54,557
Belgium/Luxembourg	8,109	7,560	699	11,738
Cameroon	1,210	8,370	984	4,521
Canada	150	—	—	—
Chile	9,503	—	—	30
Dahomey	515	7,246	280	6,511
Denmark	5,411	—	—	—
Ethiopia	—	60	—	500
French Polynesia	834	896	—	7
Gabon Republic	132	885	104	698
Germany (West)	66,160	16,870	29,444	8,971
Ghana	—	6,626	—	13,410
Greece	500	13,556	—	1
Guinea	911	3,427	—	—
High Volta Republic	—	6,090	362	5,019
Holland	2,736	42,267	37,967	30,073
Iran	9,500	—	—	—
Ireland	18,051	—	32,477	—
Israel	16,498	2	—	—
Italy	52,780	30,228	12,599	10,792
Ivory Coast	5,031	13,096	4,410	9,894
Liberia	—	1,101	—	969
Malaysia	200	—	—	—
Mali	—	4	—	2,042
Mauritania	1	7,994	—	8,999
Morocco	50	21,341	3,683	38,301
New Caledonia	1,693	1,101	41	196
Niger Republic	1,185	7,232	733	4,601
Nigeria	—	12,580	—	12,290
Norway	3,688	2,245	—	437
Oasia and Saoura	—	—	6,145	5,430
Senegal	19,116	32,758	20,400	28,218
Sierra Leone	—	4,536	—	4,386
Spain	5,783	—	—	—
Spanish Territories in Africa	—	518	—	1,251
Sudan	17,400	5,000	—	—
Sweden	22,689	1,161	—	—
Switzerland	7,916	67,137	18,949	91,851
Togo	147	2,598	232	3,932
Tunisia	6,749	50	—	—
United Kingdom	1,956	4,358	5,328	3,093
Uruguay	—	—	2,000	—
U.S.A.	9,652	24,809	—	—
Vietnam	4	—	333	—
Other Countries	358	1,299	701	1,197
	426,510	412,274	294,751	363,888

Florida sugar crop[2].—Sugar production in Florida during the past season totalled 424,129 tons, from a total of 4,631,726 tons of cane, according to the U.S. Dept. of Agriculture.

Brevities

Bagasse hardboard in Egypt[3].—A plant is to be erected near the sugar factory of Nag-Hamadi in Upper Egypt for the manufacture of bagasse hardboard.

* * *

U.S. cane sugar expansion[4].—The Atlantic Sugar Refining Company, located near West Palm Beach, Florida, has begun erection of a 5000-ton cane sugar factory. The Cajun Sugar Cooperative Inc. is erecting a sugar factory, also of 5000 tons capacity, in the Parish of Iberia, Louisiana. A third 5000-ton factory is projected for south of New Orleans, while other Louisiana factories are being expanded.

* * *

Iran sugar plans[5].—A newly-formed company, Shirin Co., of Khorasan plans to erect a sugar factory in the neighbourhood of Meshed to have an initial capacity of 2500 tons of beet per day, later to be raised to 3000 tons. Two-thirds of the pulp is to be dried and a molasses de-sugaring plant is also planned.

* * *

Hungarian beet crop.—A harvest of 3,374,000 tons of beet was produced from 118,379 hectares in the 1963 crop[6] and yielded 454,350 tons of sugar[7]. The crop yield of 28·6 tons per hectare was a considerable improvement over the 1962 and 1958/62 figures of 21·1 and 21·2 tons/ha, 2,653,000 tons of beet having been produced from 125,000 ha in 1962. For 1964 it is planned to harvest 120,000 ha of beet[8].

* * *

Refinery closure in New York[9].—The National Sugar Refining Company announced on the 13th May that its refinery in New York was to be closed permanently as from the 30th June. The refinery has not been working to full capacity for some time and the company has decided that it would be uneconomic to keep the plant in New York running as well as the refinery in Philadelphia. It is planned, however, to continue to supply areas which are at present receiving sugar from the New York refinery.

* * *

Philippines sugar expansion[10].—The area devoted to sugar cane in the Philippines has grown of recent years—from 224,399 ha in 1961/62 to 243,658 ha in 1962/63 and 282,410 ha in 1963/64. The sugar outturn in 1962/63, at 1,714,296 short tons, was 95,908 tons more than in 1961/62, while the 1963/64 crop is forecast at 1,970,214 tons. Two new centrals, both imported from Puerto Rico, are being assembled, one as Hacienda Kabankalan in Silay and the other as Hacienda Dos Hermanas in Talisay, both Negros Occidental, and are to be ready for operation in 1964/65. Recent investment in the enlargement of mill capacities and increased cane plantings amount to sixty million pesos ($30 million).

* * *

Sugar technology education in South Africa[11].—On the 9th March 1964 the first full-time course in sugar technology in South Africa commenced at the Sugar Milling Research Institute. Students are to be employed by the Institute for five years and after preliminary lectures at the Institute, lasting two weeks, they will be allocated to various sugar factories and the refinery for planned practical training. In the second, third and fourth years they will return to Durban and attend lectures at the Natal Technical College. On successful completion of the course, students will receive a Diploma in Sugar Technology and will then leave the S.M.R.I. to seek employment in the industry.

1 C. Czarnikow Ltd., *Sugar Review*, 1964, (647), 35.
2 *Public Ledger*, 29th April 1964.
3 *Zeitsch. Zuckerind.*, 1964, **89**, 215.
4 *Sugar J.* (La.), 1964, **26**, (10), 34.
5 *Zeitsch. Zuckerind.*, 1964, **89**, 215.
6 F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (11). 10.
7 *Merrill Lynch*, 24th April 1964.
8 F. O. Licht, *Internatioanl Sugar Rpt.*, 1964, **96**, (11), 1.
9 C. Carnikow Ltd., *Sugar Review*, 1964, (661), 92.
10 *Sugar News* (Philippines), 1964, **40**, 71.
11 *S. African Sugar J.*, 1964, **48**, 183.

BREVITIES

Intersuc 64.—This is the name given to the 1964 International Trade Exhibition of the Confectionery, Chocolate and Biscuit Industries—all users of very large quantities of sugar. It is to be held at the Parc des Expositions, Porte de Versailles, Paris, France, between the 6th and 9th September, and further information is available from Intersuc, 48 Avenue de Villiers, Paris 17e.

* * *

The late P. V. Golovin.—The death is reported of Professor PAVEL VASIL'EVICH GOLOVIN, a foremost figure in Soviet sugar technology and head of the Department of Sugar Technology at the Food Industry Technological Institute in Kiev. He was also in charge of the sugar laboratory of the Institute of Organic Chemistry in the Ukrainian Academy of Sciences. He was the author of many works and patents, and his was the first manual of sugar technology to be published in the Soviet Union. Many honours were conferred on him for his work.

* * *

The late M. A. del Valle.—The death occurred on the 18th May of Manuel A. del Valle, General Chairman of the I.S.S.C.T. 12th Congress to be held in Puerto Rico in 1965. Born in 1895, he was trained in chemical engineering at the University of Michigan and, apart from service in the U.S. Army in 1917/18, was engaged in the Puerto Rico sugar industry for the whole of his working life. Apart from employment as Chief Chemist and Factory Superintendent of a number of sugar factories, he was Professor and Head of the Sugar Chemistry Dept. of the A. & M. College, University of Puerto Rico from 1919 to 1925, and rose to be President of Eastern Associates. He was appointed Chairman of the Board of Fajardo Eastern Associates when his company merged with Fajardo Sugar Co.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 17th June* 1964)	s d
Anglo-Ceylon (5s)	9/–
Antigua Sugar Factory (£1)	14/3
Booker Bros. (10s)	19/9
British Sugar Corp. Ltd. (£1)	30/9
Caroni Ord. (2s)	4/–
Caroni 6% Cum. Pref. (£1)	16/–
Demerara Co. (Holdings) Ltd.	8/1½
Distillers Co. Ltd. (10s units)	27/1½
Gledhow Chaka's Kraal (R1)	30/–
Hulett & Sons (R1)	43/–
Jamaica Sugar Estates Ltd. (5s units)	5/10½
Leach's Argentine (10s units)	17/6
Manbré & Garton Ltd. (10s)	34/9
Reynolds Bros. (R1)	23/6
St. Kitts (London) Ltd. (£1)	21/3
Sena Sugar Estates Ltd. (10s)	8/3
Tate & Lyle Ltd. (£1)	35/6
Trinidad Sugar (5s stock units)	3/2¼
United Molasses (10s stock units)	31/–
West Indies Sugar Co. Ltd. (£1)	18/3

CLOSING MIDDLE

New York Stocks (*at 16th June* 1964)	$
American Crystal ($10)	56¾
Amer. Sugar Ref. Co. ($12.50)	19
Central Aguirre ($5)	27⅝
North American Ind. ($10)	37⅞
Great Western Sugar Co.	14¾
South P.R. Sugar Co.	31⅛
United Fruit Co.	22

Sugar production in British Guiana[1].—Total production in 1963 was 317,137 tons of sugar from 95,076 acres (estates only) and of this amount 281,131 tons were exported. Local consumption was 22,612 tons. In the previous year 326,023 tons of sugar were produced from 98,793 acres.

* * *

Egypt sugar expansion plans[2].—Under the provisions of an ambitious expansion and modernization programme, the Egyptian sugar industry is hoped to be able to produce in excess of 1,000,000 tons of sugar by 1968. During 1963/64 production amounted to 410,000 tons.

* * *

Molasses report.—During recent years, F. O. Licht K.G. have received so many requests for information concerning the production of molasses, molasses prices, imports, exports and utilization, that they have decided to publish a new fortnightly report under the title "F. O. Licht's International Molasses Report," to appear from the 1st July 1964 in German and English. Its cost will be DM 55.00 per half-year, including air-mail postage.

* * *

Bulk sugar terminal in Portuguese East Africa[3].—The Southern Rhodesian sugar industry and the Caminhos de Ferro Moçambique (C.F.M.) will shortly work out a scheme to store and handle bulk Rhodesian sugar at Lourenço Marques, the Southern Rhodesian Goverment has announced in Salisbury. The statement said than when additional milling capacity comes into operation in September 1965, sugar exports will be at the rate of 200,000 tons a year, rising to 300,000 tons a year. All this sugar will need to be shipped from Lourenço Marques and, as the sugar producing area is some distance from the port, it is essential to reduce production and transport costs to a minimum.

* * *

Colombia sugar expansion[4].—The Sugar Producers' Association has announced details for the expansion of the sugar industry in the Cauca valley. The 1968 goal for exports is 600,000 metric tons, raw value. Of the 19 mills in the valley, 11 are expanding their crushing capacity; five of these, including three of the largest, are in the process of trebling their productive capacity. Two new mills are being built, one to start operations in 1965. Plans for building two more mills of 5000 tons/day capacity each have been approved and another is under consideration. Production is planned to be 1,100,000 tons, raw value, in 1968 of which 500,000 tons will be for domestic consumption and 600,000 tons for export. It is estimated that 220,000–250,000 ha will be under sugar cane or about 55–60% of the arable land in the Cauca Valley.

* * *

Queensland University course in sugar technology[5].—The post-graduate course in sugar technology was discontinued at the end of 1963[6], but following discussions with the Bureau of Sugar Experiment Stations, the University is now offering Sugar Technology as an elective subject in the final year of the Chemical Engineering course. The course comprises two lectures a week with some practical work and will enable the most important sections of the subject to be covered, giving students some introduction to the specialized technology of the sugar industry. The lectures are being given by Mr. G. H. JENKINS, previously Senior Lecturer in Sugar Technology who has now taken up the post of Technical Secretary to the Faculty of Engineering. The Bureau of Sugar Experiment Stations is making an annual grant of £A500 to the University in recognition of the elective course, as well as carrying on the scholarships previously offered in Sugar Technology, which are now available for the fifth year of Chemical Engineering

[1] *Overseas Review* (Barclays D.C.O.), March 1964, p. 76.
[2] *Merrill Lynch*, 8th May 1964.
[3] *Public Ledger*, 2nd May 1964.
[4] *Willett & Gray*, 1964, **88**, 163.
[5] *Australian Sugar J.*, 1964, **55**, 845.
[6] *I.S.J.*, 1963, **65**, 380.

BUYERS' GUIDE

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

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

Accumulators, Steam.
see Steam Accumulators.

Activated carbon.
Haller & Phillips Ltd.
Lurgi Gesellschaft für Chemotechnik m.b.H.
Norit Sales Corporation Ltd.
Pittsburgh Chemical Company, Activated Carbon Division.

Agricultural implements.
Massey-Ferguson (Export) Ltd.
F. W. Pettit Ltd.

Agricultural machinery.
Massey-Ferguson (Export) Ltd.

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.
Serck Radiators Ltd.
A.B. Svenska Fläktfabriken.
Wellington Engineering Works Ltd.

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

Air heaters.
Babcock & Wilcox Ltd.
International Combustion Products Ltd.
Serck Radiators Ltd.
Stabilag Engineering Ltd.
A.B. Svenska Fläktfabriken.
Wellington Engineering Works Ltd.

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

Alcohol plant.
A.P.V. Co. Ltd.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
CEKOP.
John Dore & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Honolulu Iron Works Co.
Etablissements A. Olier.
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.
John Thompson Water Tube Boilers Ltd.

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

Bearings and pillow blocks.
Crofts (Engineers) Ltd.
Eisenwerk Wülfel.
Ransome & Marles Bearing Co. Ltd.
Rex Chainbelt Inc.
The Skefko Ball Bearing Co. Ltd.

Beet diffusers, Continuous.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
CEKOP.
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.
Etablissements A. Olier.
Société Française des Constructions Babcock & Wilcox.
Stork-Werkspoor (V.M.F.)

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

Beet harvesters.
Catchpole Engineering Co. Ltd.
H. Vissers N.V.

Beet hoes.
Martin-Markham Ltd.

Beet mechanical discharging and storage equipment.
Elfa-Apparate-Vertriebs G.m.b.H.
Officine Meccaniche di Savona Servettaz-Basevi S.p.A.

Beet pulp presses.
BMA Braunschweigische Maschinenbauanstalt.
CEKOP.
Choquenet L. Fonderies et Ateliers.
Cocksedge & Co. Ltd.
Fletcher and Stewart Ltd.
Hein, Lehmann & Co. A.G.

Beet pulp presses—*continued.*
AB. Landsverk.
Etablissements A. Olier.
Rose, Downs & Thompson Ltd.
Stord Bartz Industri A/S.
Weigelwerk G.m.b.H.

Beet seed.
A/S De danske Sukkerfabrikker.

Beet seed rubbing machines.
Cocksedge & Co. Ltd.

Beet slicers.
CEKOP.
Choquenet L. Fonderies et Ateliers.
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.
Soc. Fives Lille—Cail.
Köllman & Gruhn.
H. Putsch & Comp.

Beet tail utilization plant.
CEKOP.
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.

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.
John Thompson-Kennicott Ltd.
Unifloc Ltd.

Boilers, Vertical.
Clayton, Son & Co. Ltd.
Cochran & Co., Annan, Ltd.
John Thompson (Wolverhampton) Ltd.

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

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.
Crone & Taylor (Engineering) Ltd.
Fletcher & Stewart Ltd.
International Combustion Products Ltd.
New Conveyor Co. Ltd.
Société Française des Constructions Babcock & Wilcox.
Spencer (Melksham) Ltd.
John Thompson (Dudley) Ltd.
John Thompson (Wolverhampton) Ltd.
Towler & Son Ltd.

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

Bunker discharge equipment.
Carmichael & Sons (Worcester) Ltd.
Crone & Taylor (Engineering) Ltd.
International Combustion Products Ltd.
Sinex Engineering Co. Ltd.
Yorkshire Engineering & Welding 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.
Massey-Ferguson (Export) Ltd.
F. W. Pettit Ltd.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
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.
Kingston Industrial Works Ltd.
Martin-Markham Ltd.
L. S. Miedema.
F. W. Pettit Ltd.
Spoorijzer N.V. Delft.
Whitlock Bros. Ltd.

Cane cultivation equipment.
Broussard Machine Co.
Massey-Ferguson (Export) Ltd.

Cane diffusers, Continuous.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A/S. De danske Sukkerfabrikker.
Extraction De Smet S.A.

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

Cane harvesters.
Cary Iron Works.
Massey-Ferguson (Export) Ltd.

Cane loaders.
Broussard Machine Co.
Cary Iron Works.

Carbon, Decolorizing.
Atlas Chemical Industries Inc.
Atlas-Goldschmidt G.m.b.H.
Atlas de Mexico S.A.
C.E.C.A.
The Clydesdale Chemical Co. Ltd.
Farnell Carbons.
Haller & Phillips Ltd.
Honeywill-Atlas Ltd.
Lurgi Gesellschaft für Chemotechnik m.b.H.
Norit Sales Corporation Ltd.
Pittsburgh Chemical Company, Activated Carbon Division.
Suchar Sales Corporation.
The Sugar Manufacturers' Supply Co. Ltd.
Sutcliffe, Speakman & 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.
CEKOP.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Neyrpic.
Etablissements A. Olier.
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.)

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.
CEKOP.
Escher Wyss (U.K.) Ltd
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co. A.G.
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.
Maschinenfabrik Buckau R. Wolf A.G.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
Hein, Lehmann & Co. A.G.
International Combustion Products Ltd.

Centrifugals—Continuous—*continued*
Sharples Centrifuges Ltd.
Watson, Laidlaw & Co. Ltd.
Western States Machine Co.

Centrifugals—Fully automatic batch-type.
ASEA.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
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.
Maschinenfabrik Buckau R. Wolf A.G.
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.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening & Sons Ltd.
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.
Bagshawe & Co. Ltd.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Pennine Chainbelt Co. Ltd.
Renold Chains Ltd.
Rex Chainbelt Inc.
A. & W. Smith & Co. Ltd.

Screw conveyors.—continued
Darrold Engineering Ltd.
G. Hopkins & Sons Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Slat conveyors.
The Borg-Warner International Corporation.
Darrold Engineering Ltd.
Fourways (Engineers) Ltd.
G. Hopkins & Sons Ltd.
Rex Chainbelt Inc.

Steel band conveyors.
Unifloc Ltd.

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

Vibratory conveyors.
Birtley Engineering Ltd.
Locker Industries (Sales) Ltd.
Rex Chainbelt Inc.
Sinex Engineering Co. Ltd.

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

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.
Werkspoor N.V.
Wyssmont Co. Inc.
see also Dryers.

Coolers, Water.
Film Cooling Towers (1925) Ltd.
Heenan & Froude Ltd.
Serck Radiators 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.
Vaughan Crane Co. Ltd.

Crystallizers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
CEKOP.
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 Limited.
Honolulu Iron Works Co.
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.
Standard Steel Corporation.
John Thompson (Dudley) Ltd.
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.
Atlas Chemical Industries Inc.
Atlas-Goldschmidt G.m.b.H.
Atlas de Mexico S.A.
BMA Braunschweigische Maschinenbauanstalt.
Graver Water Conditioning Co.
Honeywill-Atlas Ltd.
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.**

Ditch digging equipment.
Massey-Ferguson (Export) Ltd.

Drainage and ridging machinery.
James A. Cuthbertson Ltd.

Drives, Variable speed.
The Borg-Warner International Corporation.
Crofts (Engineers) Ltd.
Eisenwerk Wülfel.
Heenan & Froude Ltd.
Mawdsley's 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.
CEKOP.
Dunford & Elliott Process Engineering Ltd.
Fletcher and Stewart Ltd.
Wm. Gardner & Sons (Glos.) Ltd.
Harvey Fabrication Limited.
Honolulu Iron Works Co.
International Combustion Products Ltd.
Robert Jenkins & Co. Ltd.
Kestner Evaporator & Engineering Co. Ltd.
Manlove Alliott & Co. Ltd.
L. A. Mitchell Group of Companies.
Etablissements A. Olier.
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.
Werkspoor N.V.
Wyssmont Co. Inc.

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.
Fly Ash Arrestor Corporation.
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.
John Thompson Water Tube Boilers Ltd.

Filter cloths.
Jeremiah Ambler Ltd.
American Plant Equipment Co.
John Bright & Brothers Ltd.
Cotton Bros. (Longton) Ltd.
Fothergill & Harvey Ltd.
N. Greening & Sons Ltd.
Harvey Perforators and Weavers Ltd.
Samuel Hill Ltd.
S. H. Johnson & Co. 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.
James Stott 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.
Sparkler Filters (G.B.) Ltd.

Filter papers.
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.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening & Sons Ltd.
Harvey Perforators and Weavers Ltd.
Ets. Krieg et Zivy.
Locker Industries (Sales) Ltd.
Russell Constructions Ltd.
Sankey Green Wire Weaving Co. Ltd.

Flanges, Non-Ferrous.
Blundell & Crompton Ltd.

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

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

Flowmeters.
Alfa-Laval AB.
Evershed & Vignoles Ltd.
Honeywell Controls Ltd.
G. Hopkins & Sons Ltd.
Meter-Flow Ltd.
Negretti & Zambra Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.

Flowmeters, Electromagnetic.
Mawdsley's Ltd.

Fly Ash Collectors, Multiple cyclone. type.
Fly Ash Arrestor Corp.

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.
The Borg-Warner International Corporation.
Crofts (Engineers) Ltd.
The English Electric Co. Ltd., Electrical Plant Divn.
Opperman Gears Ltd.
Siemens-Schuckertwerke A.G.

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

Graders, Earth.
Massey-Ferguson (Export) Ltd.

Granulators, ***see*** Dryers.

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

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

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

Heat exchangers, Tubular.
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Blairs Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Burnett & Rolfe Ltd.
Carrier Engineering Co. Ltd.
Clayton, Son & Co. Ltd.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
Foster Wheeler Ltd.
Harvey Fabrication Limited.
International Combustion Ltd.
Robert Jenkins & Co. Ltd.
Kingston Industrial Works Ltd.
AB. Landsverk.
L. A. Mitchell Group of Companies.
Richardsons, Westgarth & Co. Ltd.
Salzgitter Maschinen A.G.
Serck Radiators Ltd.
S.P.E.I. Chim.
John Thompson Water Tube Boilers Ltd.
Towler & Son Ltd.
Wellington Engineering Works Ltd.
Worthington Corporation.

Heated storage vessels.
Stabilag Engineering Ltd.

Herbicides.
Diamond Alkali Company.

Hydraulic controls for valves, etc.
Arca Regler G.m.b.H.
Edwards Engineering Corp.

Hydraulic lifting equipment.
Cotterell & Pither Ltd.

Insecticides.
Diamond Alkali Company.

Instruments, Process control.
Arca Regler G.m.b.H.
Bellingham & Stanley Ltd.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Evershed & Vignoles Ltd.
Honeywell Controls Ltd.
Metrimpex, Budapest.
Negretti & Zambra Ltd.
Neptune Meter Co. Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) 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.
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.
John Thompson—Kennicott Ltd.

Irrigation equipment.
British Overhead Irrigation Ltd.
Farrow & Sons Ltd.
Guthrie Allsebrook & Co. Ltd.
Harvey Fabrication Limited.
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.
CEKOP.
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.
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.)
Vulcan Iron Works Inc.
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.
N. Greening & Sons Ltd.
Gutehoffnungshütte Sterkrade A.G.
Harvey Perforators and Weavers Ltd.
Locker Industries (Sales) Ltd.
The Mirrlees Watson Co. Ltd.
Russell Constructions 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.
Burnett & Rolfe Ltd.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Kestner Evaporator & Engineering Co. Ltd.
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.)
Vulcan Iron Works Inc.

Knives, Milling—Drives.
The English Electric Co. Ltd., Electrical Plant Divn.
Siemens-Schuckertwerke A.G.
Western Gear Corporation.

Laboratory apparatus and equipment.
Endecotts (Filters) Ltd.
Haver & Boecker.
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.
Honeywell Controls 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.
John Thompson Motor Pressings Ltd.

Lens cleaning tissues.
J. Barcham Green Ltd.

Level indicators and controllers.
Arca Regler G.m.b.H.
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.
Vulcan Iron Works Inc.

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.
Unifloc Ltd.

Loading machinery.
Chaseside Engineering Co. Ltd.
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.
Spoorijzer N.V. Delft.

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

Magnetic separators.
Brimag Ltd.
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.
Lindars Automation Ltd.
Metal Detection Ltd.

Meters, Integrating, for liquids.
Neptune Meter Co. 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.
Dibert Bancroft & Ross Co. Ltd.
Farrel Corporation.
Soc. Fives Lille-Cail.
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.).
Vulcan Iron Works Inc.

Mill roll movement indicators and recorders.
Edwards Engineering Corp.

Centrifugal pumps—continued
L. A. Mitchell Group of Companies.
Rex Chainbelt Inc.
Saunders Valve Co. Ltd.
Stothert & Pitt Ltd.
G. & J. Weir Ltd.
Worthington Corporation.

Corrosion-proof pumps.
The Albany Engineering Co. Ltd.
A.P.V. Co. Ltd.
Howard Pneumatic Engineering Co. Ltd.
Kestner Evaporator & Engineering Co. Ltd.
Lee, Howl & Co. Ltd.
L. A. Mitchell Group of Companies.
Mono Pumps Ltd.
Worthington Corporation.

Filtrate pumps.
The Eimco Corporation.
Lee, Howl & Co. Ltd.
L. A. Mitchell Group of Companies.

Irrigation pumps.
British Overhead Irrigation Ltd.
Farrow & Sons Ltd.
Guthrie Allsebrook & Co. Ltd.
Chas. P. Kinnell & Co. Ltd.
Lee,Howl & Co. Ltd.
Martin-Markham Ltd.
L. A. Mitchell Group of Companies.
Worthington Corporation.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Membrane pumps.
The Eimco Corporation.

Molasses pumps.
The Albany Engineering Co. Ltd.
Amandus Kahl Nachf.
Comet Pump & Engineering Co. Ltd.
Howard Pneumatic Engineering Co. Ltd.
Jobson & Beckwith Ltd.
L. A. Mitchell Group of Companies.
Mono Pumps Ltd.
Stothert & Pitt Ltd.
Worthington Corporation
Zwicky Ltd., Viking Pumps Divn.

Positive-action pumps.
The Albany Engineering Co. Ltd.
Comet Pump & Engineering Co. Ltd.
Howard Pneumatic Engineering Co. Ltd.
Jobson & Beckwith Ltd.
Mono Pumps Ltd.
Stothert & Pitt Ltd.
G. & J. Weir Ltd.
Worthington Corporation.
Zwicky Ltd., Viking Pumps Divn.

Rotary pumps.
The Albany Engineering Co. Ltd.
Comet Pump & Engineering Co. Ltd.
The Eimco Corporation.
Howard Pneumatic Engineering Co. Ltd.
Jobson & Beckwith Ltd.
L. A. Mitchell Group of Companies.
Mono Pumps Ltd.
Machinefabriek Reineveld N.V.
Stothert & Pitt Ltd.
Worthington Corporation.
Zwicky Ltd., Viking Pumps Divn.

Self-priming pumps.
The Albany Engineering Co. Ltd.
Auto Diesels Ltd.
Comet Pump & Engineering Co. Ltd.
The Eimco Corporation.
Kestner Evaporator & Engineering Co. Ltd.
Lee, Howl & Co. Ltd.
L. A. Mitchell Group of Companies.
Mono Pumps Ltd.
Rex Chainbelt Inc.
Stothert & Pitt Ltd.
Zwicky Ltd., Viking Pumps Divn.

Sump pumps.
The Albany Engineering Co. Ltd.
The Eimco Corporation.
Jobson & Beckwith Ltd.

Vacuum pumps.
see Vacuum pumps.

Railway, *see* Locomotives *and* Track.

Rectifiers.
The English Electric Co. Ltd., Electrical Plant Divn.

Reduction gears.
ASEA.
The Borg-Warner International Corporation.
Maschinenfabrik Buckau R. Wolf A.G.
Crofts (Engineers) Ltd.
Eisenwerk Wülfel.
Farrel Corporation.
Lufkin Foundry & Machine Co.
Opperman Gears Ltd.
Power Plant Gears Ltd.
Salzgitter Maschinen A.G.
A. &. W. Smith & Co. Ltd.
Stork-Werkspoor (V.M.F.)
Vulcan Iron Works Inc.
Western Gear Corporation.

Refinery equipment.
American Plant Equipment Co.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
James Buchanan & Son (Liverpool) Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
CEKOP.
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.
The Mirrlees Watson Co. Ltd.
L. A. Mitchell Group of Companies.
Norit Sales Corporation Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stein Atkinson Stordy Ltd.
Stork-Werkspoor (V.M.F.)
Suchar Sales Corporation.
Technoexport Czechoslovakia.
Toyo Chemical Engineering Co. Ltd

Refractory bricks.
General Refractories Ltd.
Johns-Manville International Corp
John G. Stein & Co. Ltd.

Refractory cement.
General Refractories Ltd.
Johns-Manville International Corp.
Lafarge Aluminous Cement Co. Ltd.
John G. Stein & Co. Ltd.

Refractory concretes.
General Refractories Ltd.
John G. Stein & Co. Ltd.

Ridgers.
Massey-Ferguson (Export) Ltd.

Road transport pneumatic bulk vehicles.
Carmichael & Sons (Worcs.) Ltd.
Darham Industries (London) Ltd.
Thompson Bros. (Bilston) Ltd.

Rotary electric vibrators.
The English Electric Co. Ltd., Electrical Plant Division.
Sinex Engineering Co. Ltd.

Rotary feeders for bulk feeding of materials.
Babcock & Wilcox Ltd.

Rotary hoes.
Martin-Markham Ltd.

Rubber belt cane carriers.
Farrel Corporation.

Saccharimeters and polarimeters.
Bellingham & Stanley Ltd.
Bendix Electronics Ltd.
Metrimpex, Budapest.
Schmidt & Haensch.
The Sugar Manufacturers' Supply Co. Ltd.

Sack closing machines.
Thomas C. Keay Ltd.
Reed Medway Sacks Ltd.
The Sack Filling & Sewing Machine Syndicate Ltd.
The Thames Packaging Equipment Co.
Thimonier & Cie.

Sack counting equipment.
Siemens–Schuckertwerke A.G.
The Thames Packaging Equipment Co.

Sack filling machines.
Brecknell, Dolman & Rogers Ltd.
Howe Richardson Scale Co. Ltd.
Librawerk Pelz & Nagel K.G.
Reed Medway Sacks Ltd.
Richard Simon & Sons Ltd.

Sack printing machines.
Thomas C. Keay Ltd.

Sampling equipment.
New Conveyor Co. Ltd.
The Thames Packaging Equipment Co.

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.
Cocksedge & Co. Ltd.
Crone & Taylor (Engineering) Ltd.
The Deister Concentrator Co. Inc.
Electromagnets Ltd.
Fletcher and Stewart Ltd.

Screens, Vibrating.—*continued*
Wm. Gardner & Sons (Glos.) Ltd.
Gutehoffnungshütte Sterkrade A.G.
Harvey Perforators and Weavers Ltd.
Haver & Boecker.
Hein, Lehmann & Co. A.G.
International Combustion Products Ltd.
Locker Industries (Sales) Ltd.
Multi-Metal Wire Cloth Co. Inc.
Rex Chainbelt Inc.
Russell Constructions Ltd.
Sharples Centrifuges Ltd.
Sinex Engineering Co. Ltd.
Spencer (Melksham) Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Unifloc Ltd.
see also Juice Strainers and Screens.

Self-regulating alternators.
Heemaf N.V.

Sewing threads, Heavy grade.
James Stott Ltd.

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.
The English Electric Co. Ltd., Electrical Plant Division.
Siemens–Schuckertwerke A.G.
Western Gear Corporation.

Skip hoists.
Babcock & Wilcox Ltd.
Crone & Taylor (Engineering) Ltd.
New Conveyor Co. Ltd.
Strachan & Henshaw Ltd.
John Thompson Conveyor Co.

Spectrophotometers.
Metrimpex, Budapest.

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

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

Steam accumulators.
Babcock & Wilcox Ltd.
Centrifix Corporation.
Cochran & Co., Annan, Ltd.
Fletcher and Stewart Ltd.
Harvey Fabrication Limited.
The Sugar Manufacturers' Supply Co. Ltd.
John Thompson Water Tube Boilers Ltd.

Steam storage equipment.
see Steam accumulators.

Steam superheaters.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Foster Wheeler Ltd.
John Thompson Water Tube Boilers Ltd.

Steam traps.
von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke.
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 Turbin AB.
Worthington Corporation.

Steam turbo-alternator sets.
Belliss & Morcom Ltd.
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.
John Thompson Motor Pressings Ltd.

Stokers—Bagasse burning spreader type.
Babcock & Wilcox Ltd.
International Combustion Products Ltd.

Storage vessels, Stainless steel.
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Burnett & Rolfe Ltd.
Harvey Fabrication Limited.
G. Hopkins & Sons Ltd.
International Combustion Products Ltd.
Robert Jenkins & Co. Ltd.
L. A. Mitchell Group of Companies.
Thompson Bros. (Bilston) Ltd.
John Thompson (Dudley) Ltd.
John Thompson (Wolverhampton) Ltd.
Towler & Son Ltd.
Yorkshire Engineering & Welding Co. 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.
Maschinenfabrik Buckau R. Wolf A.G.
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.

Sugar machinery, General.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
CEKOP.
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.
Etablissements A. Olier.
Salzgitter Maschinen A.G.
A. &. W. Smith & Co. Ltd.
Southern Cross Engineering & Foundry Works.
Stork-Werkspoor (V.M.F.)
Technoexport Czechoslovakia.
Vulcan Iron Works Inc.

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.
Arca Regler G.m.b.H.
The British Rototherm Co. Ltd.
Evershed & Vignoles Ltd.
Fielden Electronics Ltd.
Honeywell Controls Ltd.
Negretti & Zambra Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
G. H. Zeal Ltd.

Test sieves, B.S. and A.S.T.M.
Endecotts (Filters) Ltd.
N. Greening & Sons Ltd.

Test sieves, B.S. and A.S.T.M.—*continued.*
Harvey Perforators and Weavers Ltd.
International Combustion Products Ltd.

Test sieve shakers.
Endecotts (Filters) Ltd.
International Combustion Products Ltd.

Thermometers.
The British Rototherm Co. Ltd.
Honeywell Controls Ltd.
Negretti & Zambra Ltd.
Taylor Instrument Companies (Europe) Ltd.
Tomey Industries Ltd.
G. H. Zeal Ltd.

Thickeners, Tray-type.
The Eimco Corporation.
International Combustion Products Ltd.

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

Tractors.
F. C. Hibberd & Co. Ltd.
Massey-Ferguson (Export) Ltd.

Tractors, Crawler.
Massey-Ferguson (Export) Ltd.

Tractors, Wheel.
Massey-Ferguson (Export) Ltd.

Trailers.
Cary Iron Works.
Robert Hudson (Raletrux) Ltd.
Lufkin Foundry & Machine Co.
Martin-Markham Ltd.
Massey-Ferguson (Export) Ltd.
L. S. Miedema.
F. W. Pettit Ltd.
Salopian-Kenneth Hudson Ltd.
Spoorijzer N.V. Delft.
Whitlock Bros. Ltd.

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

Trench gratings.
Grill Floors Ltd.

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

Tubes for boilers, evaporators, juice heaters, vacuum pans, etc.
Anaconda American Brass Ltd.
Babcock & Wilcox Ltd.
Hudson & Wright Ltd.
Serck Radiators Ltd.
Serck Tubes 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*).
G. Hopkins & Sons Ltd.
The Lunkenheimer Company.
T.I. Stainless Tubes Ltd.
Yorkshire Imperial Metals Ltd. (*copper, brass and plastic*).

Vacuum pans, *see* Pans.

Vacuum pumps.
Alley Compressors Ltd.
Sir W. H. Bailey & Co. 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.
Worthington Corporation.

Valves.
A.P.V. Co. Ltd.
Arca Regler G.m.b.H.
von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke.
Sir W. H. Bailey & Co. Ltd.
Blundell & Crompton Ltd.
Honeywell Controls Ltd.
The Lunkenheimer Company.
The Magnetic Valve Co. Ltd.
Saunders Valve Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.

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

Valves, Relief.
Sir W. H. Bailey & Co. Ltd.
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 Fläktfabriken.

Weighing machines.
Adequate Weighers 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.
Lindars Automation Ltd.
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.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
N. Greening & Sons Ltd.
Rotatools (U.K.) Ltd.

Wire cloth.
Endecotts (Filters) Ltd.
Ferguson Perforating & Wire Company.
Fontaine & Co. G.m.b.H.
N. Greening & Sons Ltd.
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.
CEKOP.
Harvey Fabrication Limited.
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.

Atlas Chemical Industries Inc.,
Wilmington, Delaware, 19899, U.S.A.
Tel.: OLympic 8-9311. *Cable:* Atchem, Wilmington.
TWX: 762-2355

Atlas-Goldschmidt G.m.b.H.,
Sollingstrasse 120, Essen 1, Germany.

Atlas de Mexico S.A.,
Buenavista No. 3-502, Mexico 3, D.F., Mexico.

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.

Anaconda American Brass Ltd.,
New Toronto, Toronto 14, Ontario, Canada.
Tel.: 259-6611. *Cable:* Copperbrass, Toronto.
Telex: 02-2144.

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

Arca Regler G.m.b.H.,
4151 Vorst b./Krefeld, Postfach 20, Germany.
Tel.: Anrath 2551. *Cable:* Arca, Vorst Bez. Düsseldorf.

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, P.O. Box 28, Otley Road, Harrogate, Yorks., England.
Tel.: Harrogate 68911. *Cable:* Aschem, Harrogate.
Telex: 5741.

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

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

Babcock & Wilcox, Société Française,
see Société Française des Constructions Babcock & Wilcox.

Bagshawe & Co. Ltd.,
Dunstable Works, Dunstable, Beds., England.
Tel.: Dunstable 64302-5. *Cable:* Bagshawe, Dunstable.

Sir W. H. Bailey & Co. Ltd.,
Albion Works, Patricroft, Manchester, England.
Tel.: Eccles 3487. *Cable:* Beacon, Eccles.
Telex: 66130.

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

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

Barrow Hepburn & Gale Ltd.,
Church Rd., Mitcham, Surrey, England.
Tel.: Mitcham 5121. *Cable:* Belting, Mitcham.
Telex: 22673 Bargale London.

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.
Telex: 33307

Bendix Electronics 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.,
see The Mirrlees Watson Co. Ltd.

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.

The Borg-Warner International Corporation,
36 South Wabash, Chicago 3, Ill., U.S.A.
Tel.: 663-2143. *Cable:* Borintco, Chicago.
Telex: 312/2220776.

Frederick Braby & Co. Ltd.,
Braby House, Smithfield Street, London E.C.1, 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.

John Bright & Brothers Ltd.,
P.O. Box 26, Rochdale, Lancs., England.
Tel.: Rochdale 4141. *Cable:* Doubler, Rochdale.

Brimag Ltd.,
80A Stratford Rd., Shirley, Solihull, Warwickshire, England.
Tel.: Shirley 4504.

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

British Charcoals & Macdonalds Ltd.,
50 Wellington St., Glasgow C.2, Scotland.
Tel.: City 6661. *Cable:* Brimac, Greenock.

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.

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

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:* Buckauwolf, Grevenbroich.
Telex: **08517111.**

Buell Ltd.,
8–10 Minerva Road, London N.W.10, England.
Tel.: Elgar 1761. *Cable:* Buellon, London N.W.10.

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 448–1. *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:* Incorrupt, London.
Telex: 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.

CEKOP Foreign Trade Enterprise,
Koscielna 12, Warsaw, Poland.
Cable: Cekop, Warszawa.
Telex: 81234.

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

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

Chaseside Engineering Co. Ltd.,
Blackburn, Lancashire, England.
Tel.: 4065. *Cable:* Chaseside, Blackburn.

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.

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 2111. *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.

Comtex Ltd.,
566 Cable Street, London E.1., England.
Tel.: Stepney 1400. *Cable:* Comfrac, London E.1.

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.

Cotton Bros (Longton) Ltd.,
Crown Works, Portland Rd., Longton, Stoke-on-Trent, Staffs., England.
Tel.: Stoke-on-Trent 33021. *Cable:* Cotbro, Longton.

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

Darham Industries (London) Ltd.,
see John Thompson Ltd.

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: 18151.

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, International Division,
99 Park Avenue, New York, N.Y., 10016, 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.

Dibert Bancroft & Ross Co. Ltd.,
New Orleans, La., U.S.A.
Tel.: 486-5821. *Cable:* Bancroft, New Orleans.

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.: 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.

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.

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

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.

The Fly Ash Arrestor Corporation,
P.O. Box 1883, Birmingham, Alabama, U.S.A.

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.

Wm. Gardner & Sons (Glos,) Ltd.,
Winglos House, Bristol Rd., Gloucester, England.
Tel.: Gloucester 21481. *Cable:* Gardner, Gloucester.

Garvens-Waagen-Fabrik G.m.b.H.,
Eichelkampstr. 4–10, Hannover-Wülfel, Germany.
Tel.: 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.

Glassfibrex Ltd.,
93 Hope St., Glasgow C.2, Scotland.
Tel.: Central 6214. *Cable:* Trius, Glasgow.

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.

Great Lakes Carbon Corporation,
630 Shatto Place, Los Angeles, California 90005, U.S.A.
Tel.: DUnkirk 1-5081. *Cable:* Dicalite, Los Angeles.
Telex: 06-74224.

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

N. Greening & Sons Ltd.,
P.O. Box 22, Britannia Works, Warrington, Lancs., England.
Tel.: Warrington 32401. *Cable:* Greenings, Warrington.
Telex: 62195.

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, 4 Düsseldorf–Grafenberg, Germany.
Tel.: Düsseldorf 66 61 21. *Cable:* Hoffnungshütte, Düsseldorf.
Telex: 0858 6710.

Guthrie, Allsebrook & Co. Ltd.,
Artesian Works, 29 Crown St., Reading, Berks., England.
Tel.: Reading 81741/2.

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 Fabrication Limited,
Greenwich Metal Works, Woolwich Road, London S.E.7, England.
Tel.: Greenwich 3232. *Cable:* Gaharvey, London S.E.7.

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

Haver & Boecker,
4740 Oelde/Westfalen, P.O. Box 163, Germany.
Tel.: (02522) 2331. *Cable:* Haboe, Oelde.
Telex: Haver Oelde 08 92 897.

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.: 15830. *Cable:* Heemaf, Hengelo.
Telex: 31307.

Heenan & Froude Ltd.,
Worcester, England.
Tel.: 15830. *Cable:* Heemaf, Hengelo.
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.,
9 Upper Belgrave St., London S.W.1, England.
Tel.: Belgravia 2212. *Cable:* Planetloco, London S.W.1.

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.

Honeywell Controls Ltd.,
Ruislip Road East, Greenford, Middx., England.
Tel.: Waxlow 2333. *Cable:* Minnreg, London.
Telex: 22765.

Honeywill-Atlas Ltd.,
Devonshire House, Mayfair Place, Piccadilly, London, W.1., England.
Tel: Mayfair 8867.

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.

Howard Pneumatic Engineering Co. Ltd.,
Fort Rd., Eastbourne, Sussex, England.
Tel.: Eastbourne 4804/5. *Cable:* Howmatic, Eastbourne.

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, Telex.
Telex: 25692.

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

International Combustion Ltd.,
19 Woburn Place, London W.C.1., England.
Tel.: Terminus 2833. *Cable:* Lopulco, Westcent, London.

International Combustion Products Ltd.,
19 Woburn Place, London W.C.1., England.
Tel.: Terminus 2833. *Cable:* Lopulco, Westcent, London.

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.

Jobson & Beckwith Ltd.,
Rotan Works, 62-66 Southwark Bridge Rd., London S.E.1, England.
Tel.: Waterloo 7102. *Cable:* Jobeclim, London.

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.

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.: 22061. *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.

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

Lindars Automation Ltd.,
see Dunfort & Elliott Process Engineering Ltd.

Link-Belt Company,
2680 Woolworth Building, New York, N.Y., 10007 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.

Lurgi Gesellschaft für Chemotechnik m.b.h.,
6 Frankfurt (Main), Lurgihaus, Germany.
Tel.: 55-06-51. *Cable:* Lurgitechnik, Frankfurt.

The Magnetic Valve Co. Ltd.,
7 Kendall Place, Baker Street, London, W.1, England.
Tel.: Hunter 1801. *Cable:* Magnevalve, London W.1.

Manlove Alliott & Co. Ltd.,
Bloomsgrove Works, Norton Street, Nottingham, England.
Tel.: Nottingham 75127. *Cable:* Manloves, Nottingham.

Martin-Markham Limited,
Lincolnshire Works, Stamford, Lincs.
Tel.: Stamford 2621/4. *Cable:* Marktrac, Stamford.

Massey-Ferguson (Export) Ltd.,
Banner Lane, Coventry, Warwickshire, England.
Tel.: Tile Hill 65211. *Cable:* Masferg, Coventry.
Telex: 31-655.

Mawdsley's Ltd.,
Dursley, Gloucestershire, England.
Tel.: Dursley 2921. *Cable:* Zone, Dursley.

Metal Detection Ltd.,
41a Summer Row, Birmingham 3, England.
Tel.: Central 0361. *Cable:* Metection, Birmingham.

Meter-Flow Ltd.,
North Feltham Trading Estate, Feltham, Middx., England.
Tel.: Feltham 5876. *Cable:* Selab, Feltham.
Telex: 23995.

Metrimpex,
P.O. Box 202, Budapest 62, Hungary.
Tel.: 126-620. *Cable:* Instrument, Budapest.
Telex: Instrument 677.

L. S. Miedema Landbouwwerktuigenfabriek N.V.,
Winsum (Fr.), Netherlands.
Tel.: 05173-241. *Cable:* Miedema, Winsumfriesland.

The Mirrlees Watson Co. Ltd.,
45 Scotland Street, Glasgow, C.5, Scotland.
Tel.: South 2701/4. *Cable:* Mirrlees, Glasgow.

L. A. Mitchell Group of Companies,
37 Peter Street, Manchester 2, England.
Tel.: Blackfriars 7224/7824. *Cable:* Inspection, Manchester.
Telex: 66653.

Mitchell Ropeways Ltd.,
Mitro House, Fengate, Peterborough, Northants., England.
Tel.: Peterborough 68471. *Cable:* Mitro, Peterborough.
Telex: 32-38.

Mono Pumps Ltd.,
Mono House, Sekforde Street, Clerkenwell Green, London, E.C.1, England.
Tel.: Clerkenwell 8911. *Cable:* Monopumps, London E.C.1.
Telex: 24453.

Herbert Morris Ltd.,
P.O. Box 7, Loughborough, Leicestershire, England.
Tel.: Loughborough 3123. *Cable:* Comorris, Loughborough.

Motor Rail Ltd.,
Simplex Works, Bedford, England.
Tel.: Bedford 4521. *Cable:* Simplex, Bedford.
Telex: 82254.

Multi-Metal Wire Cloth Co. Inc.,
1341 Garrison Avenue, Bronx, New York 10474, U.S.A.
Tel.: Kilpatrick 2-2500. *Cable:* Multimetal, New York.

Murray Iron Works Company,
Burlington, Iowa, U.S.A.
Tel.: Area Code 319,754-6541. *Cable:* Murrayiron, Burlington.

Negretti & Zambra Ltd.,
Stocklake, Aylesbury, Bucks., England.
Tel.: Aylesbury 4454/2612. *Cable:* Negretti, Aylesbury.

Neptune Meter Co. Ltd.,
Redcar, Yorkshire, England.
Tel.: Redcar 2205. *Cable:* Meters, Redcar.

Netherlands Instruments and Apparatus Manufacturing and Trading Co., A. H. Korthof Ltd.,
P.O. Box 46, N.Z. Voorburgwal 156, Amsterdam-C, Holland
Tel.: 230734. *Cable:* Korthofah, Amsterdam

The New Conveyor Co. Ltd.,
Brook Street, Smethwick, Birmingham 40, England.
Tel.: Smethwick 2100. *Cable:* Aptitude, Birmingham

Neyrpic,
Boite Postale 48, Grenoble (Isère), France.
Tel.: Grenoble 44-73-80. *Cable:* Neyrpic, Grenoble.

Niagara Filters Europe,
Division of N.V. "AMA",
Kwakelkade 28, Alkmaar, Holland.
Tel.: 16543/4. *Cable:* Niagara, Alkmaar.
Telex: 31791.

Nordberg Manufacturing Company,
Clifton House, 83/89 Uxbridge Road, Ealing, London W.5, England.
Tel.: Ealing 6765/9. *Cable:* Nordberg, London W.5.
Telex: 23108

Nordiska Maskinfilt AB.,
Halmstad, Sweden.
Tel.: 187 00 *Cable:* Nordiskafilt, Halmstad.
Telex: 3558.

Norit Sales Corporation Ltd.,
see N.V. Norit Verkoop Centrale.

N.V. Norit Verkoop Centrale,
2de Weteringplantsoen 15, Amsterdam C, Holland.
Tel.: Amsterdam 39911. *Cable:* Noritcarbo, Amsterdam.

Officine Meccaniche di Savona Servettaz-Basevi S.p.A.,
Piazza della Vittoria 10-7, Genova, Italy.
Tel.: 593.851. *Cable:* Basevi, Genova.

Etablissements A. Olier,
12 Avenue George V, Paris, France.
Tel.: 359-29-30. *Cable:* Androlier, Paris.

Opperman Gears Ltd.,
Newbury, Berkshire, England.
Tel.: 1701. *Cable:* Oppigear, Newbury.
Telex: 84157.

Pac-O-Power Inc.,
P.O. Box 20061, Houston, Texas 77025, U.S.A.
Tel.: RI 7-0901.

Parsons & Whittemore Lyddon Ltd.,
20-26 Wellesley Road, Croydon, Surrey, England.
Tel.: Municipal 3399. *Cable:* Lyddexpor, London.
Telex: 22491.

The Paterson Engineering Co. Ltd.,
129 Kingsway, London, W.C.2, England.
Tel.: Holborn 8787. *Cable:* Cumulative, London.
Telex: 24539.

Pennine Chainbelt Co. Ltd.,
Modder Place, Armley, Leeds 12, England.
Tel.: Leeds 63-8755. *Cable:* Pennine, Leeds

Logan Perkins,
613 Dumaine Street, New Orleans 16, La., U.S.A.
Cable: Perco, New Orleans.

Permag Ltd.,
see Rapid Magnetic Ltd.

The Permutit Co. Ltd.,
Permutit House, Gunnersbury Avenue, London W.4, England.
Tel.: Chiswick 6431. *Cable:* Permutit, London W.4.
Telex: 24440.

F. W. Pettit Ltd.,
Moulton, Spalding, Lincs., England.
Tel.: Moulton Lincs. 458. *Cable:* Agripet, Moulton, Spalding.

Pittsburgh Chemical Company, Activated Carbon Division,
Grant Building, Pittsburgh 19, Pa., U.S.A.
Tel.: 281-8950. *Cable:* Pitkemco, Pittsburgh.

Plymouth Locomotive Works,
Division of The Fate-Root-Heath Company, Plymouth, Ohio, U.S.A.
Tel.: 419-687-4641. *Cable:* Fateco, Plymouth.

Porritt Bro. & Austin Ltd.,
Broadway Mills, Haslingden, Lancs., England.
Tel.: Rossendale 2421. *Cable:* Neotex, Haslingden, Telex
Telex: 63127.

Porritts & Spencer Ltd, Industrial Fabrics Export Division,
Broadway, Haslingden, Lancs., England.
Tel.: Rossendale 2421. *Cable:* Neotex, Haslingden, Telex
Telex: 63127.

Port Engineering Works Ltd.,
Andrew Yule & Co., Ltd.,
8 Clive Row, Calcutta, India.
Tel.: 22-4311. *Cable:* Yuletide, Calcutta

Pott, Cassels & Williamson Ltd.,
see The Mirrlees Watson Co. Ltd.

Power Plant Gears Ltd.,
West Drayton, Middlesex, England.
Tel.: West Drayton 2626. *Cable:* Roc, West Drayton.

Priestman Brothers Ltd.,
Hedon Road, Hull, England.
Tel.: 75111. *Cable:* Priestman, Hull.
Telex: 52120.

H. Putsch & Comp.,
Postfach 1263, Frankfurter Str. 5–25, 58 Hagen, Germany.
Tel.: Hagen 22341. *Cable:* Putsch, Hagen.
Telex: 0823/795.

Railway Mine & Plantation Equipment Ltd.,
Imperial House, Dominion Street, London, E.C.2, England.
Tel.: Monarch 7000. *Cable:* Minplan, London E.C.2.
Telex: 23787 (Code "Steel").

Ransome & Marles Bearing Co. Ltd.,
Newark-on-Trent, Notts., England.
Tel.: Newark 5123. *Cable:* Bearings, Newark.
Telex: 37-626.

Rapid Magnetic Ltd.,
Lombard Street, Birmingham 12, England.
Tel.: Victoria 1137. *Cable:* Magnetism, Birmingham

Reed Medway Sacks Ltd.,
Larkfield, near Maidstone, Kent, Entland.
Tel.: Maidstone 7–7777. *Cable:* Satchelsac, Larkfield.
Telex: 89148 Reed, Aylseford.

Machinefabriek Reineveld N.V.,
P.O. Box 22, Haagweg 127, Delft, Holland.
Tel.: Delft 24890. *Cable:* Reineveld, Delft.
Telex: 31027.

Renold Chains Ltd.,
Renold House, Wythenshawe, Manchester, England.
Tel.: Mercury 5221 (STD 061). *Cable:* Driving, Manchester.
Telex: 66320.

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

Richardsons, Westgarth & Co. Ltd.,
P.O. Box 2, Wallsend, Northumberland, England.
Tel.: Wallsend 623141. *Cable:* Richwest, Wallsend.
Telex: 53–314.

Rose, Downs & Thompson Ltd.,
Old Foundry, Hull, England.
Tel.: 29864. *Cable:* Rosedowns, Hull.
Telex: 52226.

Rotameter Manufacturing Co. Ltd.,
(A member of the Elliott-Automation Group),
330 Purley Way, Croydon, Surrey, England.
Tel.: Croydon 3816. *Cable:* Rotaflo, Croydon.
Telex: 24292.

Rotatools (U.K.) Ltd.,
Pembroke Works, 43/45 Pembroke Place, Liverpool 3, England.
Tel.: Royal 6117 and 2682. *Cable:* Scalewell, Liverpool.

Russell Constructions Ltd.,
Russell House, Adam Street, Adelphi, London W.C.2, England.
Tel.: Temple Bar 0055/9. *Cable:* Russelcon, London, W.C.2.

Sackfilling & Sewing Machine Syndicate Ltd.,
Timewell Works, Lockfield Avenue, Brimsdown, Enfield, Middlesex, England.
Tel.: Howard 1188. *Cable:* Fecit, Enfield.
Telex: 9 522 445.

Salopian–Kenneth Hudson Ltd.,
Prees, Whitchurch, Shropshire, England.
Tel.: Prees 331–5. *Cable:* Implements, Prees.

Salzgitter Maschinen Aktiengesellschaft,
Salzgitter-Bad, Western Germany.
Tel.: Salzgitter 3441. *Cable:* Samag, Salzgitter-Bad.

Sankey Green Wire Weaving Co. Ltd.,
Thelwall New Road, Thelwall, Nr. Warrington, Lancs., England
Tel.: Warrington 61211. *Cable:* Sanco, Warrington.

SAPAL Société Anonyme des Plieuses Automatiques,
Case Postal 487, Lausanne-Ecublens, Switzerland.
Tel.: (021) 34 44 61. *Cable:* Autoplieuse, Lausanne.
Telex: 23 541.

Saunders Valve Co. Ltd.,
Cwmbran, Monmouthshire, England.
Tel.: Cwmbran 3081. *Cable:* Saunval, Newportmon.

Schill & Seilacher Chemische Fabrik,
Hamburg 48, Liebigstrasse 59, Germany.
Tel.: 734851. *Cable:* Schillseilacher, Hamburg.
Telex: 02 12932.

Schmidt & Haensch,
Berlin 62, Naumannstrasse 33, Germany.
Tel.: 71 16 25/6. *Cable:* Polarisation, Berlin.

Schumacher'sche Fabrik.
Bietigheim/Württemberg, Germany.
Tel.: 7721. *Cable:* Schumafilt, Bietigheim.
Telex: 724217.

Serck Radiators Ltd.,
Warwick Rd., Birmingham 11, England.
Tel.: Victoria 4353. *Cable:* Serckrad, Birmingham.
Telex: 33-141.

Serck Tubes Ltd.,
Warwick Rd., Birmingham 11, England.
Tel.: Victoria 4353. *Cable:* Nerleak, Birmingham.
Telex: 33-141.

N.V. Servo-Balans,
Wegastraat 40, Den Haag, Holland.
Tel.: Den Haag 723874. *Cable:* Servobalans, Den Haag.

Sharples Centrifuges Ltd.,
Doman Road, Camberley, Surrey, England.
Tel.: Camberley 3101/7. *Cable:* Superspin, Camberley.
Telex: 8583.

Siemens–Schuckertwerke A.G.,
Berlin-Erlangen, Germany.
Tel.: 811–09131. *Cable:* Siemenschuckert, Erlangen.
Telex: 0629871.

SIG Swiss Industrial Company,
Neuhausen Rhine Falls, Switzerland.
Tel.: (053) 5 77 31. *Cable:* Sig, Neuhausenamrheinfall.
Telex: 5 27 23.

Simon Handling Engineers Ltd.,
Cheadle Heath, Stockport, Cheshire, England.
Tel.: Gatley 3621. *Cable:* SHEL, Telex, Stockport.
Telex: 66–287.

Richard Simon & Sons Ltd.,
Phoenix Works, Basford, Nottingham, England.
Tel.: Nottingham 75136. *Cable:* Balance, Nottingham.

The Sinex Engineering Co. Ltd.,
North Feltham Trading Estate, Central Way, Feltham, Middlesex, England.
Tel.: Feltham 5081. *Cable:* Sinexvibro, Feltham.

Richard Sizer Ltd.,
Cuber Works, Hull, England.
Tel.: Hull 23155. *Cable:* Sizer, Hull Telex.
Telex: 52236.

The Skefko Ball Bearing Co. Ltd.,
Luton, Beds., England.
Tel.: Luton 21244. *Cable:* Skefko, Luton.
Telex: 82120.

A. & W. Smith & Co. Ltd.,
21 Mincing Lane, London, E.C.3, England.
Tel.: Mansion House 4294. *Cable:* Sugrengine, London.
Telex: 2–2404.

Société Française des Constructions Babcock & Wilcox,
48 rue La Boétie, Paris 8e, France.
Tel.: ELY 8950; BAL 21-50. *Cable:* Babcock, Paris.
Telex: 25763.

Southern Cross Engineering & Foundry Works,
Calle Marginal 59, Urbanización Mercedita, Box 910, Ponce, Puerto Rico 00732.
Tel.: 842-1380 Ponce, Puerto Rico.
Cable: Sudcross, Ponce, Puerto Rico.

Sparkler Filter Manufacturing Co.,
101 Cartwright Road, Conroe, Texas, U.S.A.
Tel.: Pleasant 6–4471.

Sparkler Filters (G.B.) Ltd.,
37 Peter Street, Manchester 2, England.
Tel.: Blackfriars 7224. *Cable:* Inspection, Manchester.
Telex: 66653.

S.P.E.I. Chim.,
106 Rue d'Amsterdam, Paris (9e), France.
Tel.: Pigalle 73–79. *Cable:* Rectifpast, Paris.
Telex: 23012 Speichim Paris.

Spencer (Melksham) Ltd.,
(A member of the Elliott-Automation Group),
Melksham, Wilts., England.
Tel.: Melksham 3481. *Cable:* Spencer, Melksham.

Spoorijzer N.V. Delft,
Postbus 10, Delft, Holland.
Tel.: 25931. *Cable:* Spoorijzer, Delft.
Telex: 31031.

Stabilag Engineering Ltd.,
Mark Road, Hemel Hempstead, Herts., England.
Tel.: Boxmoor 4481/4. *Cable:* Stabilag, Hemel Hempstead.

Stal-Laval Turbin AB.,
Finspong, Sweden.
Tel.: 0122–120 00. *Cable:* Stalaval, Finspong.
Telex: 640 45.

Standard Steel Corporation,
5073 Boyle Avenue, Los Angeles 58, California, U.S.A.
Tel.: LU 5–1234. *Cable:* Stansteel, Los Angeles.
TWX: 910-321-3090.

Stein Atkinson Stordy Ltd.,
Cumbria House, Goldthorn Hill, Wolverhampton, England.
Tel.: Wolverhampton 37341. *Cable:* Thermal, Wolverhampton.

John G. Stein & Co. Ltd.,
Bonnybridge, Stirlingshire, Scotland.
Tel.: Banknock 255/8; 361/2. *Cable:* Stein, Bonnybridge, Telex.
Telex: 77506.

Stockdale Engineering Ltd.,
Poynton, Cheshire, England.
Tel.: Poynton 2601. *Cable:* Mechanical, Poynton.

Stord Bartz Industri A/S.,
P.O. Box 777, Bergen, Norway.
Tel.: Bergen 10030. *Cable:* System, Bergen.
Telex: 2051.

Stork-Werkspoor (V.M.F.),
Hengelo, Holland.
Tel.: Hengelo 2641–4341. *Cable:* Machinefabriek, Hengelo.
Telex: 31324.

Stothert & Pitt Ltd.,
Lower Bristol Road Bath, Somerset, England.
Tel.: Bath 2277/63041 *Cable:* Stothert, Bath.
Telex: 44177.

James Stott Ltd.,
P.O. Box 33, Rochdale, Lancs., England.
Tel.: Rochdale 49611. *Cable:* Doubler, Rochdale.

Strachan & Henshaw Ltd.,
Ashton Works, Ashton Vale Road, Bristol, 3 England.
Tel.: Bristol 664677. *Cable:* Stelhoist, Bristol, Telex.
Telex: 44170.

Suchar Sales Corporation.,
9 East 41st Street, New York 17, N.Y., U.S.A.
Tel.: TN 7–0540. *Cable:* Sucharing, New York.

The Sugar Manufacturers' Supply Co. Ltd.,
7–8 Idol Lane, London, E.C.3, England.
Tel.: Mansion House 4710. *Cable:* Sumasuco, London, E.C.3.

Sutcliffe, Speakman & Co. Ltd.,
Guest St., Leigh, Lancashire, England.
Tel.: Leigh 72101. *Cable:* Utilization, Leigh.

A.B. Svenska Fläktfabriken,
P.O. Box 20040, Stockholm 20, Sweden.
Tel.: Stockholm 23 83 20. *Cable:* Flaktfabriken.
Telex: 10430.

Taylor Instrument Companies (Europe) Ltd.,
Gunnels Wood Road, Stevenage, Herts., England.
Tel.: Stevenage 3210. *Cable:* Taylortrol, Stevenage.
Telex: 82281.

Technical Paper Sales Ltd.,
30–34 New Bridge Street, London, E.C.4, England.
Tel.: Fleet Street 9833. *Cable:* Papermen, London, Telex.
Telex: 22600 Stasaleco.

Technoexport Czechoslovakia,
56 Vaclavske nam., Prague 2, Czechoslovakia.
Cable: Technoexport, Prague.

The Thames Packaging Equipment Co.
28 City Road, London, E.C.1, England.
Tel.: Monarch 7387/8. *Cable:* Pakitup, London.

Thimmonier & Cie.,
79 Rue de Bourgogne, Lyon, France.
Tel.: 83-73-45. *Cable:* Thimonnier Machines, Lyon.

Thompson Bros. (Bilston) Ltd.,
see John Thompson Ltd.

John Thompson Ltd.,
Ettingshall, Wolverhampton, England.
Tel.: Bilston 41121. *Cable:* Boiler, Telex, Wolverhampton.
Telex: 33-212.

John Thompson Conveyor Co.,
see John Thompson Ltd.

John Thompson (Dudley) Ltd.,
see John Thompson Ltd.

John Thompson-Kennicott Ltd.,
see John Thompson Ltd.

John Thompson Motor Pressings Ltd.,
see John Thompson Ltd.

John Thompson Pipework Ltd.,
see John Thompson Ltd.

John Thompson Water Tube Boilers Ltd.,
see John Thompson Ltd.

John Thompson (Wolverhampton) Ltd.
see John Thompson Ltd.

T.I. Stainless Tubes Ltd.,
Broadwell Road, Oldbury, Birmingham, England.
Tel.: Broadwell 1585. *Cable:* Tistan, Oldbury, Telex.
Telex: 33387.

Tintometer Sales Ltd.,
Salisbury, Wilts., England.
Tel.: Salisbury 2837/6160. *Cable:* Tintometer, Salisbury.

Tomey Industries Ltd.,
Catherine Street, Aston, Birmingham 6, England.
Tel.: East 1786. *Cable:* Tomey, Birmingham.

Towler & Son Ltd.,
Riverbank Works, Stratford, London, E.15, England.
Tel.: Maryland 3214. *Cable:* Dogal, London, E.15.

Toyo Chemical Engineering Co. Ltd.,
72, Ohirakicho 2-chome, Fukushima-ku, Osaka, Japan.
Tel.: Osaka (461) 8861–5. *Cable:* Toyokakoki, Osaka.

Turner Brothers Asbestos Co. Ltd.,
P.O. Box 40, Rochdale, Lancs., England.
Tel.: Rochdale 4221. *Cable:* Turners, Rochdale.
Telex: 63–174.

Unifloc Ltd.,
11/16 Adelaide Street, Swansea, Glam., Wales.
Tel.: 55164. *Cable:* Unifloc, Swansea.

Vaughan Crane Co. Ltd.,
West Gorton, Manchester 12, England.
Tel.: East 2771/8. *Cable:* Vaunting, Manchester 12.

H. Vissers N.V.,
Nieuw Vennep, Holland.
Tel.: Nieuw Vennep 841. *Cable:* Vicon, Nieuw Vennep.
Telex: 31769.

Vulcan Iron Works Inc.,
P.O. Box 661, Wilkes-Barre, Penna., U.S.A.
Tel.: 822-2161 Area Code: 717. *Cable:* Vulworks, Wilkes-Barre.

Walmsleys (Bury) Ltd.,
(incorporating Ashworth & Parker Ltd.).
Riverside Works, Woodhill Road, Bury, Lancs., England.
Tel.: Bury 5125/6. *Cable:* Kinetic, Bury.

Watson, Laidlaw & Co. Ltd.,
98 Laidlaw Street, Glasgow, C.5, Scotland.
Tel.: South 2545. *Cable:* Fugal, Glasgow.

F. E. Weatherill Ltd.,
Tewin Road, Welwyn Garden City, Herts., England.
Tel.: 20141. *Cable:* Weatherhyd, Welwyn Garden City.
Telex 24198.

Weigelwerk Aktiengesellschaft,
43 Essen, Altendorferstr. 110, Germany.
Tel.: Essen 20461. *Cable:* Weigelwerk, Essen.
Telex: 0857 404.

G. & J. Weir Ltd.,
Cathcart, Glasgow, S.4, Scotland.
Tel.: Merrylee 7141. *Cable:* Giweir, Glasgow, Telex.
Telex: 77161-2.

Wellington Engineering Works Ltd.,
Great Bridge, Tipton, Staffs., England.
Tel.: Tipton 2761. *Cable:* Vigilantia, Tipton.

Werkspoor N.V.,
see Stork-Werkspoor (V.M.F.)

Western Gear Corporation,
Industrial Products Division, P.O. Box 126, Belmont, Calif., U.S.A.
Tel.: LYtel 3–7611. *Cable:* Westgear, Los Angeles.
Telex: 03–4468.

The Western States Machine Company,
Hamilton, Ohio, U.S.A.
Tel.: 513–894–4758. *Cable:* Wesmaco, Hamilton, Ohio.

Westfalia Separator A.G.,
474 Oelde, Germany.
Tel.: Oelde 2222. *Cable:* Westfalia, Oelde.
Telex: 892899.

Joseph Westwood & Co. Ltd.,
Napier Yard, Millwall, London, E.14, England.
Tel.: East 1043. *Cable:* Westwood, London.

Whitlock Bros. Ltd.,
Great Yeldham, Essex, England.
Tel.: Great Yeldham 305.
Cable: Whitlok, Great Yeldham Telex.
Telex: 1896.

H. Williams & Son Ltd., Industrial Descaling Tools Division,
Lark Works, St. Albans Road, Sandridge, St. Albans, Herts., England.
Tel.: St. Albans 56026. *Cable:* Descaltools, St. Albans.

Worthington Corporation,
Harrison, New Jersey, U.S.A.
Tel.: 201–HU–4–1234. *Cable:* Worthington, Harrison.
Telex: 201–621–7848.

Wright Rain Ltd.,
Crowe, Ringwood, Hampshire, England.
Tel.: Ringwood 2251. *Cable:* Wrightrain, Ringwood, Telex.
Telex: 41206.

Wright Rain Africa (Pvt.) Ltd.,
35 Birmingham Road, Box 3237, Salisbury, Southern Rhodesia.
Tel.: Salisbury 25810. *Cable:* Wrightrain, Salisbury.

Wyssmont Co. Inc.,
1470 Bergen Blvd., Fort Lee, N.J., U.S.A.
Tel.: 210-947-4600. *Cable:* Wyssmontco, Fort Lee.

Otto H. York Co. Inc.,
6 Central Avenue, West Orange, N.J., U.S.A.
Tel.: OR 7-3000. *Cable:* Ottoyork, West Orange.

Yorkshire Engineering & Welding Co. Ltd.,
Friars Works, Bradford Rd., Idle, Bradford, Yorks., England.
Tel.: Idle 470. *Cable:* Yewco, Bradford.

Yorkshire Imperial Metals Ltd.,
P.O. Box 166, Leeds, Yorkshire, England.
Tel.: Leeds 7–2222. *Cable:* Yorkimp, Leeds.
Telex: 55–130.

G. H. Zeal Ltd.,
Lombard Road, Morden Road, Merton, London S.W.19. England.
Tel.: Liberty 2283 (4 lines). *Cable:* Zealdom, London, S.W.19.

Zwicky Ltd., Viking Pumps Divn.,
772/7 Buckingham Ave., Slough Trading Estate, Slough Bucks, England.
Tel.: Slough 21201. *Cable:* Zwiklim, Slough.