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A TECHNICAL AND COMMERCIAL PERIODICAL DEVOTED ENTIRELY TO THE SUGAR INDUSTRY

EDITED BY:

D. LEIGHTON, B.Sc., F.R.I.C.

M. G. COPE, A.I.L.(*Rus.*)

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PANEL OF REFEREES

ERRATA AND CORRIGENDA

Page 24. Line 3 from bottom of column 2. Read "PIETRZYKOWSKI" for "PIETRZKOWSKI".

Page 39. Line 49 of column 2. Read "4-year" for "4-your".

Page 40. Line 13 of column 1. Read "WIEHE" for "WEIHE".

Page 180. Line 4 from bottom of column 2. Read "H. GRUSZECKA" for "A. GRUSZECKA".

Page 260. Line 9 of column 2. Read "BHOJ" for "BHOJE".

Page 260. Line 18 of column 1. Read "ARCENAUX" for "ARCENEAUX".

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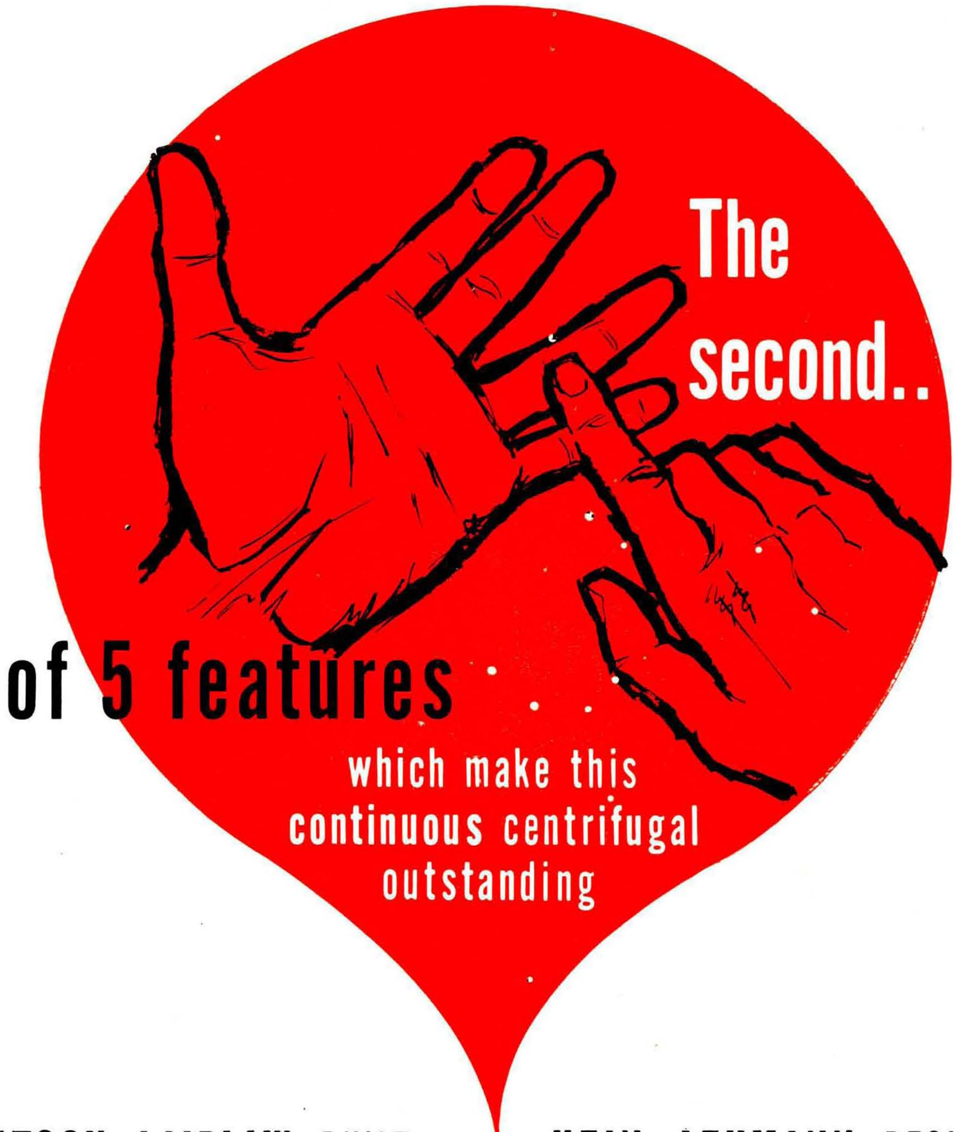

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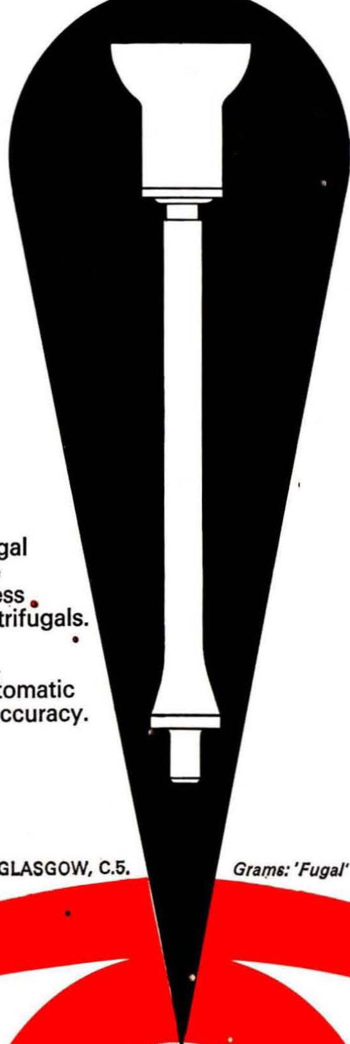

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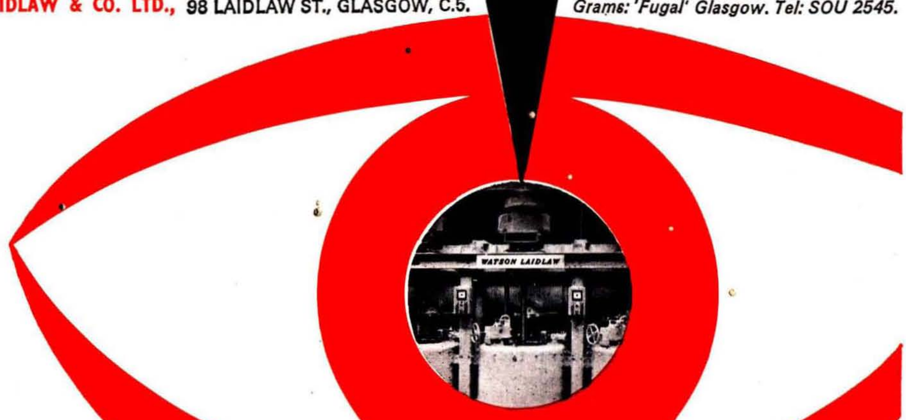

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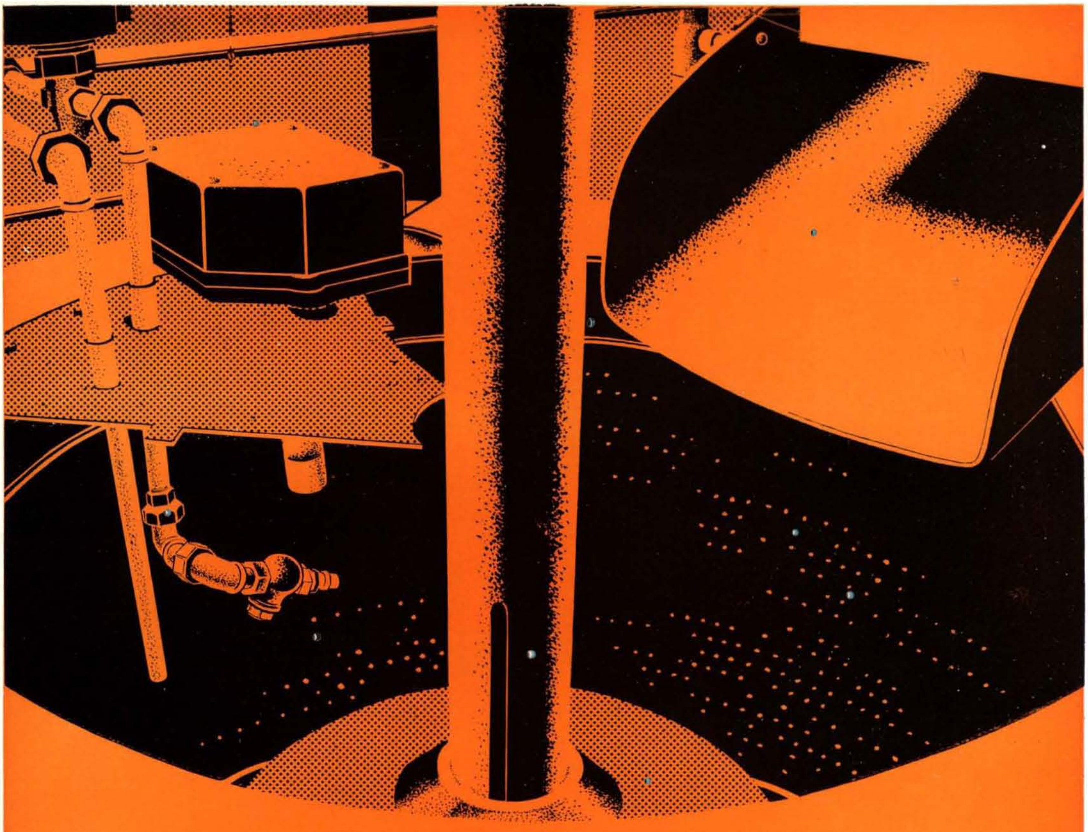

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NOTES AND COMMENTS

U.S. sugar quotas, 1963.

On the 27th November the U.S. Dept. of Agriculture announced that it proposed to set the U.S. sugar requirements for 1963 at 9,800,000 short tons, raw value, as compared with 10,000,000 tons in 1962[1]. It was also proposed to fix the import fee on global quota sugars at $1.80 per 100 lb as compared with the 1962 fee of $2.40. Consequently the import fee on raw sugar imported under individual foreign country quotas, other than the Philippines, would be 36 cents per 100 lb (20 % of the $1.80 fee). The Cuban quota under such a proposal would be 1,504,341 tons, and it is proposed that 750,000 tons of this be authorized as global quota sugar for entry between 1st January and 31st May 1963. The trade was asked to state its views on the proposals by the 5th December.

B. W. Dyer & Company, the New York sugar economists and brokers, have pointed out, however, that the import fee of $1.80 per 100 lb results in a net price of only about $3.75 per 100 lb, whereas prices paid in the world market are around $4.00 or more per 100 lb. Moreover, the availability of U.S. supplies is further complicated by the legislative provision which gives special consideration to global-quota countries that buy U.S. agricultural commodities in return. "Barter" deals may be feasible, claims Dyer, when there is a substantial premium in the U.S. sugar price, but hardly practicable when there is an apparent discount.

Last year, the U.S. had to rely on many new sources to replace Cuban sugar. Cuba, however, received a U.S. price premium generally averaging over $2.00 per 100 lb above the world price, but global-quota suppliers do not receive a premium.

* * *

Commonwealth Sugar Agreement.

The Ministry of Agriculture, Fisheries and Food announced on the 23rd November 1962 that the series of meetings between the parties to the Commonwealth Sugar Agreement which began on 5th November had been concluded. Discussions took place on the price to be paid for the 1963 negotiated price sugar bought by the United Kingdom under the terms of the Agreement and on other matters arising under the Agreement.

Full agreement was reached on the following matters:

(i) *Price for* 1963.—The price to be paid for 1963 negotiated price sugar will be £46. 0s. 10d. per long ton. This compares with the negotiated price in 1962 of £45. 15s. 3d.

(ii) *Negotiated Price Quotas.*—Negotiated Price Quotas for the year 1963 will be 5% above basic quotas. These quotas (i.e. the quantities of sugar bought by the Sugar Board on behalf of Her Majesty's Government at the negotiated price) are fixed under Articles 13 and 15 of the Commonwealth Sugar Agreement, the latter of which provides for an increase when United Kingdom consumption of sugar exceeds 2,550,000 tons. Negotiated price quotas in 1962 were 4½% above basic.

(iii) *Duration of the Agreement.*—The Agreement has been extended for a further year and will now run to the end of 1970.

Supply of sugar to New Zealand.—The present arrangements, whereby the exporting parties to the Commonwealth Sugar Agreement supply 75,000 long tons of sugar a year to New Zealand, terminate on the 31st December, 1963. The New Zealand Government and the Parties to the Commonwealth Sugar Agreement have agreed to an extension of these arrangements. There will be no fixed term to the agreement, but either party may request a review of the arrangements if in their opinion circumstances so warrant.

The negotiated price quotas for 1963 for individual territories are as follows:—

	1963	
Australia	315,000	long tons
British Honduras	18,900	,, ,,
East Africa	5,250	,, ,,
Fiji	126,000	,, ,,
Mauritius	351,750	,, ,,
The West Indies and British Guiana	673,103	,, ,,
	1,490,003	,, ,,

[1] *Lamborn*, 1962, **40**, 244.

An annotated text of the Commonwealth Sugar Agreement was published in London in April 1962[1]. Copies are available from the Commonwealth Sugar Exporters, 40 Norfolk Street, Strand, London W.C.2, price 3s. 0d.

* * *

Sugar in the U.S.S.R.

Information on sugar consumption in the Union of Soviet Socialist Republics is included in a review, by D. A. Music, of the sugar industry in that country, published in a recent issue of FAO's *Monthly Bulletin of Agricultural Economics and Statistics*[2].

Increased sugar consumption "represents a considerable change in the dietary habits of the Soviet population", to which imports of raw sugar from Cuba have made a particularly important contribution. In 1960 Cuban sugar was 17% of the total sugar refined in the Soviet Union while in 1961 it had increased to 27%.

Two-thirds of the Cuban sugar processed in 1960 was in the off-season. Processing was done mostly in the Ukraine and the Baltic Republics within easy reach of the Black Sea and the Baltic Sea ports. However, up to 300 tons of imported cane sugar was being processed daily as far east within the U.S.S.R. as Kazakhstan in Central Asia in the second half of 1961. Altogether 71 factories were busy processing raw Cuban sugar in the Soviet Union in the summer of 1961.

The Soviet Union has also been rapidly increasing its own cultivation of sugar beet. The area under beet rose by more than one million hectares between 1957 and 1961 alone. This increased area by itself is more than the total combined sugar beet areas of France, West Germany, Italy and the U.K. put together. At present the sugar beet area is estimated at 3·26 million hectares and is still rising. A big part of the growth in sugar beet cultivation has been concentrated in the Krasnodar region between the Black Sea and the Caspian, where 16 large new beet processing factories were already in operation in 1961. The Soviet authorities are encouraging sugar beet cultivation by putting a 30% premium on the price of sugar beet paid to collective farms in the first three years of new beet cultivation.

Although the yield of beet per hectare remains low, the rise in the acreage has led to a great expansion in sugar beet production. From some 30 million tons in 1954–1961, it is planned to increase production to about 80 million tons by 1965. This target could be reached if the current rise in acreage continues.

Not only are the peoples of the Soviet Union eating more sugar, but the country is refining more than it did three years ago. Parallel with the large growth in production, processing capacity of the factories has been expanded rapidly. At the start of the current seven-year plan in January 1959, there were 236 factories in the Soviet Union. These could process about 290,000 tons of sugar beet per day. By the beginning of 1962, 269 factories were in operation with a daily capacity of over 442,000 tons of beet. By 1965 a further 55 factories are to be built, the construction of 50 having already started. By then the sugar industry in the Soviet Union will have a processing capacity of about 630,000 tons per day, and the U.S.S.R. could process any quantity of sugar which Cuba may sell to it.

While processing capacity would not be a bottleneck in sugar production in the U.S.S.R., the country still has to solve the problems of high factory costs and lower sugar yields and wastage. At present, transport of beet from the fields to the factories is a high proportion of the cost incurred by some factories. This the U.S.S.R. plans to overcome by a concentration of beet sowings, and the construction of new factories close to the cultivated areas.

* * *

Caroni Ltd. 1961/62 report.

From a purely operational point of view 1961/62 has been a year of frustration. In late 1961 was forecast a crop which would be about average, although certainly not as good as 1961. In the event, conditions were rather worse than had been expected. There was patchy rainfall during the growing period and heavy attacks by the later broods of the froghopper pest, intensified by a drought in October and November. Moreover, for the first time in six years, there were sporadic labour troubles which cost, in all, 26 working days during crop.

Sugar production was 179,974 tons, compared with 103,620 tons the previous year and an average of 85,051 tons over the last five years (1957/61).

The 1962 figure includes the results of the Ste. Madeleine Sugar Company, which became a wholly-owned subsidiary during the year and produced 75,144 tons of sugar.

The Woodford Lodge Estates Limited, which was acquired in July, 1961, was wound up during the year and its assets transferred to Caroni.

The 1962 crop was sold in the following markets:

	1962		1961	
	%	*Average f.a.s. price £ per ton 96° Basis*	%	*Average f.a.s. price £ per ton 96° Basis*
Trinidad	17	36·35	11	36·10
U.K. & Canada	78	42·05	69	40·35
U.S.A.	5	42·00	20	43·95
	100	41·05	100	40·60

A very good growing period has been had for the 1963 crop, although at times the rains have been almost excessive. Froghopper attacks so far have been relatively light. At both estates the cane looks excellent, but there must be a dry reaping season and no labour disturbances if a really good crop is to be produced.

[1] *I.S.J.*, 1962, **64**, 190.
[2] 1962, **11**, (9), 13–20.

REQUIREMENTS FOR CANE MECHANIZATION

Considerations on some factors influencing the possible development of a unified system of sugar cane cultivation, and on the requirements for mechanization of operations.

H. A. THOMPSON
(Caroni Ltd. and The West Indies Sugar Co. Ltd.)

PART I

THE development of a fully integrated system for mechanized field operations in the sugar cane industry has not really progressed very far as yet, with the exception of developments in Louisiana and Hawaii. The trend of mechanization which has taken place in these territories is quite divergent, and closely related to special circumstances in each country, which, unfortunately, are not really representative of many of the major sugar producing areas of the world.

In many other sugar producing areas strenuous efforts are now being made to mechanize operations much more completely than has hitherto been the case, and in particular cane loading and cutting are receiving attention. It is of interest to consider mechanization, on a rather broad basis, to see to what extent it might be possible to develop cultivation techniques and equipment, which would find almost worldwide application, or which could be readily modified to suit localized conditions.

To gain a basic concept of what is required from a field mechanization programme it might be best to consider, first of all, the range of conditions under which the major proportion of the sugar cane is grown, so as to define fairly precisely the requirements as far as mechanization is concerned.

With the exception of some relatively small areas, such as the very wet Hilo coast in Hawaii and completely arid areas of Peru, sugar cane is grown in areas which experience a marked climatic contrast between the growing and the cropping seasons, particularly as regards rainfall. Successful sugar production is very dependent on a dry cropping period, which facilitates harvesting operations as well as providing ripening conditions so as to develop the maximum sugar content in the cane. The reliability of the dry season reaping period varies considerably, from crop periods in which rain is a very rare occurrence, as for example in Peru and parts of Africa and India, to areas in which the cropping season can occasionally be marred by quite heavy rainfall. The latter areas are often associated with oceanic climates and are in the tropics proper. Expansion of the sugar industry in the continental areas, such as Africa, India and South America, is likely to increase the proportion of the cane areas with reliable dry season climates.

Generally speaking, except under some light soil conditions, or where irrigation is necessary because of insufficient wet season rainfall, very little in the way of cultivation is possible in many sugar producing areas during the out-of-crop season, so that the main cultivation effort takes place under dry conditions, and this has an important influence on the nature of the operations being carried out, the power requirements, and the type of equipment which can be used.

In rain grown cane areas the fields are generally in a dry condition at reaping, and under irrigation fields are generally dried out for some weeks to assist ripening. Because of the cane leaf cover, and the extensive root system of the sugar cane plant, this drying out results in the moisture content of the soil often being considerably lower, particularly in the sub-surface layer than it would be under short grass or bare soil. The intensive drying out experienced, and subsequent absence of rainfall, means that it is rarely possible to cultivate the soils at anywhere near their optimum moisture content, either for minimal draught requirements, or for the formation of stable soil structure. Primary cultivation, at least, is thus very often really only a means of producing a mechanical tilth through the physical break up of the soil. The physical characteristics of the soil have, therefore, a dominant influence on the selection of primary cultivation techniques, and the power requirement is very closely related to factors such as clay content, and the extent to which the soils form compact masses on drying.

Fortunately, the most successful sugar-producing areas are those which have been established on alluvial soils with a fairly level topography, and where conditions are relatively suitable for mechanical operations. There are, however, very extensive areas of rolling to steep land under sugar cane as, for instance, in Natal, and much of the small farmer production of sugar in the Caribbean islands, including Cuba and Puerto Rico, is on the less favourable areas from the point of view of topography. It is, however, doubtful, as the cost of hand labour increases, that many of these areas will continue to be kept in production.

Sugar is produced in a very wide range of soils indeed, particularly as regards texture and water relations, from soils having very satisfactory internal drainage, with a stable structure and easily worked texture, such as are to be found in the red soil areas of Cuba and on much of the volcanic soil found elsewhere, to very heavy marine clays with poor internal drainage and little, if anything, in the way of a stable structure. Generally speaking, however, sugar cane soils are "heavy" by comparison with the arable crop soils of temperate areas and much more subjected to intense wetting and drying out.

Only a global survey would give a precise classification as regards the "workability" of sugar soils, but it is quite likely that such a survey would show that the bulk of the sugar cane soil areas will be found to have clay percentages over 30%, with quite extensive areas in which the clay content reaches 50% or more. A dry tropical soil, with 30% or more clay, is quite a formidable proposition when it comes to the preparation of a really suitable and stable tilth and, in preliminary thinking, it might be best to try and assess the requirements of the heavier types of soil so that any equipment developed would be suitable for the maximum area, since it would have built-in ruggedness and power, which would make it even more suitable, and reliable, for use under more favourable conditions.

The original cane cultivation techniques were developed to fit in with animal drawn equipment and the extensive use of hand work. This led to many very specialised systems of cultivation, such as the rayungan system developed in Java, the Grand Bank in Puerto Rico and the cambered bed system in some areas of the West Indies. Mechanization has, very often, simply been a replacement of either animal power or hand work for some operations, while retaining the basic form of the cultivations as it was developed in the initial stages. We have thus a highly developed mechanical maintenance and reforming technique for the cambered beds in use in Trinidad, which system was developed through the necessity of removing excess surface water from very intractable and poorly structured soils with, originally, very limited mechanical power available. On the other hand very extensive areas in Cuba, and elsewhere, are cultivated without any attention being paid to soil drainage because of the relatively good internal drainage of the soils. In such areas a relatively flat type of cultivation has been the result, although rather more provision for drainage might be advantageous.

The development of adequate drainage is one of the most important factors in the successful cultivation of sugar cane, and this is of equal importance under irrigated and non-irrigated conditions, and, in fact, it is much more difficult to develop adequate drainage under an irrigation regime, particularly with surface irrigation, since the drainage is an attempt to do exactly the opposite of what is being attempted to be done by irrigation.

There has often been considerable confusion in thought relating to soil drainage, resulting in a failure to differentiate clearly between what might be termed regional drainage and the internal drainage of the soil itself. Failure to recognise the differences, in the requirements for regional and internal soil drainage, has often led to difficulties in modifying cultivation systems to fit in with mechanization, and a clear appreciation of the soil physics involved is necessary before real progress can be made.

Before considering what might be the most desirable and most widely applicable form that mechanized cultivation should take, it might be instructive to examine rather specifically some of the factors which have a profound influence in the final form of the cultivation. It would probably be most convenient to consider the implications in respect of three arbitrary categories of soil under light, normal and heavy.

Drainage

The drainage requirement of a soil is perhaps the most important of the criteria governing its utilization, since all cultural and harvest operations are profoundly influenced by the essential drainage pattern. It is therefore very necessary that a clear understanding of the drainage needs of each particular soil is clearly understood, since any unnecessary frequency or depth of drain is an obstacle and complicates operations appreciably.

On the very light soils, or on heavier soils which have a very stable granular structure, drainage is only necessary to deal with localized accumulations of water, or as a means of regulating the water table level, particularly if there is some stratification with bands of heavier soil in the immediate subsoil.

The provision of satisfactory drainage for more normal soils, in which water movement is somewhat restricted, can sometimes be even more difficult than that involving very heavy soils, in which water movement is very limited, so that passage of water through the soils, to any appreciable depth, is very slight. In light soils there is little restriction to the development of an extensive root system, whereas in medium heavy soils the development of a good root system is very often controlled by the effectiveness of drainage. The drainage requirement of such soils does, of course, vary considerably with the rainfall, and the removal of local accumulations of water assumes much greater importance than in light soils. In many soils local depressions in the surface soil can lead to accumulation of water and, quite frequently, extensive drainage systems have to be established for its removal, and which do not really influence the drainage within the soil to any great extent, and, in fact, a far better job would often be done by land planing so as to remove the risk of localized accumulations of water.

The real internal soil drainage problems in the cane growing areas are mainly associated with the heavy clay soils, except perhaps where soil salinity is a major factor, and it is in the rationalization of the drainage of such heavy clays, to fit in with mechanical operations, that the greatest progress would be made in the mechanization of the sugar cane crop. Many of the best sugar cane soils, particularly from the point of view of juice quality, are quite heavy clays, which crack deeply on drying and which, when wet, contain so much moisture that cultivation is impossible without a lapse of at least ten or twelve days following saturation, and on which transport becomes bogged down very readily.

As far as drainage of heavy tropical soils is concerned, particularly those which swell when wetted, the main consideration which has to be kept in mind is that water movement through such a soil becomes negligible once it is really wet. Aeration is also greatly reduced, so the under wet conditions root growth and vitality are very much impaired. The only really satisfactory answer, with such limitations, is to prevent waterlogging of the maximum possible soil volume and to provide a drainage system which will prohibit the accumulation of standing water.

The cambered bed system, as developed in Jamaica and Trinidad, provides a satisfactory means of achieving this. The camber ensures that the accumulation of water will not occur on the surface of the soil, as there is always a down-grade present, and the deep drains between the beds ensure that the greater inequalities of topography will be adequately taken care of and drained of water, which might otherwise settle. While there is a general belief that the deep drains between the beds provide very efficient subsoil drainage this is not likely to be the case when the clay content of the soil is very high. Although this type of cultivation provides a very efficient method of dealing with excess water, and high intensities and quantities of rainfall, it would be hard to devise a system of cultivation which would be more difficult to mechanize in all its stages than the cambered bed system.

In the preparation of the cambered bed cultivation operations are arranged so that, in theory, a depth of from 15–18 in of soil would be provided with a good mechanical tilth, and by the prevention of water-logging it is hoped that the tilth is preserved. In fact, the cambered bed system succeeds because it removes the possibility of water-logging from a volume of top soil, and any other technique which likewise preserves the top soil in an unsaturated condition should also succeed.

The nearest approach to a system of cultivation which can do this and yet be mechanized to a high degree is that which has been developed in Louisiana, which system was developed primarily in an attempt to overcome poor drainage conditions in the very low lying lands along the Mississippi. The Louisiana technique achieves, in miniature, the same objectives as the cambered bed system by providing, in the 6 ft beds, a volume of soil which does not become water-logged and an efficient drainage system between the beds to remove surplus water. Further aspects of the Louisiana layout will be considered in more detail later.

Primary Cultivation

As was pointed out earlier the primary cultivation operations have, most often, to be carried out when the soils are very dry. For simplicity of management, and because of the often indifferent level of education of many plantation workers, a fairly definite pattern of operations is generally laid down and the same scheme of work is carried out throughout the property. There may be quite a variation in the number of harrowings or rippings required for soils of different texture, but most often the basic equipment usage is the same throughout, and does not necessarily provide the correct treatment for the range of soil types encountered.

Historically much of the primary cultivation was carried out by means of cattle teams. Later, the old Fowler type of steam plough was extensively used, and in one or two places it is still in use. With the advent of the relatively powerful crawler tractors it was possible to speed up operations. As the horse power of the tractors increased there has been a tendency to utilize the greater power available by deeper ploughing and cultivation, as well as by using implements covering larger areas in one pass, and thus speeding up operations. Undoubtedly, in many areas, the employment of this increased power and the changes that resulted in primary cultivation operations, have been made without a clear understanding of the effects on the soil brought about by such factors as soil compaction, the greater possibility of doing cultivation work when soil conditions are unfavourable, as well as cultivation to an unnecessarily great depth.

There is now, however, an increasing awareness among trained cultivation personnel that there is need for a re-appraisal of the cultivation requirements of many soils, as well as an awareness of the attraction of wheeled tractors as against track machines, particularly from the point of view of expenditure on maintenance as well as on initial costs.

The main use to which the higher available tractor power has been put is to increase the depth of cultivated soil, and it is here that considerable doubt exists as to the wisdom of universal deep cultivation. There is not much basic information available but what is available indicates that in very heavy soils (50% or so clay), deep cultivation, when the soils are very dry, may be quite advantageous, although when the moisture content is too high actual damage to the soil may be done. There is a great need for a proper study to be made of cultivated depth in relation to soil type and system of cultivation. There are indications that a very satisfactory crop can be grown if the top 9 in or 10 in of a heavy soil is in good condition. It is also possible that deep cultivation, to 18 in–24 in, when done under good conditions enables a mechanical tilth to be maintained for longer than would have been the case with a shallow cultivation, particularly where there has not been proper provision for drainage, or where a flat type of cultivation has been used. With the dependence of long ratooning on the maintenance of good tilth, the importance of correct primary cultivation on all-over costs can be appreciated.

It would appear to be very probable that some of the very heavy soils may require cultivation to a depth of 12 in or more. When such soils are ploughed, or ripped, when dry, the resultant soil surface is very rough indeed, and it is rather difficult to visualise the use of wheeled tractors under such conditions unless they are of a very large size. It may well be that for the very heavy soils the initial preparation and a first harrowing may have to be done with a crawler tractor. On normal and light soils there would seem to be no reason why wheeled tractors could not be used much more extensively, particularly with the advent of 4 wheel drive tractors with the considerable power and tractive force which can be built into them. It is quite possible, through the indiscriminate use of high power tractors, that actual damage is being done on many light soils through soil inversion in too great a depth, as well as the performance of some unnecessary operations with consequent increases in the cost of cultivation.

Considering, however, the implications of world wide sugar cane mechanization it would seem to be necessary to make provision, in any integrated system, for equipment capable of dealing with heavy clay soils in a dry and compacted state. This may require consideration of the inclusion of track equipment in many areas.

The yield response from thorough deep cultivation done under conditions which permitted deep shattering of the soil, compared with good surface type cultivation to 10 in or so, under the same soil conditions, has been known to result in an increase of 5 tons or more cane per acre in a twelve month plant crop. Such increases cannot be ignored, although results would require to be studied to see how far the cane yield was influenced by the secondary cultivation techniques used after planting. It is conceivable that, under cultivation conditions favouring growth, the effect of a primary cultivation might not be so marked, particularly in heavy soils where root development is likely to be restricted to the top soil. *(To be continued)*.

AGRICULTURAL ABSTRACTS

A "Lindane" sprayer. N. C. COURTICE. *Cane Growers' Quarterly Bull.*, 1962, **26**, 14–15.—Alterations to the original sprayer, designed to render it more efficient, are described. Ancillary equipment adapted to handle with greater safety the 4-lb packets in which "Lindane" is now bought is also described.

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Grub infestation and control in S. Queensland cane fields. R. W. MUNGOMERY. *Cane Growers' Quarterly Bull.*, 1962, **26**, 33–34.—Guidance is given as to the control best adapted to varying conditions such as degree of infestation.

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Potash and c.c.s. L. G. VALLANCE and K. C. LEVERINGTON. *Cane Growers' Quarterly Bull.*, 1962, **26**, 35. Attention is drawn to the fact, confirmed by figures, that though climatic conditions are the major determining factor of c.c.s. value, on potash deficient soils appreciable improvement results from potash dressings.

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Sugar cane in Spain. P. RIVALS. *J. d'Agric. Trop. et de Bot. Appliquée*, 1961, **8**, (8–9), 293–302.—The cultivation of the sugar cane in Spain is dealt with, production being restricted to a coastal strip in the extreme south. Some notes are given on the history of sugar cane in Spain where it has been known at least since the 12th century. About 5000 ha are under sugar cane (with irrigation) in the Malaga-Almeria area, where the climate is extremely hot and dry. Information on varieties grown indicates that the two most important varieties today are the Java varieties POJ 2727 and POJ 2725. Methods of cultivation and production are outlined, also yields, which are from 40 to 80 tons of cane per hectare.

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Infectious diseases of sugar cane. F. M. L. SHEFFIELD. *East African Agricultural and Forestry Journal*, 1962, **27**, 207–210.—A résumé is given of those diseases of sugar cane known to be present in East Africa. Of the devastating diseases of sugar cane throughout the world only two have existed in East Africa until a few years ago when smut appeared. The opinion is expressed that smut probably reached East Africa through smuggled cane. The author states "Despite the heavy penalties that can be incurred, it is fairly evident that setts have been smuggled in: there are growing on some estates varieties which, if the growers identifications are correct, have never been officially imported into any East African territory."

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Sulphur deficiency in sugar cane. A. R. DUTT. *Empire J. Exp. Agric.*, 1962, **30**, 257–262.—Sulphur deficiency in sugar cane produces chlorosis and anthocyanin pigment formation in the leaves. This may be corrected by foliar application of sulphur compounds, e.g. iron or zinc sulphate. In mild chlorosis the leaf tissue between the parallel veins become light yellow but in severe chlorosis even the unfolding buds are almost white. It is concluded that sulphur, although not a constituent of the chlorophyll molecule, seems to be associated with its formation and that anthocyanin pigments in red leaves indicates that sulphur deficiency affects carbohydrate metabolism in sugar cane. Drought or inadequate soil moisture appears to reduce absorption of soil sulphur by plants, as evidenced by the recovery affected by irrigation and rain.

SUGAR CANE AGRICULTURE IN QUEENSLAND

Proceedings, 29th Conference Queensland Society of Sugar Cane Technologists, 1962

Field Investigations

PARTICULARLY in times of over-production, it is of considerable importance so to adjust the area under cultivation that the standover, uncut crop is reduced to a minimum. In view of the seasonal variations in yield, there must be a measure of luck in forecasting, but the problem has been tackled by A. G. BARRIE for the Mossman area where the need for close adjustment is all the more important because cane cannot be left to stand over in the area. The objective is sought through reduction of area planted, not through reduced yield. The method adopted, using the trend in production of sugar per acre through a period of 19 years, is to calculate the area which would produce the highest net income. As BARRIE points out, however, the market situation is the controlling factor, to the extent that any estimate of area may be rendered null.

The same question of how best to meet the problem of over-production is approached from a different angle by W. J. S. SLOAN. The prospects of growing alternative crops, such as fruit, and of establishing a cattle industry are discussed.

The adoption of mechanized farming as a standard practice has necessitated modification in the lay-out of experimental plots. The new system, adopted at Fairymead, is described by R. A. YATES. In this, long 4-row plots are used of which the two centre lines are cut. The system involves weighing in the field and the possibilities in this direction are explored. The same author describes the symptoms of unhealthy cane in certain low-lying hollows in the Isis District of South Queensland. Leaf analysis showed these unusual symptoms to be due to potash deficiency. A possible explanation is high magnesium toxicity accompanied by low calcium.

Frost is wide-spread in the Mackay District but, except for a few pockets, damage was not found by C. G. STORY to be severe in any of the varieties grown. It is best, however, to leave a week before determining the harvesting rota so that the most highly damaged crops may be cut first. The cultivation of legumes is a common practice and the various problems connected therewith are briefly discussed by G. A. CHRISTIE.

Pests, diseases and weeds

Difficulties in determining the numbers of the larvae of the soldier fly, *Metoponia rubriceps*, in ratoon crops under field conditions led O. W. STURGESS to grow cane in drums to which from 10 to 80 larvae were added per drum. The number of ratoon shoots developed in 11 weeks fell from 38 in the control with no larvae to 5 with 80 larvae. Funnel ant, *Aphaenogaster pythia*, is another insect which causes considerable damage locally and work on its control by insecticides since 1957 is reviewed by G. WILSON. "Aldrin" and "Heptachlor" gave the best results but the major outstanding problem is how to get reasonable control over 3 crops (plant and 2 ratoons) at economic cost.

Since ratoon stunting disease has been brought under control it has been possible to make more accurate studies of chlorotic streak. These, conducted in N. Queensland, are reported by B. T. EGAN. The difficulties in selecting healthy material for the comparative trials are shown to be considerable but not insuperable. Significant increases both of cane, sugar and c.c.s. were obtained from healthy cane except in the trial on heavy clay which became waterlogged during the 6th to 8th months period after planting. Here secondary spread into the healthy plots became marked in the 10th month and differences were eliminated in the ratoon crop.

Johnson grass appears to have been present in the Lower Burdekin area for some 20 years. The area infested now is not large and it is worth attempting its elimination. The means of accomplishing this are discussed by L. S. CHAPMAN and J. A. HUCKNALL. The various methods to this end include dry fallow ploughing, seedling control at all stages, elimination from the ratoon crop, chemical sterilization of non-cropped areas and headlands and, for isolated patches, hand digging plus sterilization or fumigation with methyl bromide. A co-operative effort would be required.

The presence of the giant sensitive plant, *Mimosa invisa*, in Australia was first recorded in 1944. The story of its rapid spread during the fifties, the damage it causes and the difficult problem of its control are recounted by S. O. SKINNER and I. T. FRESHWATER. Arsenical sprays and diesel oil give effective control but are a risk to cattle. Elimination will be a long process for, like so many leguminous plants, it has a hard-coated seed which can lie dormant for many years.

A. C. ARVIER describes trials with a new potential herbicide, "Diquat", 9,10-dihydro-8a,10a, diazonia-phenanthrene dibromide, and discusses its possibilities as compared with "Paraquat"—a herbicide not yet on the market but under test.

H. M.-L.

F.46-136, an early maturing sugar cane variety. F. LE GRAND and T. BREGGER. *Circ. Florida Agric. Exp. Sta.*, 1961, (S–133), 3–7; through *Plant Sci.*, 1962, **39**, 271.—Variety F.46-136 is an early maturing cane variety with a low fibre content that yields a moderately high cane tonnage and a higher than average sucrose content in the early grinding season. Because of the high sucrose content in the early grinding season the variety may be of benefit to the expansion of the sugar cane industry in the colder areas of the Florida Everglades.

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Agricultural practices in Taiwan cane fields. WAN-CHUN-HSU. *Sugar y Azúcar*, 1962, **57**, (6), 36–37.—This illustrated record describes briefly the advances made in mechanization. At present it is in the cultural practices, land preparation and fertilizer distribution that the advances have been made. Planting and harvesting are still done by hand.

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Pathogenicity of the reniform nematode on various hosts. A. AYALA. *J. Agric.* (Univ. Puerto Rico), 1962, **46**, (2), 73–82.—The interest in this article centres on the fact that the extent of the damage done by nematodes is being increasingly realized. In the present case sugar cane is not attacked by the particular nematode studied, *Rotylenchus sp.*, taken from *Cajanus indicus* (pigeon pea). Since, however, it is regularly attacked in the field, it would appear that there must be more than one species of this little-studied genus.

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Effect of hot-water treatment on the control of ratoon stunting disease. J. ADSUAR and J. H. LÓPEZ-ROSA. *J. Agric.* (Univ. Puerto Rico), 1962, **46**, (2), 83–86.—A test with a number of commercial varieties of their response to exposure at 50°C for two hours indicated marked differences in varietal resistance.

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Failure to transmit the causal agent of ratoon-stunting disease through the soil. J. ADSUAR and J. H. LÓPEZ-ROSA. *J. Agric.* (Univ. Puerto Rico), 1962, **46**, (2), 87–90.—With diseased and healthy setts grown in the same pots but separated by a wooden label, no transmission of the disease was found, neither through the soil nor through the intermingled leaves.

* * *

Cane payment in Mauritius. S. STAUB. *Sugar J.* (La.), 1962, **25**, (3), 22–24.—The whole system by which cane deliveries are controlled is described, together with arrangements of payment for quality.

Reclamation of tidal land in Yunlin. Y. CHU. *Taiwan Sugar*, 1961, **8**, (11), 17–20.—The experimental reclamation by the Taiwan Sugar Corporation of some 25 km × 3·5 km of tidal land is described. On it an experimental farm has been established. It is anticipated that, as the salt diminishes, the land, of which there are some 50-60 thousand hectares available, will be suitable for cane cultivation.

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Mechanization of sugar cane harvesting. J. P. CORRECH. *La Industria Azuc.*, 1962, **68**, 131–137.—A general review of the development of mechanical harvesting is given together with a description of the present position.

* * *

It pays to fertilize. J. L. DU TOIT. *S. African Sugar J.*, 1962, **46**, 665.—Data drawn from 35 regional trials are tabulated to show increases in plant and ratoon crops for soils with less than 500 lb muriate of potash per acre, as compared with little or no increase from soils with more than that figure. Also given are the increases in the same two crops in response to nitrogen. One case is given where the cost of a mixed dressing was 35 Rand/acre and the sucrose yield was raised from 6·28, with no fertilizer, to 11·45 tons/acre.

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Notes on Taiwan sugar cane agriculture. C. S. E. INDUSTRIAL TEAM. *Sugar News* (Philippines), 1962, **38**, 262–267.—The whole field of agriculture is covered in sections dealing respectively with land preparation using animal-power and tractors, planting, cultivation, fertilization, inter-cropping, and irrigation. Additional sections deal with rice, pineapples and pig-raising.

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The why of decreasing sugar yields in Puerto Rico. F. CHARDON. *Sugar J.* (La.), 1962, **25**, (1), 32-39.—The position is complex, but the basic factor is the brevity of the period of maturity. Lengthening of the harvesting season in either direction means a higher proportion of inferior juice. Yet economic conditions compel such a lengthening. These same conditions also lead to delay in conducting cultural operations and, with increasing harvest mechanization, more trash reaches the factory.

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Chemical weed control in Puerto Rican sugar cane. W. R. IREY. *Sugar J.* (La.), 1962, **25**, (1), 63-65.—Results with the use of "Karmex" and "Telvar" proved satisfactory as compared with manual weeding at some $30–$50 per acre.

FUNDAMENTAL INVESTIGATION INTO THE NATURE AND CHARACTERISTICS OF BONE CHAR

By MICHAEL LORANT

PART I

To increase understanding of the fundamental nature of bone char and other solid adsorbents, and thus to indicate the direction for improvement, the U.S. National Bureau of Standards has been conducting a long-range, cooperative, research programme under the sponsorship of the Bone Char Research Project, Inc. This programme, which was started by 4 refiners with the close co-operation of the late F. J. Bates, former chief of the polarimetry group, was brought to the Bureau in 1939. International interest and participation in the programme, now under the direction of Dr. V. R. Deitz of the Bureau's research staff, has steadily increased until there are now 28 industrial supporters of the work—including sugar refiners and adsorbent manufacturers in Australia, Belgium, Brazil, Britain, Canada, France, Netherlands, South Africa and the United States.

Since the initiation of the bone char research programme, several basic aspects of the adsorption process have been analysed and clarified. Investigations cover the entire field of solid adsorbents and touch upon many other pertinent areas. Bone char contains a carbonaceous fraction and an apatitic calcium phosphate fraction, both of which are important in other areas of research besides sugar refining. For example, investigations on the carbonaceous residue have applications ranging from granular carbon adsorbents to the graphite used in atomic reactors. The hydroxyapatite and its structure are studied by widely diverse groups in medicine and dentistry who are investigating bone and teeth structures, by geologists examining uranium deposits which tend to concentrate in similar structure, and by agriculturists developing fertilizers that are derived from phosphate rock.

Bone char may be classified as a mixed adsorbent. The carbonaceous residue, about 8% by weight, contains in addition to carbon a relatively large amount of hydrogen, oxygen, sulphur, and nitrogen The remaining fraction is chiefly calcium and phosphate, but contains smaller quantities of sodium, magnesium, sulphate, carbonate, and a dilute acid-insoluble ash. As both fractions come from the original bone, they exist in a very intimate and closely-jointed mixture. Despite their widely different properties, they do not always react independently.

The surface area of bone char was first investigated using a gas adsorption method at low temperatures. It was soon learned that the depurative properties of bone char depend on many other factors beside extent of surface, although this is one of the primary considerations. The porosity and the density did not correlate very well with the adsorption properties in solution systems.

The basic calcium phosphate fraction of bone char is one of the most insoluble substances known. Evidence has been obtained to indicate that some of the insolubility is due to a surface complex that completely covers the hydroxyapatite structure. This surface complex is only one unit cell deep and is of a different composition than hydroxyapatite. Such behaviour has fundamental implications in regard to calcification and "solubility" process in basic calcium phosphates.

Many tests have been developed at the Bureau for measuring various properties of bone char. Bone char is a very heterogeneous granular material and even the sampling has proved to be most critical.

The attrition that bone char undergoes during its hundreds of cycles of use in sugar refining gradually decreases the particle size. The available testing sieves used for particle-size evaluation were critically examined, and a thorough study was made of the sieving process. From this study, it was learned that the tolerances permitted in the openings of testing sieves were quite broad and, that, if the size of the sieve opening was not uniform throughout, then the larger openings—rather than the average holes—controlled the passage of the particles. As a result, discrepancies were frequently found when sieve analyses from different laboratories were compared.

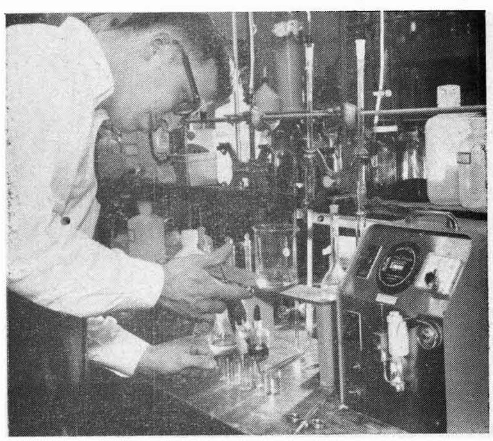

Fig. 1.

A simple rapid gas chromatographic method was developed by the U.S. National Bureau of Standards for determining low levels of carbonate (down to 0·2 p.p.m.). To liberate the CO_2, H. M. Rootare, staff scientist of the Bureau, admits acid to the sample-containing flask. A gas chromatograph is used to measure the amounts of CO_2 released.

To eliminate this source of error, a sieve calibration method was developed which employs a mixture of glass spheres of graduated sizes. This procedure has now been adopted by the Bureau's length laboratory as a standard method of determining the effective opening of testing sieves. Two standard samples of graduated glass spheres have been prepared. With these standards of certified particle-size distribution, a uniform basis is provided for calibrating testing sieves.

The decrease in bulk volume caused by changes in the nestling together of different-sized particles (volume shrinkage) has been investigated. From this study a correlation was discovered between volume shrinkage and particle-size distribution. This relationship may have considerable significance for the general problem of flow through packings of granular materials.

An improved test has been developed for studying the abrasion hardness of bone char. In this test a sample of the char is mechanically stirred in a specified manner so that the abrading actions are similar to those encountered in commercial operations. The results are expressed in terms of the percentage reduction in particle size and the percentage dust formation (through No. 70 sieve). In general, this attrition hardness test is suitable for almost any granular solid, although it was designed specifically for bone char.

The key factor in the successful revivification of bone char is the kilning step. After bone char has been used for sugar liquor purification, it goes through a four-step regeneration process. First, water is introduced to the cisterns to displace the bulk of the remaining sugar. Second, the char is washed for as long as two days with enormous quantities of water. After this, it is dried and then finally heat-treated in the absence of oxygen in a kiln operating in the range 500 to 600°C. The organic materials are pyrolysed and the inorganic salts—especially calcium salts—which are not washed out or decomposed in the kilning, gradually accumulate in the char through many regeneration cycles. This accumulation increases the crystallite size of the hydroxyapatite so that the bulk density may attain a value twice that of new char.

The mechanism by which the adsorbed calcium is incorporated into the char structure during kilning involves two fundamental factors. First, during the adsorption and desorption processes taking place in solution phase, there is a flux of calcium into the structure which is accompanied by a dynamic exchange among all ions at the boundary surface. This exchange results in a more stable arrangement, i.e. it leads to crystallite growth within the apatitic structure. Second, during the subsequent kilning there is a migration of calcium ions from the surface into the structure of the solid. A kinetic study indicates that the migration takes place with an activation energy of about 25 kcal. Kilning experiments with commercial and laboratory-prepared samples of hydroxyapatite—one of the char's main constituents—have parallelled studies with bone char.

If for some reason the char is kilned at too low a temperature, its adsorptive capacity will gradually deteriorate. A few cycles of proper reburning will overcome the damage caused by inferior kilning.

Excess carbon—obtained from pyrolysis of adsorbed organic matter—tends to accumulate in bone char as it does in all thermally activated adsorbents and catalysts. Because the carbon in bone char must be maintained at an approximately constant level for maximum effectiveness, this extra carbon must be removed. As the means commonly employed for decarbonization is oxidation, the reactions of bone char with oxygen have been studied in some detail. The criteria for uniform decarbonization are long reaction time, low temperature, and the appropriate concentration of oxygen. Unfortunately, these conditions are not always compatible with practical requirements.

Oxygen reacts with bone char, even at low temperature, to form a chemisorbed carbon-oxygen complex. Evidence has been obtained to show that chemisorbed oxygen is essential to the decolorization of sugar liquors.

Sulphate, adsorbed by bone char from sugar liquors, also enters into the chemical reactions during kilning. The close intermixing of the carbonaceous and the hydroxyapatite fractions of bone char facilitate sulphate reduction to sulphide at the maximum kilning temperatures (500–540°C). However, during the cooling process which follows kilning of actual bone char, the sulphate reduction is masked by surface oxidation. The existence of the sulphide cannot be determined by a surface reaction, but it can be detected by dissolving the char in strong acids. The chemical reduction of adsorbed sulphate takes placc several hundred degrees below that occuring in mechanical mixtures of calcium sulphate with charcoal. This is typical of the increased chemical reactivity at interfaces. As yet, it is not known what percentage of this increase is due to the intimate mixture of reactants and what percentage to a different stage of reactivity at the interfaces.

To evaluate the effectiveness of bone char as an adsorbent, it was necessary to develop criteria for judging various properties of sugar solutions. Recently, the trend in commerce toward sugar in liquid form has placed increased emphasis on those visual properties of sugar solutions that indicate the degree of purity.

The visual properties, colour and turbidity—more noticeable in sugar liquors than in crystal sugars—are experimental evidence of the presence of dissolved impurities (colorant) and suspended solids (turbidity). However, it is important to recognize that dissolved impurities with no colour, suspended matter with no turbidity, or suspended matter with both colour and turbidity can be present in solutions. As long as all of the various coloured and turbid impurities present in the liquor were considered together as "colour," a general theory of colour removal by bone char, or any other adsorbent, could not be developed. Because the action of the bone char is to remove the impurities

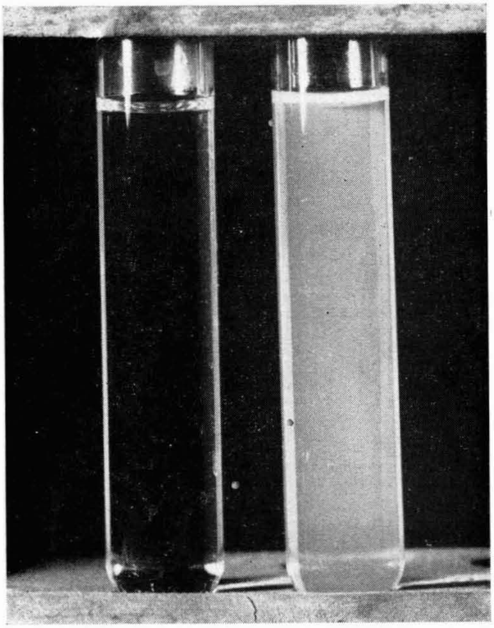

Fig. 2.

Turbidity in sugar liquors is experimental evidence of the presence of suspended solids. However, some contaminants have the same refractive index as the sugar solution, so that the turbidity is masked. This is illustrated by the two test tubes, both of which contain the same amount of silica. The liquid on the left is a 65% sucrose solution which has the same refractive index as silica, whereas the liquid on the right is water which has a different refractive index.

which cause these properties, it was necessary to study the measurement of colour and turbidity—both separately and grouped together under the term attenuancy.

Historically, the primary judgment of sugar impurity has been the level of its brownish-amber colour. As early as 1927 the Bureau worked on the fundamental spectrophotometric aspects of the colour problem. The goal of this work was to determine accurately the transmittances at specified wavelengths for a large variety of sugar products. The optical evaluation must differentiate between a transmittancy reading of an instrument and the appearance of the sugar colour to the eye. With these factors in mind, the Bureau established a colour scale for sugar solutions based on the fundamental investigations of D. B. JUDD of the Bureau staff. By using this scale the perceptible differences between the colour of a commercial sugar and that of a highly purified sucrose solution were evaluated. Recently, this procedure was extended to include such dark-coloured products as maple sugar and honey.

The method expressed the visual appearance of sugar liquors on a scale evaluated from the primary spectrophotometric data. To characterize a commercial sugar, a solution is placed in a spectrophotometer for transmittancy measurements. From the transmittances of the solution at two specific wavelengths, a simple chart may be used to give the solution's visual colour directly in Bureau units. The development of this standard scale of sugar colour has made it possible to evaluate objectively the visual appearance of liquid sugar products and has thus eliminated human error.

Light scattering, a very sensitive measure of colloidal impurities, greatly influences the visual appearance of liquids containing sugar. Although commercial sugar solutions have long been recognized as having low level turbidity, a thorough study of their light-scattering behaviour had never been conducted. When the scattered light was measured directly with a modified commercial microphotometer, commercial sugar solutions were found to disperse light waves predominantly in the forward direction. The turbidity can be obtained by integrating the observed scattering over all angles.

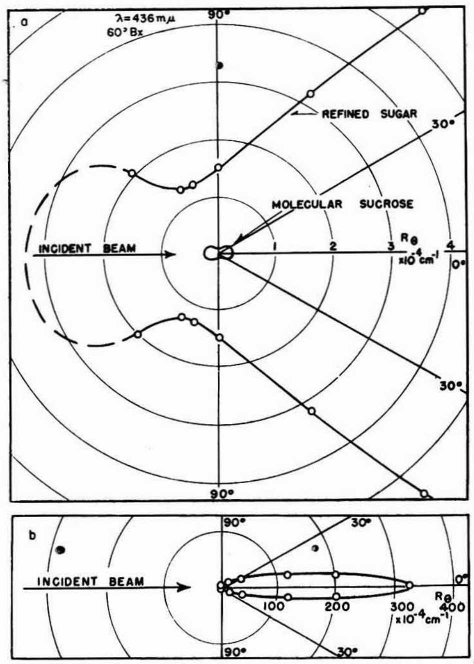

Fig. 3.

Light scattering pattern (scattering envelope) of a refined sugar compared with that of molecular sucrose. Light scattering is a sensitive measure of non-sucrose constituents. In the bottom panel, the scale is changed 100-fold to illustrate the large forward scattering of refined sugar.

Light-scattering measurements can be made independently of any absorption of light by colour bodies whereas transmission measurements always include effects of both absorption and scattering. Therefore, the effects of colour and turbidity can be separated optically, without mechanical filtration or physical separation of the two types of impurities. Thus, by obtaining both scattering and transmission data, attenuancy can be resolved into its components, absorption and scattering.

Sugar—like many organic compounds—is unstable. It is more unstable when hot and when in water solution. Because the refining of sugar is always done in hot solutions, the whole process can be considered as working against definite odds. In examining the thermal stability of sugar solutions, Bureau scientists found that some impurities seemed to inhibit degradation, whereas the degradation products themselves were autocatalytic. Some of the degradation products have been shown to be organic anions.

(To be continued)

THE DRYING OF WHITE SUGAR
and its Effect on Bulk Handling

By T. RODGERS, B.Sc., D.R.C.S.T., A.M.I.Chem.E. and C. LEWIS

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PART II

It is necessary now to digress a little from our test results. It so happened that it had been decided that we should carry out a test at King's Lynn last campaign, by fitting a mechanical circulator to one of the white sugar vacuum pans. In fact, the circulator was fitted only about 3 weeks before the humidity oven was received, but already by normal drying tests, and by previously described tests using P_2O_5 we had noticed rather exceptional results on the sugar produced in this pan. In fact the sugar was exceptional in more than one respect—but we shall deal with this later. We were particularly interested therefore in carrying out some comparative tests with the sugar produced by forced circulation and that by the normal technique, under conditions closer to those used in the factory drying plant.

In Table IV we record results from seven tests using in each case sugar boiled in an ordinary pan, i.e. without mechanical circulation. These tests were carried out at varying temperatures and relative humidities in the oven, as recorded in the Table, and we also include a screening analysis, the Coefficient of Variation and the Mean Aperture of the sugar in each test. The invert sugar content in all cases was not more than 0·007%. It should be noted that for the relative humidities and temperatures used, there does not appear to be a significant correlation between these variables and the rate of release of moisture over the 133-hour period. However, if we consider the first 24-hour period, there is an indication that the higher the temperature the greater the rate of moisture release. This is a point we shall discuss later in the paper. The number of tests however was too small and as we hope to show later the form of the crystals exerts such a great influence on this moisture that we cannot draw too definite conclusions from the results.

In order to illustrate the results better, they are plotted in Fig. 1. On the left hand column is shown the 3 hour moisture, the curves show the loss in moisture over the 133 hours, and the column on the right records the sum of the latter and the loss due to drying the residual sample for 3 hours at 105°C.

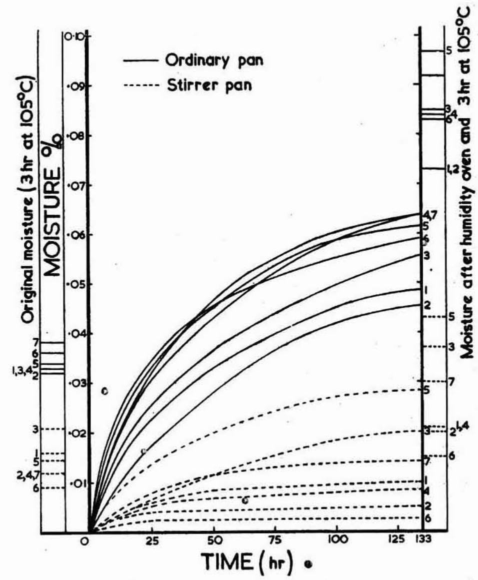

Fig. 1

A similar set of tests was carried out using sugar sampled fresh from the granulator, and previously boiled in the pan fitted with the mechanical circulator. These results are recorded in Table V giving the same data as obtained in the tests on Table IV. We should particularly draw attention to the fact that these seven tests were done with the same oven conditions respectively as tests 1 to 7 in Table IV. In fact they were done at the same time so that the pans were also boiled at the same time; thus the two sugars

Table IV (Ordinary Pan)

Test	% R.H.	T °C	3 hr at 105°C	% Moisture after hours 24	48	72	90	112	133	3 hr at 105°C	% in-crease	Screening Analysis On 18	On 25	On 36	Through 36	C.V.	M.A.
1	50	30	0·033	0·024	0·031	0·038	0·037	0·048	0·047	0·073	121·2	9·4	33·8	34·2	22·6	34	0·0231
2	53	31	0·032	0·023	0·027	0·035	0·040	0·044	0·045	0·073	128·1	13·6	37·0	28·8	20·4	36	0·0245
3	62	32	0·033	0·025	0·035	—	0·049	0·051	0·057	0·085	157·6	14·0	44·0	30·5	11·5	28	0·0258
4	45	41	0·033	0·030	0·043	0·048	0·054	0·061	0·064	0·084	154·5	22·2	36·6	27·5	13·9	34	0·0267
5	50	40	0·034	0·032	0·045	0·053	0·063	0·058	0·062	0·097	185·3	7·2	30·1	35·3	27·4	36	0·0220
6	60	41	0·036	0·034	0·049	0·051	0·054	0·056	0·059	0·083	130·5	13·7	36·8	27·4	22·1	37	0·0242
7	53	50	0·036	0·031	0·046	0·054	0·060	0·061	0·064	0·092	142·1	9·3	30·1	33·6	26·9	36	0·0223
Average			0·0338							0·0838	147·9					34·4	0·0241

Table V (Pan with Mechanical Circulation)

Test	% R.H.	T °C	3 hr at 105°C	% Moisture after hours 24	48	72	90	112	133	3 hr at 105°C	% In-crease	Screening Analysis On 18	On 25	On 36	Through 36	C.V.	M.A.
1	50	30	0·016	0·006	0·008	0·008	0·006	0·008	0·010	0·021	31·3	0·6	29·1	48·3	22·0	30	0·0215
2	53	31	0·012	0·003	0·004	0·005	0·004	0·003	0·001	0·020	66·6	6·6	50·6	28·4	14·4	31	0·0259
3	62	32	0·021	0·007	0·011	—	0·017	0·019	0·020	0·037	76·2	3·0	38·6	37·5	20·9	30	0·0229
4	45	41	0·012	0·005	0·006	0·004	0·005	0·007	0·009	0·021	75·0	4·1	45·5	32·2	18·2	31	0·0244
5	50	40	0·015	0·014	0·019	0·024	0·031	0·026	0·028	0·043	186·7	2·0	30·0	41·9	26·1	30	0·0215
6	60	41	0·009	0	0·002	0·001	0·001	0	0·002	0·016	77·8	0·8	34·7	37·0	25·5	33	0·0220
7	53	50	0·012	0·006	0·011	0·012	0·015	0·014	0·014	0·030	150·0	0·4	20·2	48·2	31·2	28	0·0198
Average			0·0138							0·0268	95·20					30·4	

were produced in the respective tests from the same juice and under the same conditions of boiling. The results are therefore directly comparable, the only difference being in the use of mechanical circulation with Table V results. The latter are also shown in Fig. 1 in broken lines, showing the striking difference in the sugar moistures as a result of mechanical circulation.

If we compare moistures in Tables IV and V, we see that not only are the initial moistures (3 hour test) appreciably lower in the second case, but the amount liberated in the humidity oven under similar conditions is also very much lower and, as we should expect, the total moisture measured after the final 3 hour drying is an average of only 0·027% with mechanical circulation, compared with 0·084% in the case of the normally boiled sugar. This of course is achieved not only with similar juice and boiling conditions, but with centrifugals working on the same cycle and sugar being cured and dried at the same rate and with similar conditions in the same factory drying plant.

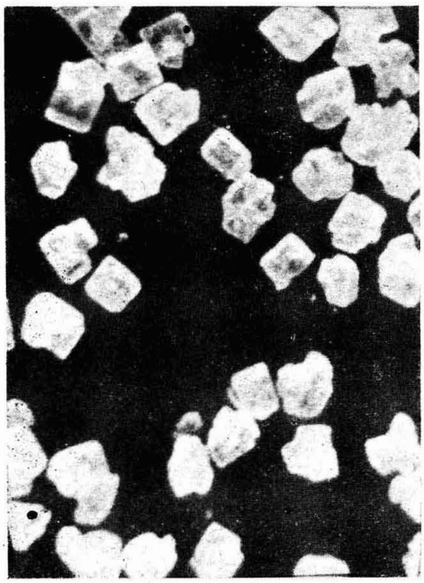

Fig. 2. Normal boiling (x 10)

We must ask what is the physical reason for this very significant difference in moisture! Looking back on the earlier results, it was shown convincingly that the larger sized particles in any sample was the fraction containing the highest % moisture, and when one examined closely this fraction from the normal boiling method one could see that there were very few well-shaped single crystals of sucrose present, but that almost all were complicated conglomerations. An equally close study of the sugar originating from the forced circulation pan revealed that there were singularly few conglomerates present in any of the screened fractions. Typical samples of each type of sugar are shown in Figs. 2, 3, 4 and 5, and serve to illustrate the difference in the individual crystal shapes. It is our belief that it is very largely this difference in crystal shape, coupled with all the other

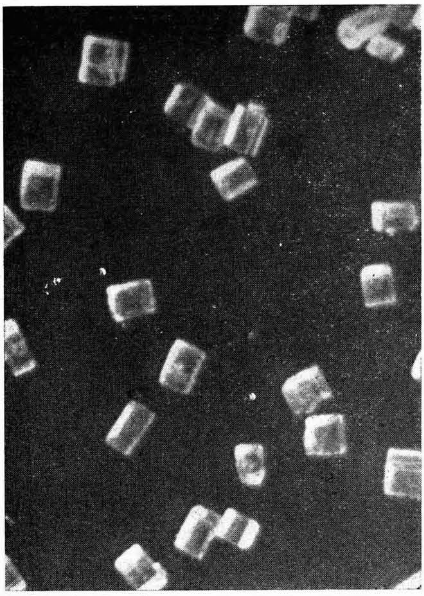

Fig. 3. Circulator Pan boiling (x 10)

Fig. 4. Normal boiling (x 70)

Fig. 5. Circulator Pan boiling (x 70)

aspects which result from it, that has given the remarkable differences in moisture between the two types of sugars.

Now comparing the sieve analysis in Tables IV and V, although it is true that the fraction "through 36" with the circulator was slightly greater, the fraction "on 18" was very much less and this was almost entirely due to the lack of conglomerates. The latter also was the reason for the lower Coefficient of Variation in almost every case of the sugar boiled with forced circulation. Similarly comparing the lines of Fig. 1, it is interesting to note the relative slopes of the curves, say at the points representing 130 hours. In the sugar boiled by forced circulation, the slope of most of the curves is virtually zero—indicating that nearly all the moisture which is going to be given up under the particular conditions of temperature and relative humidity has already been liberated. With the normal boiling technique the indications are that an appreciable amount of moisture has still to be given off, i.e. the latter sugar takes a longer time to reach equilibrium conditions—and this is a most important factor when sizing sugar conditioning plant.

To illustrate the typical difference in composition of the sugar produced by the normal technique and by a forced circulation of massecuite, we have recorded in Table VI the conductivity ash of the samples as shown in Tables IV and V. As the respective numbers represent samples of sugar boiled from the same liquor, the results are recorded side by side, and the third column shows the % ash in the circulator pan sugar expressed as a percentage of the % ash in the normal pan.

Table VI

	% *Ash* X	% *Ash* Y	$\frac{X}{Y}$ %
Samples 1	0·011	0·016	88·75
2	0·009	0·011	81·82
3	0·009	0·010	90·00
4	0·007	0·011	63·63
5	0·007	0·014	50·00
6	0·006	0·012	50·00
7	0·008	0·012	66·66
Average	0·0081	0·0123	65·85

X = Sugar from Circulator Pan.
Y = Sugar from Normal Pan.

On average therefore the ash in the circulator pan sugar is two-thirds of the ash in the normal sugar.

In addition to these ash contents, we also record a comparison of a general analysis between two samples of sugar as determined by our Central Laboratory.

	Circulator Pan	*Ordinary Pan*
Visual Grade	—2·00 (A1*)	—2·00 (A1*)
Reflectance	—5·00	—3·85
Light Absorption V′	8·1	10·6
Light Absorption R′	0·8	1·8
Calculated colour V′ –1·9R′	6·6	7·1
Calculated turbidity 1·91R′	1·5	3·5
Conductimetric ash %	0·006	0·009
Moisture %	0·011	0·037
Sulphite mg/kg	13·1	13·9
Foaming Index At. B.Pt. ..	100	94
At. 117·8°C	96	93
Screening Analysis %		
On 18	2·8	14·2
18–25	38·0	34·3
25–36	28·4	24·1
Through 36	30·8	22·0
M.A.	0·0215	0·0247
C.V.	31	38
Oxygen Maximum micro amps	6·0	3·8

In this respect a detailed investigation by KEANE *et al.*[1] on white sugar reported that in general over 50% of the ash, sulphates, chlorides, sodium, potassium and total nitrogen is located on the outer 5% of the crystal. HIBBERT & WOODWARK[2] reported similar findings in 1951. On the other hand, KEANE reports that colour, calcium and sulphites are more uniformly distributed throughout the whole crystal. In examining the two results therefore, it appears as though we have been successful in eliminating some of the surface impurities by the use of mechanical circulation when boiling the sugar.

So far, all the tests had been carried out on freshly produced sugar, and all had shown, to a greater or less extent, this effect of a slow liberation of moisture, even beyond 130 hours after manufacture. It was decided now to find out the behaviour of a sugar which had been stored for some considerable time. This was carried out on both normally boiled sugar and that produced from the "Circulator" pan samples being analysed as freshly produced and after 68 days. It was decided to keep the latter samples in an unsealed, but covered, container in the laboratory. Another sample was examined at the same time as the two "aged" samples. This was ex-silo storage—but of course it is not possible to give an accurate estimate of its age. The results are not tabulated, but shown on Fig. 6.

[1] *Ind. Eng. Chem.*, 1935, **27**, 30.
[2] *B.S.C. 4th Tech. Conf.*, 1951; *I.S.J.*, 1951, **53**, 277.

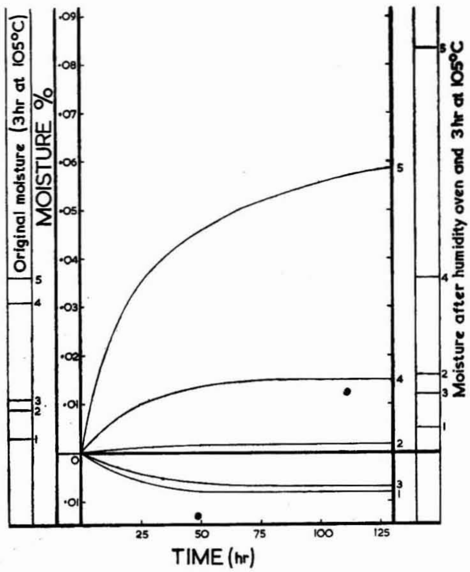

Fig. 6

The duration of these tests (1 to 5) was 130 hours, and the conditions in the humidity oven in each case were 60% R.H. and 40°C. Sample 1 was sugar produced in the circulator pan, and kept in the laboratory for 68 days. Sample 2 was the same sugar freshly produced, i.e. direct from the granulator. Sample 3 was a sugar boiled by normal technique (incidentally at the same time as Samples 1 and 2) and kept for 68 days in the laboratory. Sample 4 was ex-silo storage and Sample 5 was the same as Sample 3 but direct from the granulator. Again the original 3 hours moisture is shown on left hand column, the curves show the moisture variation with time of the various samples, and the right hand column is the moisture liberated in a final 3 hours drying at 105°C of the samples removed from the oven.

It will be seen from Fig 6, that samples 1 and 3 actually picked up moisture while remaining in the oven under the conditions previously stated, presumably because drier conditions (i.e. less than 60% R.H.) obtained in the Laboratory. Sample 4, from the silos, lost moisture, whence it would be fair to assume that the conditions of the air trapped in the sugar mass were at least worse, i.e. higher R.H., than those in the laboratory. Sample 2, being sugar freshly produced from the circulator pan, shows very good characteristics, while sample 5 is typical of previous results from this type of sugar. Another interesting point is the shape of curves in the case of samples 1, 3 and 4. Samples 3 and 4 both consisted of "aged" sugar produced by boiling with normal technique, but the form of all three curves is similar i.e. in the first approx. 48 hours the sugars are reaching an equilibrium moisture consistent with the oven conditions, and thereafter the moisture remains constant. Sample 2 has very little trapped moisture to liberate, but Sample 5 (compare with Sample 3) still has not reached equilibrium after 130 hours. In the same way we can compare the initial and final moistures (3 hours test) i.e. left and right hand columns, and see that with 1, 3 and 4 the results are very similar, i.e. the final moisture in this way is very nearly equal to the initial moisture plus the moisture picked up or lost in the humidity oven. With 2 and 5, although 2 in particular shows very good characteristics, there is a definitely higher final moisture in both cases—extremely higher in Sample 5. All these results indicate the necessity to "condition" or "age" sugar in order to achieve stable conditions for storage, but we feel that they also show that Sample 2 is vastly superior to attempt to condition, or store, than is Sample 5.

We have had to work so far with King's Lynn sugar, but close examination of other sugars has shown that there is a good proportion of conglomerates in all samples examined—and this applies to refined sugar produced both in B.S.C. and by other refiners. In order to ascertain that this slow release of moisture from freshly produced sugar was fairly general to our white sugar factories, tests which we describe below were carried out at these factories. The procedure was to dry one sample for 3 hours at 105°C, put a duplicate sample in a P_2O_5 desiccator for 120 hours, reweigh the latter and finally dry this sample by the standard method. This was the same procedure as with our own tests, but a desiccator was used in place of the humidity oven.

The results from all these factories, including King's Lynn, are shown on Fig. 7. Original 3 hours drying is on the left hand column, the loss in weight in the desiccator is indicated by the end-point of the sloping line, and the right hand column is the total loss in weight in desiccator plus the final 3 hours drying. For each factory, the graphical results represent the arithmetical averages of a number of samples examined. It is quite apparent that similar trends were observed at all factories, although the magnitude of the difference between the final and original moisture varied to some extent.

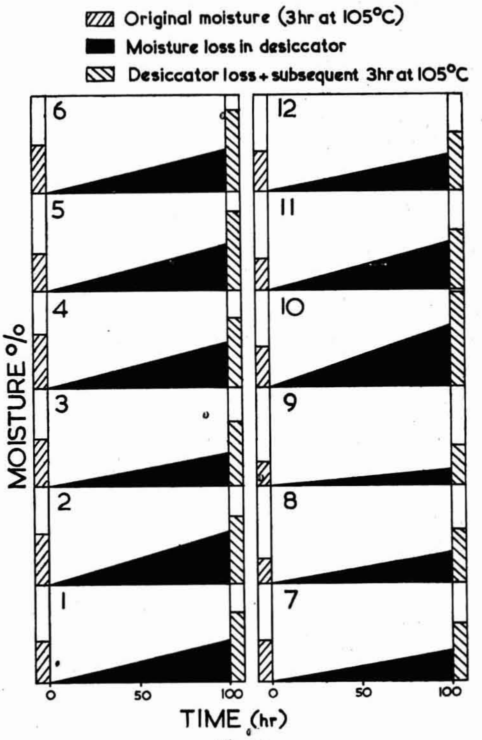

Fig. 7

(To be continued)

VACUUM PAN CONTROL

By G. C. de BRUYN (Sugar Technologist, Verenigde Coöperative Suikerfabrieken, Dinteloord, Holland)

PART II

Results

It may be seen from Chart I that the supersaturation during boiling up of the pan was kept at a fairly constant value. When the pan was full and concentration started one panman preferred to raise the vacuum at once, while the other raised it in steps. We could not see much difference between the two methods. It may be noticed that the final supersaturation reading at the end of a boiling was fairly constant, so that the indication of the supersaturation meter was used by the panmen as an indication of the concentration of the boiling. Chart II shows that the vacuum during the boiling cycle was practically constant. The steam pressure was kept practically constant during the whole boiling cycle.

Below is given a log of a complete boiling as it was kept by our panmen. We asked them to do so because we noticed that they had so much confidence in the instruments that once the S.S.R.C. was set on automatic they would leave the pan and only attend to it when it was full. It happened once that the shock grain was not sucked in. It stuck in the seed cup because the cup had been wet when it was filled with seed grain. The result was a full pan without grain.

Boiling No. 159

Time	*Vac. cm mercury*	*Temp. masse. (°C)*	*Indication super-saturation meter*	*Steam pressure atm. gauge*	*Molasses* °*Bx*	*Pol*	*Purity*	*Temp. °C*	*Supersat. acc. Grut's tables*	*Remarks*
14·04										Push reset button, A.P.R.C. on, automatic evacuation starts.
14·08	55									Feed handvalve opened.
14·10	60	81	31	0						Main steam valve opened, steam-pressure controller set at 0·5 atm. gauge.
14·13	60	81	32	0·2						Feed handvalve closed. Pan filled to 15 cm above upper tubesheet.
14·15	60	80	34	0·5						S.S.R.C. on automatic.
14·24	60·5	75	44	0·55						
14·26	60·5	75	46·5	0·55	83·3	72·2	86·7	75	1·22	Shock-seeding. Automatic feed after 30 seconds.
14·30	60·5	76	46	0·55						Sufficient grain. Clearly visible in pan microscope.
14·55	60·5	77	46	0·55						Feed tank empty. Pan feed on water.
15·02	60·5	76	43	0·5						Panman's remark: Grain grows too slowly. Setpoint S.S.R.C. raised to 48.
15·30	60·5	77	46	0·5						Water on pan closed. Feed on again. Setpoint S.S.R.C. kept on 48.
15·50	60·5	77	48	0·5						
16·00	60·5	77	50	0·5						Pan full (300 hl). S.S.R.C. on manual. Started to raise vacuum gradually to 66 cm.
16·45	66	76	66	0·5						End of boiling. Steam valve closed A.P.R.C. on manual. Pan discharged.

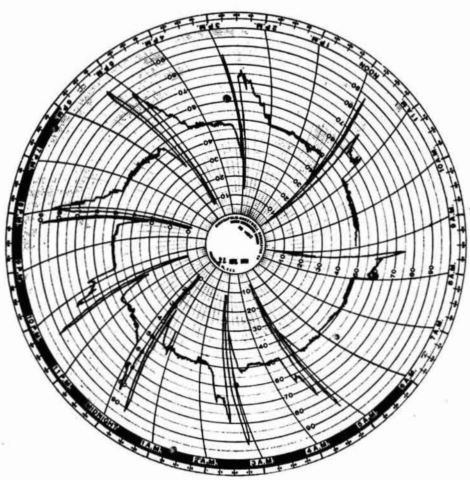

Chart I

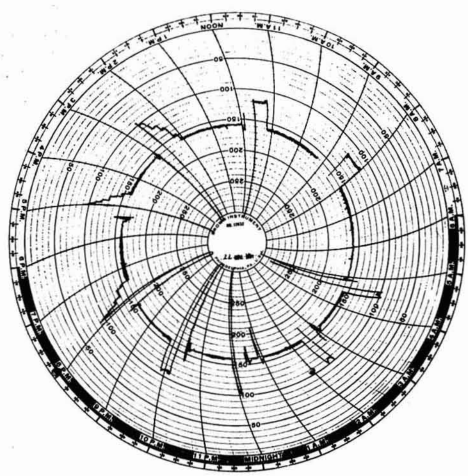

Chart II

Conclusion

The pan made about 400 boilings, which could be worked very well in the centrifugals. Through lack of time and shortage of personnel we were not able to make a complete analysis of the boilings made in our experimental pan. Visually they compared well with the same boilings made in 3 other pans which were not equipped with instruments. A totally inexperienced man was able, after brief instruction, to work the pan.

The instruments, apart from the mobility controller, proved to be very reliable. Under present conditions, where we still have sufficient panmen on our permanent staff, it will not be necessary to equip all our pans with control instruments. We think, however, that some further experimentation with control instruments on our white sugar pans could give definite advantages as regards uniform quality of our white sugar.

SUGAR-HOUSE PRACTICE

Graining for low purity massecuites. II. SIR JOHN SAINT, R. R. TROTT and F. J. HUTCHINS. *Proc. B.W.I. Sugar Tech.*, 1960, 187–192.—The supersaturation of mother liquor in a pan was determined using two methods: (1) Claassen's formula, and (2) Harman's method in which a syrup sample from the pan was allowed to cool and crystallize in a large test tube and the saturation temperature at which all the crystals just dissolve determined by SIR JOHN SAINT's method[1]. The greatest deviation between the two methods was 0·02 supersaturation. Further tests have confirmed the original finding[2] that addition of the proper amount of slurry, prepared as described earlier[3], to syrup at about 1·2 supersaturation and occupying 30–40% of the pan volume will give a number of crystals (10 × 10⁴ per ml) permitting the final seed massecuite to be used as grain for 3 or 4 C-massecuites and yield a C-sugar with an average grain size of about 0·4 mm. It was found that conductivity measurements were not adequate to give a reliable indication of syrup supersaturation, and periodic calibration of conductivity against supersaturation is recommended for boiling control.

* * *

"Separan AP-30" as an aid to clarification. R. R. TROTT and F. J. HUTCHINS. *Proc. B.W.I. Sugar Tech.*, 1960, 203–205.—Addition of 0·1% "Separan" in water to hot limed juice entering the subsiders was found to accelerate coagulation and mud settling, resulting in increased clarifier throughput and clearer juices. While 1 p.p.m. was used as a general rate, no standard dose is recommended although 3 p.p.m. is regarded as a maximum, and 1–1·5 p.p.m. the normal at which even the most refractory juices would be improved. As little as 0·1—0·2 p.p.m. will increase clarifier throughput for normal juices.

* * *

The application of automatic control units at St. Kitts (Basseterre) Sugar Factory Ltd. J. E. DE RAAD. *Proc. B.W.I. Sugar Tech.*, 1960, 224–227.—Brief details are given of the Evershed & Vignoles automatic process control system installed for the 1960 crop. The system controls the levels in the weighed juice, clarified juice and syrup tanks and evaporators, liming of the juice, and temperature in the juice heaters. While it is difficult to assess monetary savings, the system has prevented juice spillage, reduced the number of mill stops, ensured easier operation and reduced labour requirements.

* * *

Modifications to spray ponds improve cooling. A. L. WEBRE. *Sugar y Azúcar*, 1962, **57**, (7), 30–32.—The basic principles of spray pond cooling are outlined and some modifications devised by the author are are described. A diagram accompanies a description of a spray pond which is provided with 64 groups of spray nozzles, each group having 4 nozzles, and has aluminium louvres situated at the lee end and lee side to prevent wind dispersion of the spray water.

The hydraulic and thermal fluctuations in nests of tubes in vertical industrial and film evaporators. I. M. FEDOTKIN and YU. M. TOBILEVICH. *Izv. Vysshikh. Ucheb. Zaved., Pishch. Prom.*, 1962, **28**, (3), 123–128.—The hydraulic fluctuations (ΔW) (maximum:minimum velocities) and heat fluctuations (ΔK and Δq) (respectively maximum:minimum heat transfer coefficient and maximum:minimum heat flow) were determined and the factors affecting their values established for multi-tube evaporators of the Kestner type. Numerous graphs are presented and a formula given for calculation of the hydrostatic temperature drop in downward movement. The highest values of ΔW and Δq were obtained with internal circulation (when the ratio of circulation tube area of cross-section to the area of the tube nest $F_{Ts}:F_k = 0$) and with "inverted" circulation ($\Delta W = 3$–15, $\Delta q = 2$–$6{\cdot}5$). The lowest value of ΔW (1·2) was obtained at high effective levels, high heat flow and an adequate cross-section area of circulation tubes. The lowest value of Δq (1·2) was obtained with natural circulation at low (optimum) levels and low heat flows. Downward flow of the solution causes continuous increase in the solution temperature as it descends the tube and consequent considerable overheating of the solution.

* * *

Determination of the profile of velocity in the downtake of massecuite vacuum pans. V. P. TROINO. *Izv. Vysshikh Ucheb. Zaved., Pishch. Prom.*, 1962, **28**, (3), 116–122.—The sectional circulation velocity in a pan downtake was determined by means of three concentric copper rings located in the lower half of the downtake (the downtake wall itself acting as a fourth electrode), the electrical conductivity being measured. Concentrated sodium triphosphate solution was added to the massecuite, its velocity being measured by the interval between detection of the passage of the ionized material by the sets of electrodes. The tests were conducted on downtakes of 290, 230 and 180 mm dia., the pressure drop also being measured. A formula is derived for calculation of the sectional velocity (w): $w = \frac{59{\cdot}35}{\eta}(R^2 - r^2)^n$ cm/sec, where R is the tube radius, r is any distance from the tube wall, η = effective viscosity and n is a factor dependent on massecuite concentration and the boiling process but not tube diameter. The formula may be used for calculation of the maximum velocity in the downtake and the circulation rate relative to the overall cross-section of the upward flow channels. During the first stages of boiling, n decreases only slightly, but with nucleation it falls abruptly. Graphs are given of the sectional velocity for different radii and at varying values of boiling time:time of circulation. The graphs are found to give good representation of the test data.

[1] *Trop. Agric.*, 1933, 72.
[2] SAINT & HUTCHINS: *I.S.J.*, 1959, **61**, 243.
[3] BADLEY: *I.S.J.*, 1959, **61**, 243.

Direct process for obtaining a refined-type sugar and raw sugar in the same industrial unit. R. ALBISUA. *Bol. Azuc. Mex.*, 1962, (154), 24–33.—The process is illustrated by a flowsheet; primary juice and secondary juice are collected, sulphured, limed, heated and settled separately. The clarified primary juice is passed through a moving-bed column of Pittsburgh CAL granular active carbon, evaporated and the syrup again passed through another carbon bed after mixing with sweet water from spent carbon. The colourless syrup is used to boil the refined strike and this spun and bagged separately; the run-off is mixed with clarified secondary juice and used for preparation of the two raw sugar strikes. Turbid juice from the rotary mud filters is returned to the secondary juice. Details of the individual stages are described.

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Factors which must be taken into account in the processing of mechanically-harvested cane. J. A. LÓPEZ H. *Bol. Est. Agric. Tucumán*, 1962, (74), 18 pp. The mechanical harvesting of cane introduces greater amounts of trash, soil, etc., and the factors influencing these are briefly discussed. The resultant effect on milling include reduction of capacity, sucrose extraction and juice purity, and increased maintenance costs for the tandem. The extent of these is discussed, with reference to the literature, as are the effect on the manufacturing process, viz. fall in recoverable sucrose and increases in molasses quantity and purity, undetermined losses, and filter cake loss. Total losses resulting from mechanical harvesting are calculated as 8·562% on sugar produced for a 2000-ton factory, compared with the 10·97% quoted by DAUBERT[1]. Data collected by YARBROUGH[2] during three seasons in Louisiana are quoted in detail as well as other reported results. The advantages of mechanical harvesting are mentioned and it is considered that the higher losses arising can be eliminated and losses even reduced provided the cane is milled less than 72 hr after harvesting.

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Systems for controlling air pollution. M. A. MASCARÓ. *Sugar y Azúcar*, 1962, 57, (6), 33–35.—Methods used by sugar factories in the U.S. and elsewhere to eliminate fly-ash when bagasse is used as boiler fuel, thus preventing air pollution, are described as are the various types of collectors used.

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Two-boiling *vs.* three-boiling system. H. F. WIEHE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1961, 78–80.—Solids balances are given for a two-boiling and a three-boiling scheme used at one Mauritius sugar factory. These are compared and show that replacement of the latter by the former involves a requirement of 41% extra pan capacity and 17% more crystallizer and centrifugal capacity. Moreover, the two-boiling system gives an A-massecuite of only 73 purity compared with 87 using the three-boiling system. If the syrup purity is abnormally low, as a result of adverse weather conditions, a massecuite purity of 73 would mean a reduction in the amount of boiling-back, but the two-boiling scheme would still require 20% more pan capacity and 4% more crystallizer and centrifugal capacity. While the scheme would prove beneficial with an A-massecuite purity of 80, there would probably be difficulties in graining and building-up of the final strike.

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Experience in bulk storage of cane raw sugar in an unheated warehouse. O. F. GROMOVAYA. *Sakhar. Prom.*, 1962, (7), 26–28.—During 133 days' storage of 99 metric tons of cane sugar in a special hopper erected in an unheated warehouse, the pol dropped from 97·95 to 97·8, and the moisture from 0·916 to 0·638%. The invert %, ash %, colour (°St.) and pH increased from 0·80, 0·425, 37·0 and 6·63 to 1·03, 0·44, 38·1 and 6·7, respectively. Details are given of the warehouse temperature and R.H. during each 10-day period of the total storage time.

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Processing standard refined sugar cubes on cutting machines. I. V. ZUSMAN. *Sakhar. Prom.*, 1962, (7), 49–50.—Difficulties encountered with the slicing of cube sugar blocks into the required cube sizes are discussed. The length of the blocks and therefore the thickness of the cubes was not related to the travel of the conveyor at the slicing machine. To make the length of the blocks conform to this would have entailed modifying the matrices and plungers of the presses. To avoid this, it was decided to make the thickness of the cubes conform to the conveyor speed and to the length of the block. Calculations are presented for determination of the number of teeth in the gears of the feed conveyor and in the ratchet for a given cube thickness. In this way, the snags were overcome and the amount of waste sharply reduced.

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Continuous flow centrifugals for third massecuites. J. ROCHA DE ALMEIDA. *Brasil Açuc.*, 1961, **58**, 219–225.—An account is given of the design, operation and advantages of the Hein, Lehmann continuous centrifugal, made in Brazil by MAUSA (Metalúrgica de Accessórios para Usinas S/A), together with results achieved in Brazil, compared with an 18 × 36-inch batch machine.

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Difficulties in milling and manufacture caused by mechanical harvesting of the cane. A. S. ALVAREZ. *La Ind. Azuc.*, 1962, **58**, 169–175.—The impurities—trash, roots, soil, etc.—introduced with cane harvested mechanically caused difficulties in milling and processing as well as increased losses. The problem is discussed generally.

[1] *Proc. Amer. Soc. Sugar Cane Tech.*, 1953, 128.
[2] *ibid.*, 162.

Refining of raw sugar at Genthin sugar factory. E. GUTKNECHT. *Zuckererzeugung*, 1962, **6**, 174–175.—Details are given of the refining process at Genthin sugar factory where five products are boiled, the A1 and A2 massecuites of 97·8 and 9·8 purity being used for raffinade and melis respectively.

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The rôle of reducing substances in the processing of raw cane sugar. I. F. BUGAYENKO. *Sakhar Prom.*, 1962, (8), 19–21.—The difference between the percentage of reducing substances in cane and beet products is noted and the problem of preventing the decomposition of cane reducing substances is discussed. The usual scheme in Soviet white sugar factories for cane sugar is carbonatation at 70–80°C with addition of 2–3% lime on weight of raw sugar; affination is usually omitted at most of these factories, so that a considerable portion of the reducing substances is decomposed. The effect of this degradation on molasses composition was studied by comparing molasses from a factory working without affination with molasses obtained from laboratory affination syrup, which was concentrated in a laboratory vacuum pan. Sucrose inversion was negligible. Both molasses were brought to "standard" conditions. The "standard" purity of the laboratory molasses was 6·8 units lower at 47·4 than the factory molasses; the lime salts content of the latter was 3 times greater than the laboratory molasses. This had to be measured iodometrically because of the high reducing substance content in the factory molasses. While the alkali ash content remained almost the same, the reducing substance:alkali ash ratios for factory and laboratory molasses were 0·635 and 1·75 respectively, indicating a greater degree of reducing substance destruction in the factory samples.

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Experience in processing raw sugar at Kuban' sugar factories. A. I. KATANA. *Sakhar. Prom.*, 1962, (8), 21–23.—Details are given of the processing of raw sugar at Adygeiskii sugar factory which uses a three-massecuite system and in 1962 produced 91·83% refined sugar, with 1·46% sugar losses and 2·68% sugar in molasses (on weight of raw sugar). Molasses purity was usually 60–61, sometimes falling to 55–56. The factory is considered typical of the 15 factories in the Kuban' trust.

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Steam economy. C. G. M. PERK. *S. African Sugar J.*, 1962, **46**, 577–587.—The relation between steam consumption of a factory's prime movers and the extent to which the multiple-effect evaporator can be bled for heating and pan boiling are discussed in connexion with the degree of steam economy of a factory. In regard to the steam consumption of the prime movers, such subjects as live steam pressure and degree of superheat are mentioned as is also the question of single- and multi-stage steam turbines as prime movers. In addition the questions of how far the bleeding of vapour for juice heating affects the required back-pressure together with to what extent bleeding for pan boiling should be introduced are discussed.

Why sugar boilers want to use live steam. T. O. SORIANO. *Sugar News* (Philippines), 1962, **38**, 255–256.—The properties of exhaust steam and throttled live steam, both at 10 p.s.i.g., are compared to see why live steam is preferred by sugar boilers. Calculations show that very little more heat is available in the same volume (about 2%) but the temperature of the live steam is higher (300°F *vs.* 240°F) and the rate of heat exchange is consequently greater by 50%. The use of live steam is wasteful, however, and where it is found necessary to maintain adequate evaporative capacity, the heating surface area should be enlarged to match milling capacity.

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Better sugar by remelting. A. VAN HENGEL. *S. African Sugar J.*, 1962, **46**, 587—595.—Since some raw sugar factories are able to run without supplementary fuel on cane of 10–11% fibre it is assumed that South African factories crushing cane of 14·5% fibre should be able to reduce fuel requirements so as to use only 12·5% for normal purposes, when 2% would be available for remelting purposes. The process is advocated so as to increase massecuite and consequently sugar purities. *C*-sugar is double cured and remelted, the C-wash being mixed with *B*-molasses. The *C*-massecuite is grained on molasses of about 72 purity and boiled off at 57·5 purity. *B*-massecuite is grained and boiled on *A*-molasses, the resulting *B*-sugar being well washed and mingled with syrup for use as footing for *A*-massecuite. Excess over the requirements for *A*-massecuite footing is remelted. *A*-massecuite is normally boiled on a syrup-melt mixture, but if the purity rises to the extent that exhaustion is not complete in three stages, the melt is collected separately and a high purity massecuite made from this (the *R*-massecuite) from which the run-off is mixed with syrup. In this case the *R*-sugar and *A*-sugar would be combined for sale. Operation of the scheme in two factories where, owing to low mixed juice purities, it has not been necessary to introduce an *R*-strike has given sugar of much higher filtrability than would otherwise have been made, the crystal size also being adequate and regular. Detailed calculations of the quantities, purities, etc., are presented.

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Experiences with continuous centrifugals at Valentine. H. ELIZONDO. *Sugar J.* (La.), 1962, **25**, (2), 10.—Comparisons are made between the performances of a Silver (Hein, Lehmann) continuous centrifugal and 24 × 40-inch batch machines handling *C*-massecuites. Sugar quality was higher with the Silver machine (average pol 91·07 *vs.* 89·70, average colour 96·36 *vs.* 115·50) although molasses purity was higher (37·18 *vs.* 36·20) probably because fine crystals pass through the screen instead of being trapped by a thick wall of sugar. Capacity was higher (121·39 cu.ft./hr *vs.* 37·5 cu.ft./hr) although power consumption was lower (25 h.p. *vs.* 40 h.p.). Cost is about the same while labour attendance is less and maintenance is simple. Disadvantages include the need to use water or steam and the relatively expensive screens.

Dependence of the resistance of juice and water passage on the state and quality of the cossettes. S. ZAGRODZKI and J. KUBIAK. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Hydrodynamic resistance of cossettes as a function of their quality, cell fill, temperature and beet quality was examined. Measurements were made with sound ripe beets, unripe beets and beets which had been frozen and also which had deteriorated owing to inadequate storage. Sugar solutions of various concentrations were used to correspond to various parts of the diffuser. The cossettes cut from ripe beets were found to maintain their rigidity at 60°C after increasing the column fill up to 130% of its initial value; at 70°C an increase to 120% only is possible without destroying the rigidity while at 80°C rigidity is lost within only 15 minutes. Liquid flow through a column of sound cossettes (15–18 m/100 g) was stopped when the weight of the cossette layer (cell fill) reached 0·60–0·63 g/cc. With unripe beets flow ceased at 0·63–0·66 g/cc, while with frozen deteriorated beets it ceased at 0·51 g/cc. The hydraulic resistance of a 1-metre column of sound cossettes varies from 50 to 700 mm w.g. when the cell fill varies from 0·39 to 0·60 g/cc, while with unripe beets this resistance decreases by 13–50% and with frozen deteriorated beets it increases by about 50%. Hydraulic resistance is also increased by rises in sugar concentration, liquid viscosity and cossette length.

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Undetermined sugar losses during diffusion. J. WIGAND. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Diffusion losses at Ochsenfurt are determined from hourly analyses of pressed pulp, while pH variations in the diffusion towers and pulp press water are controlled in the laboratory and also by means of automatic recorders. The addition of formalin to the diffusers and of chlorine to the returned pulp press water suppresses microbiological activity while a separate microbiological laboratory keeps a continuous watch on bacterial flora. Quick working and the avoidance of any juice retention are also important measures to prevent undetermined losses.

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Undetermined losses in sugar production at modern beet sugar factories. J. WIGAND. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—It is essential to know the weight and polarization of beets received in order to determine the losses; the first is determined with weighing machines having movable beams while the dirt tare is estimated by an authorized agent of the beet growers' association. In the factory are used conveyor-weighing machines, adjusted daily and checked with standard weights every 10–14 days. Beet tails are sent directly for drying without extraction. Cossettes are sampled in the presence of an agent of the growers' association and analysed hourly for sugar content, check samples being tested by an agricultural board at Würzburg. Exact control of pre-liming (Brieghel-Müller system, to pH 11·2), main liming (to total lime usage of 2% on beet) and counter-current carbonatation (to pH 10·8) is necessary to obtain low losses in the filter-cake (always below 0·1%). Spillages are returned to predefecation or to the pump-box of first carbonatation. Other factors in avoiding undetermined losses are high working speed, avoidance of hold-ups in juice flow, and the rapid boiling of strikes at low temperatures.

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The economical limit of sugar extraction from beets. S. ZAGRODZKI and S. M. ZAGRODZKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Laboratory extractions for 70 min and at 70°C, approximating to the factory process, were carried out at various periods during the campaign using cossettes (15 m/100 g), the varying quality of which was taken into account. Purities of press juice, raw juice and juice after liming and carbonatation were determined. Purities of the cell juice remaining in the exhausted pulp, the raw juice and the corresponding thick juice were plotted on semi-log graph paper *vs.* the sugar content remaining after extraction. It was thus possible to establish how much of the sugar extracted by further diffusion may be recovered as white sugar and how much passes to molasses. Economic evaluation of the costs involved in higher steam usage for evaporation, poorer quality and lower pulp yield showed that under Polish conditions the economical limit of sugar extraction was to a pulp loss of 0·3% on beet.

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Application of measurement methods in the sugar industry. S. MICHALOWICZ. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Flow, level and pH measurement are discussed and the experience of the author's organization, Cukroprojekt, in determining the best means for control purposes, are described. For steam and water flow measurement the normal orifice-type of meter is suitable but the classical Venturi tube is more convenient for juice, milk of lime and carbonatation gas because the conical inlet and outlet afford no room for accumulation of sludge. Water (10 litres/hr) should be used for purging and not air since when the latter is used a pressure shock caused by suddenly closing the va ve behind the Venturi tube pushes juice into the tubes leading to the instrument. Condensing chambers similar to those applied for steam orifices are used as purge water chambers, while steam condensate is used as purging water. The float method of measuring level is obsolete and inconvenient where a change of range is necessary, and the method used for the whole factory is to pass air into a bubble pipe, measuring the water gauge pressure. If blocking of the pipe occurs, additional purging with water is used. Small air flows are regulated with rotameters. Mechanically cleaned electrodes are convenient for pH measurement but trouble is still experienced with choking of pipes and a proper solution has yet to be found.

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Purification of beet juice and the utilization of carbonatation mud. J. VAŠÁTKO. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Recent experiments have achieved good results in the solution of the problem of single-stage carbonatation. Progressive pre-liming is combined with subsequent simultaneous liming and carbonatation at the alkalinity of the last carbonatation and recirculation of part of the carbonatation juice or carbonatation muds to the diffusion juice. The carbonatation mud is used in the production of V-K chalk by flotation and chlorination; the product can be used for protection of agricultural products during vegetation and storage, as a carrier for micro-elements, active materials, etc.

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Some questions relating to coagulation of raw juice colloids. V. TIBENSKÝ. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—As a result of a study of the Brieghel-Müller stabilization of colloids it is concluded that ion exchange on the colloids, according to Dedek's hypothesis, and the resulting natural alkalinity in defecated juice are independent of the fashion of milk-of-lime addition during the preliming. Coagulation of colloids only occurs when the pectin is de-esterified, and coagulation after de-esterification is greater in alkaline medium. As the rate of de-esterification depends on the pH and temperature of the medium the influence of temperature on the proper coagulation of colloids with lime is very appreciable. The insoluble lime salts as they form adsorb the colloids of raw juice.

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Retention time of mud particles in apparatus for juice purification. J. DOBRZYCKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—If a process takes place continuously in a reaction vessel under intensive stirring, the retention time of an individual particle of the material depends on chance: it may leave the vessel at once or after a prolonged time. In a case where an optimum reaction time exists, this dispersion of retention times about the mean has an unfavourable effect on the result of the continuous process. Thus, e.g., diverse retention times of individual mud particles in a carbonatation tank lead to non-uniform particle size of the mud and impair its filtrability. On the basis of mathematical analyses of the suspension flow through single- and multi-vessel schemes, formulae have been derived for determining the retention time of any given particle in a scheme consisting of a liming tank and one or more carbonatation tanks. In addition the case of juice recirculation from carbonatation tank to liming tank has also been examined.

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Proportional feeder for lime or juice. S. ZAGRODZKI and S. M. ZAGRODZKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—A new rotary feeder includes a set of bent tubes rotating around a horizontal axis, the quantity of liquid added being proportional to the quantity of diffusion juice and to the level of the liquid in the chambers of the feeder. A gearbox with continuous change of rotation velocity permits the correction of the ratio of the liming agent to the diffusion juice flow. A continuous factory pH meter or an electronic density meter sends electric impulses correcting the speed of rotation of the feeder. Full-scale examination of the feeder showed that it can be used in preliming and main liming; the pH in the individual chambers of the preliming tank did not fluctuate and in the prelimed juice was a little above 11. The defecated juice contained a constant amount of lime although the raw juice flow rate and milk of lime density had varied. Variation in alkalinity did not exceed 5%.

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Use of ion exchangers for thin juice purification in beet sugar production. P. V. GOLOVIN, A. A. GERASIMENKO and M. A. ABRAMOVA. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—A four-resin scheme has been developed for thin juice treatment; it comprises successive treatment with cation, anion, cation and anion exchangers, the cation exchangers being used by the static method, in suspension, and the anion exchangers in the dynamic method. The cation exchanger-treated juices from the 1st and third stages are of pH 3·9–4·1 and after the anion exchangers of pH 8·4–8·8. The thin juice produced is colourless and of 97·5–98·0 purity. Calcium salts and non-sugars are almost completely removed and on the laboratory scale an additional yield of 1·2–1·4% of sugar on beet has been achieved.

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Fundamental problems of the modern purification of juice in Hungary. K. VUKOV. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Research is being carried out in Hungary on such problems as the duration and temperature of progressive pre-liming, progression through counter-current liming, the rôle of calcium carbonate in the preliming process, and the influence of preliming on filtration, sedimentation and the composition of juice. Attempts are being made to develop a standard purification process.

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Cell-divided defecation apparatus. T. JAWOROWSKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The apparatus described consists of two vertical tanks. The first is designed for continuous progressive preliming in six steps and the second for continuous main liming with varying reaction time and carrying out multi-stage liming. Both cylindrical tanks are divided by alternately installed conical rings and plates, which form 6 reaction compartments and two stabilization compartments. The tanks are equipped with stirrers, foam skimming blades and sand catchers in their bottom part; the last can be emptied without stopping the process. Limed juice is used as the liming agent in the preliming tank. Its amount is proportional to the supply and is regulated by dividing the entire stream of juice leaving the main defecation tank. In a case installed below, six suitable blades divide the total juice stream into 7 parts which flow to the 6 compartments of the preliming tank and to the raw juice tank. The main liming is done with milk-of-lime supplied by a bucket wheel feeder and proportional to the juice flow rate. Its flow is regulated by a venturi tube system controlling the milk-of-lime feeder. A supplementary density meter system corrects for the milk-of-lime density. The apparatus gave good results at Chelmza factory during the 1961 campaign; lime consumption was 1·09% on beets and F_k of the juice was 11·9. pH in the compartments increased progressively and correctly, i.e. 8·4, 8·7, 9·05, 9·6, 10·7, 11·03.

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A circulation carbonatator. S. ZAGRODZKI and H. ZAORSKA. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—A new carbonatation tank has been developed which is characterized by the intensive internal circulation of juice. Samples can be taken from various levels in the vessel, which can be used for normal carbonatation, carbonatation with recycling and for defeco-saturation. The main part of the carbonatation occurs in the first compartment. Kiln gas absorption is 75% in the counter-current system, 70% in the concurrent system and 60–65% with defeco-saturation. After changing the control valve position the effluent juice reaches its new alkalinity within 30 seconds in the con-current system and within 1 minute when in counter-current, so permitting easy automation. The gas inlets and other tubes were shown not to scale-up during the campaign.

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Continuous pressure mud thickener. J. LEKAWSKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The thickener is a closed conical vessel with a conical bottom. Inside is a perforated cone covered with a screen of coarse wire net and a "Steelon" filter cloth. Round a vertical axle rotate two scraper arms mounted at the same angle as that formed by the side lines of the perforated cone. The axle can be moved up or down so adjusting the clearance between the scraper arms and cloth, and thus the mud thickness. The surplus mud is scraped off and falls into the bottom funnel from which it is removed as a slurry containing 20% solids, while the clear filtrate is withdrawn from the internal cone.

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Pressure filters with hydromechanical cake removal and filtration procedure without obtaining waste water from wet cake discharge. R. SZAREJKO. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The filters[1] were first described in 1955 and to date a total of 71 are operating and a further 21 are being installed. The advantages are discussed. Carbonatation muds are removed with water; where the factory cannot discharge its mud directly into a river a fairly expensive purification plant is necessary; by sending the mud to a thickener it is possible to remove it without the drainage water which can then be recirculated for use in the next filtration cycle for sweetening-off the cake, so eliminating the waste.

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Pressure filter with pneumatic dry cake removal. S. ZAGRODZKI and S. M. ZAGRODZKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The filter consists of a vertical cylinder with a conical lower part and containing several concentric filter elements. It is compact and has no dead spaces, will hold a relatively large amount of mud and has no moving parts. It is light, cheap and occupies little space. Cake removal is brought about with compressed air. Filtration rate reaches 5–10 litres/sq.m./min depending on pressure, with a 150 sq.m. filter. The filter is little susceptible to mud quality and requires little sweetening-off water. Cake removal takes only a few minutes and the filtrate is clear enough to go to process.

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The influence of the cooling rate of low-grade massecuite on molasses exhaustibility. K. WAGNEROWSKI, D. DABROWSKA and C. DABROWSKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Massecuite of 78 purity containing sugar crystals of definite size and surface:weight ratio, was prepared with a non-sugar: water ratio of 2·25, 2·75 and 3·25, respectively and cooled in a mingler with a fixed rotation speed and controlled cooling rate from 5° to 0·25°C per hour. Samples taken at intervals of mother liquor were analysed for R.D.S., sucrose, purity, viscosity and true supersaturation. The massecuite was cooled in each test to a temperature at which it was still possible to take a sample of mother syrup, when the

[1] *I.S.J.*, 1958, **60**, 210.

viscosity was about 300 poises, and then cooled further in an attempt to reach complete exhaustion. The results were adjusted by calculation to exactly comparable conditions and were then illustrated in the form of diagrams which allow comparison of the practical and theoretical courses of crystallization. They also permit the determination of the true supersaturation and mother syrup viscosity at each stage of crystallization. Comparison of the results permits the determination of several correlations of the crystallization parameters, viz. supersaturation, viscosity, purity and molasses exhaustion, at chosen temperatures, non-sugar concentrations and cooling rates. From the experiments it is also possible to determine the optimal limits for the cooling rate of low-grade massecuite within which complete exhaustion is possible.

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Modified method of second carbonatation. B. NOWAKOWSKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—In the new technique described, 200% of totally or partially saturated juice is recirculated after heating to 110°C under a pressure of 1·5 kg/sq.cm. and then expanded into the upper part of the carbonatation tank. A certain amount of separately precipitated $CaCO_3$ is added to the juice before heating in order to facilitate the crystallization.

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Sugar crystallization and the formation of molasses from normal and delimed juices. S. ZAGRODZKI and J. MARCZYNSKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Laboratory-scale multi-stage crystallization of sugar from factory juices produced normally and using ion exchange deliming was carried out at various times during the campaign. From normal juices exhausted molasses was obtained of 59% true purity; the corresponding purity for delimed juices was 62 purity. The purity of the exhausted molasses appears to depend on the degree of deliming and on the lime salts content of the juice. The problem of juice deliming is mostly considered from the point of view of the prevention of evaporator scaling; the experiments show that the additional loss of sugar in molasses is a factor which should also be considered.

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Examination of automatic regulated preliming. S. ZAGRODZKI and H. ZAORSKA. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The full scale tests of the rotary feeder at Goslawice sugar factory in 1961/62 were carried out using juice from sound beets and partly deteriorated beets. Limed juice was used as preliming reagent and also limed juice mixed with 1st carbonatation and over-carbonatation juice. The efficiency of the new device was examined by observing the course of alkalinity and pH of the juice in each cell, the sludge sedimentation in prelimed juice and the filtrability coefficient of juice after first carbonatation. In comparison with other equipment examined by the Warsaw Institute of Sugar Industry and with the Brieghel-Müller prelimer, the new device gave better results, the filtrability coefficient reaching 3·3–7·2 depending on the method of preliming and continuous carbonatation. The device allows flexible application of different methods of juice purification, depending on the quality of the beets, so that optimum preliming can be maintained. It works well under narly all conditions and improves the results of first carbonatation even when processing deteriorated beets.

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Influence of over carbonatation on the absorption of colour substances by calcium carbonate. S. ZAGRODZKI and J. DOBRZYCKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Overcarbonatation, i.e. to lower than pH 11, in first carbonatation causes a deterioration in juice quality, a rise in colour being possibly caused by peptization of colloids coagulated during preliming, change of colour intensity of dissolved substances, and a change in the absorption capacity of the calcium carbonate. Coloured products of the alkaline degradation of invert sugar were adsorbed by precipitation of calcium carbonate at pH 11 from a solution containing them; the precipitate was washed and transferred to a fresh sucrose solution. After making slightly more alkaline, CO_2 was introduced and juice samples taken at intervals. Their absorbency index at 461 mμ and 560 mμ was measured and correlated with pH. Overcarbonatation below pH 10·5 caused desorption of colouring matter, the desorption being greater for the coloured substances absorbing light of the shorter wavelength.

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Alkaline decomposition of invert sugar and the importance of its products for customary juice purification. S. Z. IVANOV and A. R. SAPRONOV. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The kinetics of the alkaline decomposition of invert sugar at temperatures of 20–80°C have been studied. The products of such decomposition are dark-coloured calcium salts of organic acids, most of them being reversible hydrophilic colloids which increase juice viscosity and impair filtration of juices and syrups and crystallization of sugar. Carbonatation removes some colour but only insignificant amounts of colloids and lime salts, while the action of activated carbons is analogous. Sulphitation converts the decomposition products into colourless leuco-compounds. Decolorization by cation exchangers is slight but is almost complete when anion exchangers are used. Identification and determination of the content of the decomposition products have been carried out using u.v. spectroscopy.

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Application of defecosaturation and second carbonatation in juice purification from deteriorated beets. S. GAWRYCH and T. PIETRZKOWSKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—During 1960 two processing schemes were developed for the processing of deteriorated beets; these were: (a) two-stage progressive defeco-saturation at pH of about 9·5 and 11, and (b) one-stage defeco-saturation at pH 9·5. The juice was then filtered and carbonatated again, optimum alkalinity being lower than in the case of sound beet and also within fairly wide limits rather than sharp and distinct. This was due to the high lime salts content; experiments are to be made on removal of the latter with small amounts of sodium carbonate or trisodium phosphate.

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Laboratory investigation of simultaneous defeco-saturation. S. ZAGRODZKI and J. DOBRZYCKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Continuous defeco-saturation and its influence on filtrability and thin juice composition were studied under laboratory conditions and compared with the standard scheme—main liming and counter-current carbonatation. Progressive preliming with milk-of-lime was used in both cases. Using defecosaturation it was possible to attain higher juice filtration velocity and in the presence of a large amount of invert resulted in lower coloured thin juice, with less invert sugar destruction. Under such conditions, overcarbonatation did not worsen juice colour and increased filtration velocity. Two-stage defeco-saturation with overcarbonatation in the first stage, compared with one-stage defeco-saturation, improved filtration velocity but gave poorer thin juice quality.

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Influence of repeated use of reburnt carbonatation mud on the efficiency of beet juice purification. S. ZAGRODZKI and W. FORNALEK. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Lime obtained from reburnt carbonatation mud over four cycles was compared with lime from limestone for raw juice purification. Juice purity with first cycle reburnt mud was 1 unit higher than with fresh lime, decreasing to 0·5, and 0·15 higher for the 2nd and 3rd cycles. Absorbancy indices at 570 mμ were smaller by 23% (first cycle) to 38% (fourth cycle) than with fresh lime. Juice filtration was poorer, F_k values being 3·30 with fresh lime, 3·70 with first cycle lime and 4·40 for the following cycles. Lime salts and ash content did not show any great deviation as to which lime was used and regeneration is not considered to have an unfavourable effect on these.

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Acceleration of sedimentation in a settling tank: a symposium. *Sakhar. Prom.*, 1962, (7), 9–17.

(I) The adsorbing and conglomerating properties of polyelectrolytes and raw juice pectins are briefly discussed (by P. M. SILIN) with mention of the practice of adding raw juice to 1st carbonatation juice (2–5% by vol. or up to 10% with very poor beet) in order to improve sedimentation.

(II) Experimental work carried out at various Soviet factories and laboratories is discussed (by I. M. LITVAK, M. I. BARABANOV and M. KH. LIKHITSKII) and the addition of raw juice to 1st carbonatation juice advocated on the basis of the results obtained. These show that raw juice addition increases the sedimentation, settling rate, clarity of the supernatant and gives the same F_k as with normal 1st carbonatation juice; the optimum juice alkalinity and amount of raw juice to be added should be determined by each individual factory.

(III) At Lannovsk sugar factory it was found (according to S. G. BONDAR') that addition of 10% raw juice (by vol.) to 1st carbonatation juice at 0·08–0·09% CaO alkalinity gave a clear, transparent filtrate and increased the settling rate; the latter was twice as slow and the juice turbid without raw juice. Additions of raw juice to juice from poor beet did not cause increase in the lime salts nor in the colour. With the Chugunov settlers, 5–7% raw juice is added (by vol.) irrespective of beet quality.

(IV) The effect of raw juice added to juice from poor beet is discussed (by A. ROSTRIPENKO). It was found that the optimum dosage was 2%, giving a clear juice. The factory slicing rate could be increased immediately from 1400 to 1600 metric tons of beet per day. Difficulties occurred in the pumping and regulation of the juice quantity when this was added to the 1st carbonatation tank and addition directly to the settlers is therefore advocated. The method of adding the raw juice depends on a number of other factors.

(V) Results of laboratory tests on addition of 5 and 10% raw juice (by vol.) to 1st carbonatation juice at various juice alkalinities are discussed by L. P. SOFRONYUK). These show a marked decrease in the volume of muds after a given time, 10% raw juice causing the greater decrease. At 5·0–12·0% raw juice addition, the mud particles were large and dense, the supernatant was transparent and the settling time was cut. Raw juice was also added to filtered juice samples and resulted in an increase in 2nd carbonatation juice purity, with a slight drop in the colour.

(VI) In laboratory tests (discussed by I. A. YAROVENKO and A. P. MIROSHNIK) the most rapid settling resulted when 5–10% (by vol.) of raw juice was added to 1st carbonatation juice. Addition of the raw juice to the 1st carbonatation vessel improved the settler performance and that of the filters, although the clear, transparent juice had a purity lower by an average of 0·3 units. A 5% dose is recommended.

(VII) With sub-standard beet it was found at Lannovsk that addition of 5–7% raw juice to 1st carbonatation juice (by weight) at 0·05% CaO alkalinity gave optimum results. For normal conditions, the alkalinity should be 0·07–0·08% (according to the author, G. IVASENKO).

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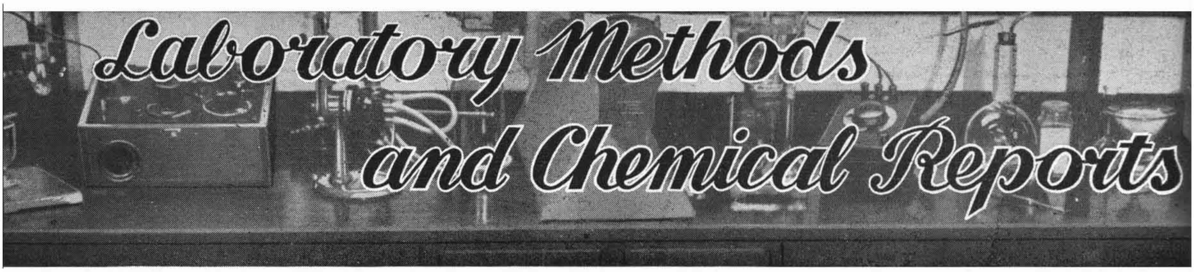
Modern after-filters. K. HANGYÁL. *Cukoripar*, 1962, **15**, 166–170.—Descriptions and illustrations are presented of a number of modern filters, including the "Hercules-RA", "Filtromat", Szarejko, Niagara, AKA-Olier, and BMA candle filter.



Studies on the analysis of molasses. V. Contents of amino-acids. I. MATUBARA, K. MORITA and S. KINOSHITA. *Hakko Kyokaishi* (J. Fermentation Assoc. Japan), 1960, **18,** 73–77. **VI. Polarographic determination of aconitic acid. VII. Organic acids in molasses.** I. MATUBARA and S. KINOSHITA. *ibid.*, 77–80; 145–149; through *S.I.A.*, 1962, **24,** Abs. 349, 369, 350.

(V) Molasses from various sources were analysed for amino-acid contents qualitatively by paper chromatography with subsequent quantitative measurements on the isolated acids by a microbiological method. Cane molasses from the Philippines, Africa, Taiwan, Indonesia and Thailand contained 0·07–0·34% of aspartic acid, 0·04–0·096% of alanine, 0·02–0·05% (each) of valine, threonine and serine, and 0·001% each of arginine, cystine, glycine, glutamic acid, histidine, phenylalanine, tryptophane and tyrosine. Cuban "high-test" molasses contained 0·07% of alanine, 0·04% of aspartic acid, 0·03% of valine, 0·017% of histidine and minute amounts of serine and threonine. Japanese beet molasses contained about 0·1% each of alanine, aspartic acid, glutamic acid and leucine, and 0·03% to 0·08% of other amino-acids. The contents of aspartic acid in different batches of molasses varied considerably, e.g. 0·1 to 0·25% in molasses from the Philippines, Indonesia and India. The alanine contents showed less variation and the accuracy of the microbiological method is affected by the type of amino-acid being measured, and the effect is minimized by analysing molasses in an optimum concentration (3–15 mg/ml); some amino-acids were more affected than others by this procedure.

(VI) Molasses (25 g) is dissolved in water and 20 ml of conc. HCl, and made up to 500 ml with adjustment of pH to 9–10 with 6N NaOH. Twenty ml of this solution, diluted to 50 ml, is mixed with 2 g of active carbon and kieselguhr mixture, heated to 200°C for 4–5 min and filtered. The filtrate is mixed with 1N HCl in a ratio of 2:5 by vol., and dissolved oxygen is removed by nitrogen bubbling. Polarograms are obtained at —0·4 to —1·0 volts with respect to the mercury electrode. The method was checked by repeated measurements with one sample and by adding known amounts of aconitic acid; for an amount of 1·43% the error was ± 1·8%. The diffusion current increases by 1·3% per °C between 20 and 40°C. The aconitic acid contents in 26 samples of molasses from eight sources were 1 — 1·5% (Philippines, Indonesia, Africa, Thailand), 0·4–0·7% (Taiwan, India, Cuba) and 0·06% (beet molasses from Japan).

(VII) Non-volatile acids in cane molasses, identified by two-dimensional paper chromatography, were found, in the order of decreasing contents, as: aconitic acid (especially in Indian molasses), lactic and malic acids, succinic acid, glycollic acid (especially in Indonesian, Taiwan and Indian molasses) and citric acid; small amounts of fumaric acid, oxalic acid and gluconic acid, and two unidentified acids were also detected. Beet molasses contained glycollic acid, succinic and lactic acids, with smaller amounts of malic, fumaric and malonic acids; there were also larger amounts of two unidentified acids. Cuban high-test molasses contained relatively large amounts of aconitic and malic acids. Volatile acids were identified on one-dimensional paper chromatograms and included acetic acid and, in traces in cane molasses, butyric acid.

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Determination of pectins in raw juice by a nephelometric method. G. B. AIMUKHAMEDOVA, N. P. SHELYKHINA and Z. A. MASLINKOVSKAYA. *Izv. Akad. Nauk Kirgiz. S.S.R., Ser. Estest. i Tekhnich. Nauk*, 1961, **3,** (2), 13–22.—The raw juice is adjusted to pH 4·8–5·0 with an acetic acid-sodium acetate buffer solution and heated for 5 min on a boiling water bath to coagulate the albumins and saponins. After filtration, the pectins are precipitated from the filtrate with alcohol and centrifuged. Colouring matter is removed by adding 0·5N sodium chlorite at pH 3–3·2 and re-precipitating the pectins with alcohol. They are centrifuged, treated with ether, dissolved in distilled water and determined nephelometrically against a column of 0·005% rosin oil. When the light reflection is the same for other fields of vision, the pectic acid content is determined from the height of the column of test solution by means of a calibration curve which covers the range 0·05–0·50% pectic acid. The advantages of the method are claimed to be simplicity, rapidity and good accuracy (deviation between nephelometric and colorimetric determination is —0·7 to +7·1% at nephelometric concentrations of 0·112–0·165% pectic acid).

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Acceleration of sucrose hydrolysis in the presence of calcium, magnesium pectinate. G. B. AIMUKHAMEDOVA and E. P. RUKAVISHNIKOVA. *Izv. Akad. Nauk Kirgiz S.S.R., Ser. Estest. i Tekhnich. Nauk*, 1961, **3,** (2), 23–27.—In investigations of the effect of pectins on sucrose inversion, it was found that as little as 0·1–0·5% of a preparation of Ca, Mg pectinate (which constitutes 70% of the total pectins in the beet root) caused a marked acceleration in sucrose inversion in aqueous solution. Normally a 20% sucrose solution is completely inverted in 9 days at 80°C, but in the presence of 0·1% Ca,Mg pectinate complete hydrolysis took place in 3–4 days. Acceleration also occurred in 4% and 70% solutions and at 50°C. It was found that the increase in the concentration of total sugars is caused basically by sucrose hydrolysis and not by oxidation conversions and hydrolysis of the pectinate. Subsequent oxidation of the reducing sugars formed and of the pectins accelerates the sucrose inversion, while complex colour substances impair the quality of the crystals.

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Comparative study of the molasses exhaustion and efficiencies of the Argentine factories during the 1961 season. J. A. LÓPEZ H. *Bol. Est. Agric. Tucumán*, 1962, (73), 11 pp.—The performances of 23 Argentine factories are classified by using the Douwes Dekker formula[1] and the results tabulated. An example is provided of the calculations involved.

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Rapid method for counting germs of *B. stearothermophilus* in sugar factory juices. H. KLAUSHOFER, C. KUNZ, W. BARTELMUS and E. SCHREYER. *Zeitsch. Zuckerind.*, 1962, **87**, 299–303.—*Bacillus stearothermophilus* counts are made under a fluorescence microscope by colouring with an antiserum specific for this organism, to which fluorescine has been added. The number of bacteria is compared with a yeast standard made up by suspending 1 g of fresh yeast in 500 ml of conductivity water and containing e.g. 20 million yeast cells per ml. The *B. stearothermophilus* germs are easily detected by a bright green fluorescence in contrast to the red colour of the yeasts and other bacteria. The ratio of yeast cells to *B. stearothermophilus* germs gives the final count. Counts are determined in 2 hours using this method.

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Filtrability of raw sugar. E. C. VIGNES. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1961, 80–85.—The method of NICHOLSON & HORSLEY[2] was used to determine the factor having the greatest effect on raw sugar filtrability. "Celite 505" was used as filter-aid and Ca acetate/ethanolamine mixture as buffering agent. The syrup was filtered through a Whatman No. 54 paper at 50 p.s.i. pressure, and filtration rates after 6, 7 and 8 min reported as a proportion of the rates for a pure sugar solution. The data showed a direct relationship between filtrability and starch content, with difficulty in filtration probably appearing at 150 p.p.m. of starch in the solution. The technique is more reliable than the Elliott method; no relationship between the values obtained by the two methods could be established.

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Preliminary note on the presence of osmophilic yeasts in raw sugars. R. ANTOINE, R. DE FROBERVILLE and C. RICAUD. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1961, 85.—In 1960 it was found at a Tate & Lyle silo containing 4300 tons of Mauritius raw sugar that the sugar pol had dropped 2·7° after several months storage. Further examination revealed the presence of two distinct types of yeasts, one containing no invertase, of the normal osmophilic type, and the other, allied to the brewing yeasts, which was highly fermentative and contained invertase. The latter yeast had not previously been encountered in raw sugar. Experiments were started in 1961 to assess the yeast flora of Mauritius raw sugar and the effect of the yeasts of the keeping quality of the sugar. It was found that, while no yeast was present in the massecuite when it was dropped from the pan, it was present in the massecuite fed to the centrifugals after cooling in the crystallizers. The final identifications of the yeasts are given together with photomicrographs.

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Further studies on the use of the refractometer for routine chemical control. F. LE GUEN and M. RANDABEL. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1961, 86–88.—Comparison of Brix, sucrose and purity determinations in first expressed juice, mixed juice and final molasses carried out using hydrometers and refractometers showed that the refractometer Brix figure is slightly lower than hydrometer Brix with the result that the sucrose value obtained from the pol reading and refractometric Brix is usually slightly higher than with the hydrometer value. The Brix differences are not constant, however, but vary with the nature of the product and from sample to sample of the same product according to the ash, organic and suspended matter present. The latter has a greater effect on hydrometer determinations which were always higher than the refractometer values. Boiling House performance figures are also tabulated; it is considered that the refractometer values are more realistic since boiling house efficiencies of >100% are occasionally obtained with hydrometer figures. The other advantages of the refractometer are given and the use of this instrument in Mauritius factories is recommended.

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On the determination of retention in vacuum filters. J. DUPONT DE R. DE ST. ANTOINE and E. C. VIGNES. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1961, 89–91.—Determination of retention of mud by a filter is given by

$$100\left(1-\frac{\text{filtrate mud solids}}{\text{feed mud solids}}\times\frac{\text{feed Brix}}{\text{filtrate Brix}}\right)$$

Of the five methods for determining the mud solids which were examined, the best is considered to be that in which mud solids (dry substance % — fibre % — juice Brix %) is obtained from dry substance (obtained by drying a weighed amount of feed, etc. to constant weight at 105°C), fibre (determined by weighing 50 g of feed or 20 g of cake over a tared 200-mesh sieve and washing until the water runs clear, draining, drying to constant weight at 105° and weighing the sieve plus remaining fibre), and juice Brix (calculated from 100 × pol % feed or cake/ expressed juice purity). It is emphasized that this method is recommended only until centrifuges are available for direct determination of the mud solids.

[1] See LÓPEZ: *I.S.J.*, 1962, **64**, 307.
[2] *I.S.J.*, 1957, **59**, 105.

Quality determination of cane in the factory. J. DUPONT DE R. DE ST. ANTOINE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1961, 92–96.—It is recommended that cane quality be determined using a disintegrator such as in the cane chipper-Rietz disintegrator method, followed by calculation of the Java ratio on the basis of an empirically determined relationship, found e.g. for Mon Trésor in 1961 to be J.R. = 103·26 — 1·66 fibre % cane. A table of 22 analyses and graphs are given showing that deviations between calculated and true Java ratios for three factories range from —0·17 to +0·20, —0·26 to +0·13 and —0·15 to +0·13, with correlation coefficients of 0·88, 0·93 and 0·89 respectively. The "Cutex" fibrator does not give sufficiently accurate fibre determinations although the effect of one unit error in fibre on sucrose in the method suggested is not great (0·14 to 0·27). However, adoption of a more accurate method is advocated.

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A new method of determining the diffusion coefficient in beet tissue. S. ZAGRODZKI and J. KUBIAK. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The method involves the measurement of the diffusion coefficient of sugar from one solution to another through a diaphragm made of beet tissue. On the outside of a tube cut from the beet is a sugar solution of known concentration, while through the tube flows water. Many determinations can be made using the same diffusion diaphragm. A vessel containing the sugar solution and tube of beet tissue is placed in a thermostat and the amount of sugar diffusing can be measured either from the fall in sugar concentration in the solution outside the tube or the rise of the sugar content in the water. The values obtained were compared with measurements made by conventional methods. Variation of the thickness of the diaphragm from 2·8 to 6·5 mm had no effect on the diffusion coefficient, while changes of water flow from 1 cm/sec to 10 cm/sec increased the coefficient by about 10%. The method may be applied in factory laboratories for estimation of beet quality.

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Influence of the quality of beet tissue on values of the diffusion coefficient. S. ZAGRODZKI and J. KUBIAK. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Diffusion coefficients were measured using ripe and unripe sugar beet and beet which had been frozen once or more, the conditions being the same for all determinations. Coefficients were: *unripe beet*, 4·04 × 10^{-4} at 70°C; *sound ripe beet*, 0·764 × 10^{-4} at 50°C, 4·185 × 10^{-4} at 60°C, and 5·36 × 10^{-4} at 70°C; *beets frozen once at —15°C*, 3·62 × 10^{-4} at 45°C, 4·15 × 10^{-4} at 50°C, 4·69 × 10^{-4} at 55°C, 5·19 × 10^{-4} at 60°C and 6·34 × 10^{-4} at 70°C; *beets frozen several times at —8°C*, 3·8 × 10^{-4} at 45°C, 4·26 × 10^{-4} at 50°C and 4·73 × 10^{-4} at 55°C. The measurements show that the diffusion coefficient of beets which had been frozen several times is 18–20% higher than that of sound beets. Freezing causes necrosis of cells which results in the higher coefficient and which can also be observed visually.

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Accuracy of determination of some elements by means of a flame photometer. H. ZAORSKA. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Application of the flame photometer to continuous determination of certain cations in flowing sugar juice requires a detailed knowledge of the influence of particular parameters on emission excitation. Continuous operation of the instrument requires the highest possible stability of determination conditions. As regards air flow, it has been found that a deviation of 100 mm above an air pressure of 6000 mm w.g. causes an increase of 0·6% in the sodium determination and 1% for potassium and calcium. When the flow of gas varies by 1%, an error of 3% results, owing to variation of the temperature of the flame in which excitation occurs. By means of a special resistance heater, designed to study the influence of temperature, it is possible to maintain precise and continuous control of the excitation temperature; use with standard solutions of Na and Ca salts has shown the excitation temperature to be a deciding factor influencing the emission, although the influence is hardly noticeable with K. Graphs demonstrate the relationships. Similar results have been found with factory juices. The influence of temperature above 1600°C is less than at about 1300°C; the smaller sensitivity of the K flame is attributed to its relatively low excitation temperature.

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Application of the method of least squares to the computing of the filtration coefficient F_k. J. DOBRZYCKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The standard method of determining the Brieghel-Müller filtration coefficient F_k is based on the measurement of the time to filter two definite volumes in a laboratory apparatus under constant pressure. To increase the accuracy of determination by removing random errors it is proposed that the times of reaching successive volumes are recorded, e.g. for 1, 2, 3, . . . n ml; the value of F_k can then be calculated as

$$\frac{24}{(n^2-1)n}\left[(n-1)t_n - 2t_1 - 2t_2 - \ldots\ldots - 2t_{n-1}\right]$$

where n represents the total measured volume and t_n the corresponding successive readings on the stopwatch. Measurements of 6 to 8 filtration times instead of 2 only slightly increases the labour cost but reduces the influence of observation errors on the result of F_k determination.

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The structure of coagulated colloids of sugar beet juice. R. KOHN and Z. KOHNOVÁ. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—See *I.S.J.*, 1961, 63, 74, 106, 170, 204.

Determination of organic acids present in beet sugar factory juices. S. ZAGRODZKI and K. SZWAJCOWSKA. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Juices were treated to remove cations by passing through "Wofatit KPS 200" resin and the effluent was then passed through "Wofatit L 150" anion exchanger, the non-polar substances passing through. The non-nitrogenous organic acids were eluted from the anion exchanger with ammonia, concentrated by evaporation and subjected to ascending paper chromatography using Whatman No 1 paper. Two kinds of solvent were used: 9:1 methanol:ammonia and 8:1:1 ethyl acetate:acetic acid:water, while the chromatograms were sprayed with 0·1N silver nitrate or 0·05% alcoholic methyl red. The acids present were identified on the chromatogram by comparison with standard solutions of the same acids in various concentrations (0·5, 1, 1·5, 2 and 3%) and were determined quantitatively by planimetry.

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Automatic determination of calcium and control of second carbonatation. H. ZAORSKA. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—A method of continuous determination of calcium in a stream of solution has been worked out. A flame photometer fitted with additional devices is able to work under factory conditions and is easily adjustable to automation. The apparatus can serve simultaneously to determine the content of several cations and record these values in chart form. The modified device has been used to determine the Ca content of 2nd carbonatation juice. By means of simultaneous examination of the same juice with an automatic pH meter the optimum end-point of 2nd carbonatation can be determined. An electric system with a potentiometer has been suggested which in combination with a flame photometer would measure the differentials $d(\mathrm{Ca})/dt$ and $d(\mathrm{pH})/dt$, automatically keep optimum conditions in the process and, in case of need, regulate any parameters of 2nd carbonatation.

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Sucrose crystallization. H. E. C. POWERS. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The author's fundamental study of nucleation and sucrose crystal growth is surveyed and his film record of such phenomena by time-lapse cinemicrography is introduced and commented on. Illustrations are included in the film of nucleation and early growth of microcrystals, the various forms of layer growth, the inclusion of impurities, the mechanism of dissolution, crystal forms, "molecular migration evaporation" to high supersaturation and the consequent crystal growth, formation of dendritic, radialitic and other crystals, etc., together with the techniques used for obtaining such records.

Influence of a sonic field on crystal nucleation in supersaturated sugar solutions. S. ZAGRODZKI and Z. NIEDZIELSKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Filtered solutions of refined sugar, sealed in vials, were subjected to sonic vibrations by placing in a metal case bolted to a spring which was fixed at one end and vibrated by means of a rotating cog. Vials which had been subjected to this treatment were placed in a thermostat together with similar untreated vials, and were examined every 15 minutes by means of a micro-projector with which the presence of crystals several microns in size could be detected. The experiments were with solutions of supersaturation coefficient 1·0 to 1·5, at temperatures of 25, 45 and 60°C, and using vibration frequencies of 5000, 8000 and 10,000 c/s. The results obtained are illustrated in graph form, and show a considerable influence of the treatment on the time of crystal nucleation.

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Restraining influence of invert sugar on crystal nucleation in supersaturated sucrose solutions. Z. NIEDZIELSKI. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Solutions of refined sugar of supersaturation coefficient 1·4 were prepared in distilled water containing 0·01 to 10% of invert sugar (a mixture of chemically pure fructose and glucose monohydrate was used). The solutions were sealed into vials and maintained at 25°C with slow rotation, observing at 15-minute intervals through a projector which could detect crystals of only a few microns in size. Results showed that the time needed for crystal nucleation increased with the amount of invert sugar present.

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Crystallization velocity of sucrose in impure solutions. A. MIRČEV. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Crystallization velocities were measured at 40, 50 and 60°C using thick juices from various factories and campaigns and model solutions prepared from after-product raw sugar and purified beet juice. In the supersaturation range 1·07 to 1·19 thick juices of the same purity had crystallization velocities which were nearly equal and were higher than that of the model thick juice of equal purity. Crystallization velocities were also measured at 40°C using factory run-offs and standard solutions prepared from thick juice and molasses. The crystallization velocities of the run-offs varied considerably among one another, particularly at high temperatures, while the curve of the crystallization velocity of the model syrup was parabolic. The results emphasize the harmful effect on crystallization velocity of the return of run-offs, which reduces boiling house production.

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.

Saunders PVC valves. Saunders Valve Co. Ltd., Cwmbran, Monmouthshire.

Rigid PVC—polyvinyl chloride—is light and smooth and has high chemical resistance to most acids, alkalis and oils; it thus is a suitable material for valves particularly to match the increasingly wide use of PVC pipework. The Saunders PVC valves are supplied in sizes from ½ to 2 in and the body is available with flanged, screwed or union ended fittings as well as with plain ends for solvent welding to PVC pipework. The valve is suitable for varying pressures and temperatures, details of which will be supplied on application.

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Spray sterilizing agent. A. Massel & Co. Ltd., 21 Water Lane, London E.C.3.

"Absonal 301" is a useful quaternary ammonium compound for combating bacteriological spoilage in areas conducive to the ready development of micro-organisms. It is marketed with an automatic mixing spray gun which produces a 1:1000 dilution in water and this, sprayed over implements, walls, machinery, etc., penetrates into crevices and fissures and forms a film with a prolonged sterilizing action, even after drying. "Absonal 301" is non-corrosive and is also an excellent de-odorant.

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PUBLICATIONS RECEIVED

TRANSDATA. George Kent Ltd., Luton, Beds.

Transdata sheets IN. 51, 52, 53 and 54 respectively provide information on industrial electronic converters, converter controllers, magnetic flow-converters, and general purpose electronic controllers for use with high level D.C. inputs.

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NEWCON NEWS, No. 1. The New Conveyor Co. Ltd., Newcon House, Brook Street, Smethwick, Birmingham 40.

The first issue of the Newcon Newsletter includes a feature on an iron ore preparation plant where New Conveyor Co. Ltd. have recently installed handling and conveying equipment, a new contract for a belt conveyor system for a Norwegian steelworks, and also contains an article on the Black Country of England, as well giving a list of Companies using Newcon equipment, some recent plants, a selection of leaflets describing individual plant items, etc. The newsletter is available to readers on request and will be published quarterly.

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New Anglo-Dutch automation company formed.—To meet the demand for industrial automation equipment of all kinds, an association of three Dutch companies and a British company prominent in this field has been formed. The new company, Berlaghe N.V., has its headquarters in Arnhem and is sponsored by Maatschappij Van Berkel's Patent N.V., Heemaf N.V. and Landre & Glinderman N.V., in association with EMI Electronics Ltd.

Maatschappij Van Berkel's Patent N.V. has specialized in the development of weighing equipment for use in automatic processes and the design of equipment used for introducing weighing data into automatic control systems. Heemaf N.V. is fully equipped to design, manufacture and put into operation complete electric installations for power supply. Problems relating to the transformation of electric into mechanical energy (drive) or vice versa (generators) have been given particular attention by this company.

Landre & Glinderman N.V. has exclusive agency agreements with many European factories, and imports capital goods and components for industrial installations. This company has worked very closely with the fourth member of the group, EMI Electronics Ltd., and for some time has been acting as agent for EMI in Holland. EMI Electronics Ltd. supplies an extensive range of automation equipment, and is able to design and install complete systems for a wide variety of industries.

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Spray drying test house.—Spray drying is the technique of spraying a liquid contining a specified solid content in solution or suspension into a regulated stream of hot air or gas in such a way that the drying is almost instantaneous, resulting in dry powder in bead form. While evaporation is taking place the individual droplets are kept well below the temperature of the surrounding air, and because of the extremely short drying times—in some cases less than one second—the process is particularly suitable for heat-sensitive products.

Particle size, bulk density, and moisture content of the powder can all be influenced by variation in the speed of the disc or nozzle used for atomization, in inlet and outlet air temperatures, concentration and temperature of the feed liquid, spray pressure and other basic operation factors. Potential customers may now use facilities new to Great Britain and installed by Steels Process Plants Ltd., Crown Works, Sunderland, Co. Durham, to observe the sample processing of their own products in strictly confidential tests under conditions very close to those found in production, with test equipment capable of all the many variations.

Two Luwa system dryers—a pilot plant and one of industrial size—are used, the former consisting of a spray drying tower about 7 ft in dia. and 7 ft straight length, together with a cyclone for separating the dried product. Evaporative capacity is up to 60 lb/hr, depending on the nature of the feed and permissible air inlet temperature. The air heater is capable of supplying air to the dryer over a wide range of temperatures up to 320°C.

The industrial size dryer is of 11 ft 7 in dia. and has a variable length according to whether disc atomization or high-pressure nozzle atomization is used. The evaporation capacity can be varied between 75 and 800 lb/hr, according to material and inlet air temperature. The latter may be up to 400°C. The test house control room houses instruments by means of which the operator may check and regulate the various plant components during operation. Laboratory equipment includes all necessary apparatus of the most modern design.

* * *

Bulk liquid sugar in New Zealand.—The weighbridge at the Chelsea refinery of the New Zealand Sugar Co. (Auckland) Ltd. supports the weight of a Leyland Beaver articulated liquid sugar tanker, operated by the New Zealand Express Co. of Auckland. With a payload of 11 tons 12 cwt, the unit weighs 21 tons, a figure which conforms to local regulations.

WORLD SUGAR REQUIREMENTS[1]

The following estimate of net import requirements for the calendar year 1963 was made by the International Sugar Council at its Thirteenth Session on 1st November, 1962[2]:—

Free Market

Country or area	*Metric tons, raw value*	
EUROPE:		
Albania	5,000	
Cyprus	16,300	
Finland	139,000	
Germany, West	100,000	
Gibraltar	3,000	
Greece	75,000	
Iceland	10,300	
Ireland	20,000	
Italy	100,000	
Malta	14,000	
Netherlands (incl. all Territories)	200,000	
Norway	150,000	
Portugal (incl. Overseas Provinces)	15,000	
Spain (incl. Dependent Teritories)	20,000	
Sweden	60,000	
Switzerland	230,000	
United Kingdom	2,000,000	
U.S.S.R.	2,000,000	
Yugoslavia	130,000	
		5,287,600
NORTH AMERICA		
Canada	700,000	
Greenland	2,000	
		702,000
CENTRAL AMERICA:		
Bahamas } Bermuda }	5,000	
Honduras	2,000	
Panama Canal Zone	2,000	
Virgin Islands (U.K.)	400	
		9,400
SOUTH AMERICA:		
Bolivia	10,000	
Chile	200,000	
Uruguay	60,000	
		270,000
ASIA:		
Afghanistan	40,000	
Arabian Peninsula:		
Aden, Colony and Protectorate	26,000	
Saudi Arabia and neighbouring Red Sea and Persian Gulf Territories	90,000	
British Borneo:		
Brunei	4,000	
North Borneo	10,000	
Sarawak	13,000	
Burma	25,000	
Cambodia	14,100	
Ceylon	204,000	
China (Mainland)	1,100,000	
Hong Kong	73,000	
Iran	350,000	
Iraq	257,000	
Israel	50,000	
Japan	1,300,000	
Jordan	49,000	
Korea (North)	50,000	
Korea (South)	75,000	
Laos	2,700	
Lebanon	35,000	
Malaya, Federation of	232,000	
Mongolia	19,600	
Nepal	4,500	
Pakistan	50,000	
Singapore	73,000	
Syria	65,000	
Vietnam (North)	10,000	
Vietnam (South)	55,000	
		4,276,900
AFRICA:		
Gambia	4,000	
Ghana	77,000	
Liberia	2,000	
Libya	25,000	
Morocco	400,000	
Nigeria	75,000	
Sierra Leone	15,000	
Somalia	15,000	
Sudan	110,000	
Tanganyika	20,000	
Tunisia	65,000	
Uganda	500	
Zanzibar and Pemba	6,500	
		845,000
OCEANIA:		
New Zealand	122,500	
U.K. Administration Oceania	2,500	
U.S. Administration Oceania	4,000	
Western Samoa	3,000	
		132,000
TOTAL FREE MARKET		11,522,900
Rounded		11,523,000

U.S. Market

U. S. A. net import requirements from foreign countries	3,630,000
Grand Total Rounded	**15,155,000**

BREVITIES

Cuban sugar industry modernization[3].—The Cuban sugar industry, run by the Empresa Consolidada del Azúcar, an agency of the Ministry of Industries, has started a streamlining, economizing and "technifying" scheme, according to the magazine *Nuestra Industria*. The magazine says that the sugar ports of Matanzas on the north coast and Guayabal on the south coast of Camagüey Province have been mechanized at a cost of 2,300,000 pesos to allow bulk shipment. Two warehouses, one with a capacity of 77,000 metric tons, have been built at Matanzas and a sugar warehouse with a capacity of 71,500 metric tons has been built at Guayabal. Bulk shipment is estimated to save 3,200,000 dollars in foreign exchange for every 800,000 tons of sugar exported. The article refers to a total of 122 special containers for transporting sugar in bulk by rail built for the 1962 harvest using railway flat cars which had been lying idle, together with a further 200 redesigned containers to be built for the 1963 sugar harvest. The sugar is moved in the special containers from the mills to the ports, where specially designed units transfer it directly from the train to the dockside warehouses and straight from the warehouses aboard sugar freighters with an average tonnage of 10,000 tons.

Work is to begin shortly on a new terminal at the docks of Cienfuegos, on the south coast of Las Villas Province, and on new sugar storage units at the Panama and Colombia mills in Camagüey Province, the Cuba Libre mill in Matanzas Province, and the Hector Molina Riano mill in Havana Province. The cost of this work will total 6,500,000 pesos. Under the old system of shipping sugar in sacks it took 7 to 10 days to load a vessel, but the new system, cutting out the operations of stacking the sacks, unstacking them and loading them manually, permits a vessel to be fully loaded in about 20 hours.

1 *I.S.C. Stat. Bull.*, 1962, **21**, (11) 94-96.
2 *I.S.J.*, 1962, **64**, 349.
3 *Public Ledger*, 10th November 1962.

ICUMSA

The secretariat of ICUMSA has been established at Paris and enquiries, book orders and other correspondence should in future be addressed to the new Secretary: Dr. R. SAUNIER, Syndicat National des Fabricants de Sucre de France, 23 Avenue d'Iéna, Paris 16e, France.

The venue for the 14th Session will be Copenhagen, Denmark, and the date has been tentatively fixed as the last week in May 1966.

Taiwan sugar production restriction[1].—The Taiwan Sugar Corporation is to limit its production of sugar to 723,000 tons this year as a consequence of low world market prices, according to the President, Mr. POWERS A. LAY. The Company is to produce by-products and canned pineapples during the period of restriction.

* * *

White sugar for animal fodder in Germany[2].—A good deal of interest was aroused recently by a report that Russia had sold to West Germany 70,000 tons of white sugar and, although there were denials, it has now transpired that a West German firm is to use the sugar in the animal feeding industry. It was said that this firm will be wanting 100,000 tons for this purpose and that 60,000 tons had been bought from Russia and negotiations for the other 40,000 tons were going on with other European countries.

Stock Exchange Quotations

London Stocks (*at 17th December* 1962)	CLOSING MIDDLE
Anglo-Ceylon (5s)	13/3
Antigua Sugar Factory (£1)	6/3
Booker Bros. (10s)	18/9
British Sugar Corp. Ltd. (£1)	24/–
Caroni Ord. (2s)	3/1½
Caroni 6% Cum. Pref. (£1)	14/6
Distillers Co. Ltd. (10s units)	32/3
Gledhow Chaka's Kraal (£1)	48/–
Hulett & Sons (R1)	33/–
Jamaica Sugar Estates Ltd. (5s units)	4/1½
Leach's Argentine (10s units)	12/6
Manbré & Garton Ltd. (10s)	42/9
Reynolds Bros. * (£1)	14/–
St. Kitts (London) Ltd. (£1)	11/–
Sena Sugar Estates Ltd. (10s)	8/6
Tate & Lyle Ltd. (£1)	47/9
Trinidad Sugar (5s stock units)	3/9
United Molasses (10s stock units)	29/–
West Indies Sugar Co. Ltd. (£1)	10/9

New York Stocks (*at 15th December* 1962)	CLOSING MIDDLE $
American Crystal ($10)	41½
Amer. Sugar Ref. Co. ($25)	37
Central Aguirre ($5)	20⅝
Cuban American ($10)	13¾
Great Western Sugar Co.	33¼
South P.R. Sugar Co.	29¾
United Fruit Co.	21⅝

* 100% capitalization and 2:1 share division

BREVITIES

C.S.R. research expansion[3].—The Colonial Sugar Refining Co. Ltd. has been building new research laboratories on a 5-acre site at East Roseville, Sydney, N.S.W., Australia, at a cost of about £A600,000. The laboratories were expected to be ready for occupation about October 1962. The buildings have been planned to accommodate about 50 graduate staff on research projects. C.S.R. already has a graduate staff of 30 working in its research department at Pyrmont, Sydney, together with 50 other personnel. Accommodation is being provided for inorganic chemistry and physics, organic chemistry, biochemistry, physical chemistry, chemical engineering and administration sections, the last including a library and workshops.

* * *

Irish Sugar Co. Ltd. 1962 report[4].—The beet yield in 1962 was well below the very high returns of the previous two campaigns. This was due to late sowings, followed by poor weather conditions and in the circumstances outturns were not unsatisfactory. The average sugar content was also low, although better than in 1960, and this too reflected the late sowings and poor growing weather. Late sowings were also a feature of the 1962 crop. This resulted in poor seed beds and, in places, uneven germination. Growing conditions in late spring and early summer were good, however, and enabled some recovery to be made, but difficulties were occasioned by considerable weed growth whilst the plant population was reduced following a particularly heavy infestation of pests. Nevertheless, subject to reasonably good weather during the remainder of the season a better than average crop is in prospect. The following interesting production statistics were given in respect of the past four campaigns:

	1958	1959	1960	1961
Acreage grown	83,593	68,454	67,553	78,443
Beet delivered (tons)	784,003	927,349	935,245	876,705
Average yield (tons/acre)	9·38	13·55	13·84	11·18
Average sugar content % beet	15·46	16·23	15·12	15·36
Cwt of white sugar per acre of beet	24·39	37·60	35·60	29·20

Production in terms of white sugar in 1961 was 114,636 tons, compared with 120,406 tons in 1960 and an annual average of 85,303 tons in the twelve years 1948–1959.

* * *

Rum distillery in Hawaii.[5]—The first rum distillery in Hawaii was opened at the end of September. It is a $500,000 cooperative venture between Joseph E. Seagram & Sons and Hawaiian Commercial and Sugar Co., and is located on the Island of Maui. The distillery has a capacity of 3000 gallons of 189-proof spirit per day and will produce 300,000 gallons a year. Another rum distillery is to be built on the Island of Hawaii, which will utilize molasses from Hutchinson Sugar Co.

* * *

New refinery for France[6].—The setting-up of a new sugar refinery in south-western France has been agreed in principle, according to a report from Paris. The refinery is to be located in the Charente-Maritime/Deux-Sèvres/Vendée area. One of the conditions of the promoters, Jean Lyons & Cie., is that growers will have to guarantee the cultivation of a beet area of between 5500 and 6000 hectares. For the first time in France, growers will take part in the running of the refinery. The new refinery, costing about 30,000,000 NF., will be capable of absorbing between 150,000 and 200,000 tons of sugar beet per year.

* * *

Sugar refinery for the Sudan[7].—Egyptian technicians will participate in the erection of a sugar refinery at El Guencia in the Sudan which will initially be of 60,000 tons capacity but will be raised to 75,000 tons in 1967.

[1] F. O. Licht, *International Sugar Rpt.*, 1962, **94**, (Supp. 20), 268.
[2] *Public Ledger*, 24th November 1962.
[3] *Australian Sugar J.*, 1962, **54**, 431.
[4] C. Czarnikow Ltd., *Sugar Review*, 1962, (588), 208.
[5] *Sugar y Azúcar*, 1962, **57**, (11), 47.
[6] *Public Ledger*, 3rd November 1962.
[7] *Echo de la Bourse*, 19th September 1962.

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.
George Fletcher & Co. Ltd.
The Mirrlees Watson Co. Ltd.

Accumulators, Steam.
see Steam Accumulators.

Air clutches.
Crofts (Engineers) Ltd.
Eisenwerk Wülfel.
Farrel-Birmingham Co. Inc.

Air compressors.
Alley Compressors Ltd.
Maschinenfabrik Willi F. Grassel.
G. &. J. Weir Ltd.
Worthington Corporation.

Air conditioning equipment.
A.B. Svenska Fläktfabriken.

Air coolers.
A.B. Svenska Fläktfabriken.

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

Air heaters.
Babcock & Wilcox Ltd.
E. Green & Son Ltd.
Stabilag Engineering Ltd.
A.B. Svenska Fläktfabriken.
John Thompson (Dudley) Limited

Air receivers.
Towler & Son Ltd.

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

Anti-foam agents.
Chemische Fabrik Stockhausen & Cie.
Schill & Seilacher Chemische Fabrik.

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

Bagasse baling presses.
Port Engineering Works Ltd.

Bagasse depithing equipment.
Lyddon & Co. Ltd.

Bagasse furnaces.
Babcock & Wilcox Ltd.
Honolulu Iron Works Co.
John Thompson Water Tube Boilers Ltd.

Bagasse—Paper & board production.
Interbagasse Products Engineering Corp.
Lyddon & Co. Ltd.

Barges, dumb or powered.
Whitlock Bros. Ltd.

Bearings and pillow blocks.
Crofts (Engineers) Ltd.
Ransome & Marles Bearing Co. Ltd.
The Skefko Ball Bearing Co. Ltd.
Stephens-Adamson Mfg. Co.

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

Beet flume equipment.
Cocksedge & Co. Ltd.
New Conveyor Co. Ltd.

Beet harvesters.
Catchpole Engineering Co. Ltd.

Beet hoes.
Martin-Markham Ltd.

Beet mechanical discharging and storage equipment.
Officine Meccaniche di Savona Servettaz-Basevi S.p.A.
U.C.M.A.S.

Beet pulp presses.
Choquenet L. Fonderies et Ateliers.
Cocksedge & Co. Ltd.
Hein, Lehmann & Co. A.G.
A.B. Landsverk.
Rose, Downs & Thompson Ltd.
Duncan Stewart & Co. Ltd.
Stord Marin Industri A./S.
U.C.M.A.S.
Weigelwerk G.m.b.H.

Beet seed.
A/S De danske Sukkerfabrikker.

Beet seed rubbing machines.
Cocksedge & Co. Ltd.

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

Beet tail utilization plant.
Köllmann & Gruhn.
New Conveyor Co. Ltd.
H. Putsch & Comp.

Beet tare house equipment.
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.
New Conveyor Co. Ltd.

Beet washing plant.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cocksedge & Co. Ltd.
New Conveyor Co. Ltd.
Salzgitter Maschinen A.G.
U.C.M.A.S.

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

Bentonite.
F. W. Berk & Co. Ltd.
The Fullers' Earth Union Ltd.

Boiler water treatment.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.
John Thompson-Kennicott Ltd.
Unifloc Ltd.

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

Boilers, Water tube.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Cochran & Co., Annan, Ltd.
George Cohen, Sons & Co. Ltd.
Edwin Danks & Co. (Oldbury) Ltd.
Davey, Paxman & Co. Ltd.
Escher Wyss (U.K.) Ltd.
Soc. Fives-Penhoet.
Foster Wheeler Ltd.
Stork-Werkspoor (V.M.F.)
John Thompson Water Tube Boilers Ltd.

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

Brushware—All classes.
The Kleen-e-ze Brush Co. Ltd.
Rotatools (U.K.) Ltd.

Bulk handling.
see Conveyors and Elevators.

Bulk storage hoppers.
Cocksedge & Co. Ltd.
George Fletcher & Co. Ltd.
New Conveyor Co. Ltd.
Spencer (Melksham) Ltd.
John Thompson (Dudley) Ltd.
John Thompson (Wolverhampton) Ltd.
Towler & Son Ltd.

Bulk sugar containers, Transportable.
Thompson Bros. (Bilston) Ltd.
Walkers Ltd.

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

Cable reeling drums.
Deco Engineering Co. Ltd.

Cane cars and trailers.
Cary Iron Works.
N.V. Locospoor.
Martin-Markham Ltd.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
Whitlock Bros. Ltd.

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

Cane carts.
Cary Iron Works.
Firestone International Company
Martin-Markham Ltd.
Spoorijzer N.V. Delft.
Whitlock Bros. Ltd.

Cane cultivation equipment.
Broussard Machine Co.

Cane diffusers, Continuous.
Extraction Continue De Smet S.A.

Cane grapples.
Joseph Westwood & Co. Ltd.

Cane harvesters.
Cary Iron Works.

Cane loaders.
Broussard Machine Co.
Cary Iron Works.
Hunslet Engine Co. Ltd.

Carbon, Decolorizing.
Activated Carbons & Chemicals Ltd.
C.E.C.A.
The Clydesdale Chemical Co. Ltd.
Farnell Carbons.
Haller & Phillips Ltd.
LURGI Gesellschaft für Chemotechnik m.b.H.
Pittsburgh Chemical Company, Activated Carbon Division.
Suchar Sales Corporation.
The Sugar Manufacturers' Supply Co. Ltd.
Sutcliffe, Speakman & Co. Ltd.
United Norit Sales Corporation Ltd.

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

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

Centrifugal clarifiers.
A.B. Separator Alfa-Laval.
Westfalia Separator A.G.

Centrifugals and accessories.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.

Centrifugals and accessories—*continued*
Hein, Lehmann & Co. A.G.
A.B. Landsverk.
Pott, Cassels & Williamson Ltd.
Machinefabriek Reineveld N.V.
Salzgitter Maschinen A.G.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Toyo Chemical Engineering Co. Ltd.
Watson, Laidlaw & Co. Ltd.
The Western States Machine Co.

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

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

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

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

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

Centrifugal motors.
Siemens-Schuckertwerke A.G.
The Western States Machine Co.

Centrifugal screens.
Dorr-Oliver Inc., Cane Sugar Divn.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
Hein, Lehmann & Co. A.G.
Ets Krieg et Zivy.
Multi-Metal Wire Cloth Co. Inc.
Nordberg Manufacturing Company.
The Sugar Manufacturers' Supply Co. Ltd.
Tiss-Metal.
The Western States Machine Co.

Chains.
Ewart Chainbelt Co. Ltd.
George Fletcher & Co. Ltd.

Chains—*continued*
Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Parsons Chain Co. Ltd.
Pennine Chainbelt Co. Ltd.
Renold Chains Ltd.
A. & W. Smith & Co. Ltd.

Char revifying plants.
Honolulu Iron Works Co.
Stein Atkinson Stordy Ltd.

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

Caustic Soda.
Diamond Alkali Company.

Muriatic Acid.
Diamond Alkali Company.

Sulphur, Roll.
F. W. Berk & Co. Ltd.

Sulphuric acid.
F. W. Berk & Co. Ltd.

Chemical plants.
A.P.V. Co. Ltd., Chemical Engineering Division.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Burnett & Rolfe Ltd.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
John Dore & Co. Ltd.
George Fletcher & Co. Ltd.
The Power-Gas Corporation Ltd.
George Scott & Son (London) Ltd.
L. A. Mitchell Ltd.
S.P.E.I. Chim.
Duncan Stewart & Co. Ltd.
Thompson Bros. (Bilston) Ltd.
John Thompson (Dudley) Ltd.
John Thompson (Wolverhampton) Ltd.
Unifloc Ltd.

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

Clarifiers, Tray-type.
The Eimco Corporation.

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

Continuous belt weighing machines.
L. A. Mitchell Ltd.

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

Conveyor bearings.
Link-Belt Company.

Conveyor belt rotary brushes.
The Kleen-e-ze Brush Co. Ltd.
Unifloc Ltd.

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

Conveyors and elevators.
Babcock & Wilcox Ltd.
Cocksedge & Co. Ltd.
George Cohen, Sons & Co. Ltd.
George Fletcher & Co. Ltd.
Hein, Lehmann & Co. A.G.
Honolulu Iron Works Co.
A.B. Landsverk.
The Lawrence Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
Herbert Morris Ltd.
Officine Meccaniche di Savona Servettaz-Basevi S.p.A.
Pennine Chainbelt Co. Ltd.
Pott, Cassels & Williamson Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Spencer (Melksham) Ltd.
Stork-Werkspoor (V.M.F.)
Strachan & Henshaw Ltd.
John Thompson Conveyor Co.
U.C.M.A.S.

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

Belt and bucket elevators.
Crone & Taylor (Engineering) Ltd.
Darrold Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Belt conveyors.
Crone & Taylor (Engineering) Ltd.
Darrold Engineering Co. Ltd.
C. J. R. Fyson & Son Ltd.
New Conveyor Co. Ltd.
Sandvik Steel Band Conveyors Ltd.
Stephens-Adamson Mfg. Co.
Unifloc Ltd.

Bucket elevators.
Crone & Taylor (Engineering) Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Chain and bucket elevators.
Crone & Taylor (Engineering) Ltd.
Darrold Engineering Co. Ltd.
Link-Belt Company.
New Conveyor Co. Ltd.
Unifloc Ltd.

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

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

Feeder conveyors.
Crone & Taylor (Engineering) Ltd.
Locker Industries (Sales) Ltd.
Podmores (Engineers) Ltd.
Unifloc Ltd.
see also Sugar throwers and trimmers.

Flight conveyors.
Darrold Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

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

Plate conveyors.
Darrold Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

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

Scraper conveyors.
Darrold Engineering Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

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

Slat conveyors.
Crone & Taylor (Engineering) Ltd.
Darrold Engineering Ltd.
Fourways (Engineers) Ltd.
G. Hopkins & Sons Ltd.

Steel band conveyors.
Sandvik Steel Band Conveyors Ltd.
Unifloc Ltd.

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

Vibratory conveyors.
Chain Belt Co.
Podmores (Engineers) Ltd.
Sinex Engineering Co. Ltd.

Conveyors and elevators, Mobile.
Crone & Taylor (Engineering) Ltd.
Fourways (Engineers) Ltd.
C. J. R. Fyson & Son Ltd.
G. Hopkins & Sons 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.
George Fletcher & Co .Ltd.
Honolulu Iron Works Co.
G. Hopkins & Sons Ltd.
Manlove, Alliott & Co. Ltd.
Richard Simon & Sons Ltd.
Standard Steel Corporation.
A.B. Svenska Flaktfabriken.
Toyo Chemical Engineering Co. Ltd.
U.C.M.A.S.
Werkspoor N.V.
see also Dryers.

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

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

Cranes.
Babcock & Wilcox Ltd.
Cary Iron Works.
George Cohen, Sons & Co. Ltd.
Herbert Morris Ltd.
Stork-Werkspoor (V.M.F.)
Stothert & Pitt Ltd.
U.C.M.A.S.
Vaughan Crane Co. Ltd.

Crystallizers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Honolulu Iron Works Co.
A.B. Landsverk.
The Mirrlees Watson Co. Ltd.
Port Engineering Works Ltd.
The Power-Gas Corporation Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Standard Steel Corporation.
Duncan Stewart & Co. Ltd.
John Thompson (Dudley) Ltd.
Towler & Son Ltd.
U.C.M.A.S.
Walker 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.
Fr. Hesser Maschinenfabrik A.G.
Standard Steel Corporation.

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

Cultivation equipment.
Ransomes, Sims & Jefferies Ltd.

Decolorizing plants.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Pittsburgh Chemical Company, Activated Carbon Divn.
Machinefabriek Reineveld N.V.
Suchar Sales Corporation.
United Norit Sales Corporation Ltd.

Decolorizing resins.
Diamond Alkali Company, Western Division.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Rohm & Haas Company.

Deliming plants.
Cane Sugar Divn., Dorr-Oliver Inc.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Demineralization plants.
Cane Sugar Divn., Dorr-Oliver Inc.
The Eimco Corporation.
IMACTI-Amsterdam.
Paterson Engineering Co. Ltd.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

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

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

Distillery plant, *see* Alcohol plant.

Drainage and ridging machinery.
Whitlock Bros. Ltd.

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

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

Duck boards.
Grill Floors Ltd.

Dust control equipment.
Buell Ltd.
Büttner-Werke A.G.
Dallow Lambert Ltd.
Dunford & Elliott Process Engineering Ltd.
Pulverizing Machinery Ltd.
A.B. Svenska Fläktfabriken.

Dust sleeves and bags.
Cotton Bros. (Longton) Ltd.
Dunford & Elliott Process Engineering Ltd.
Heath Filtration Ltd.
Samuel Hill Ltd.
Porritt Bro. Austin Ltd.
Porritts & Spencer Ltd., Industrial Fabrics Export Division.
Richardson & Sheeres Ltd.

Economizers.
Babcock & Wilcox Ltd.
Soc. Fives Lille-Cail.
E. Green & Son Ltd.
John Thompson Water Tube Boilers Ltd.

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

Electric motors.
ASEA.
George Cohen, Sons & Co. Ltd.
Comtex Ltd.
The English Electric Co. Ltd. Electrical Plant Divn.
The Harland Engineering Co. Ltd.
Heemaf N.V.
Siemens-Schuckerwterke A.G.

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

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

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

Electronic equipment.
Bristol's Instrument Co. Ltd.
The English Electric Co. Ltd., Electrical Plant Divn.
Evershed & Vignoles Ltd.
Fielden Electronics Ltd.

Engineering design and contracting services.
Humphreys & Glasgow Ltd.

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

Engines, Steam.
Ashworth & Parker Ltd.
Blairs Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor (V.M.F.)
Walkers Ltd.

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

Evaporators and condensing plant.
A.P.V. Co. Ltd., Industrial Engineering Dept.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Burnett & Rolfe Ltd.
A. F. Craig & Co. Ltd.
Daniels (B.B.A.) Ltd.

Evaporators and condensing plant—*continued*
John Dore & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Honolulu Iron Works Co.
A.B. Landsverk.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor (V.M.F.)
Technoexport Czechoslovakia.
John Thompson Water Tube Boilers Ltd.
Toyo Chemical Engineering Co. Ltd.
U.C.M.A.S.
Walkers Ltd.

Evaporator tube cleaners.
see Tube cleaners.

Filters.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cotton Bros. (Longton) Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Invest Export.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Sankey Green Wire Weaving Co. Ltd.
Duncan Stewart & Co. Ltd.
U.C.M.A.S.
Werkspoor N.V.

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

Diatomite filters.
Filtres Philippe S.A.
Niagara Filters Europe.
Paterson Engineering Co Ltd.
Schumacher'sche Fabrik.
Unifloc Ltd.

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

Gravity and pressure filters.
Davey, Paxman & Co. Ltd.
G. Hopkins & Sons Ltd.
The Permutit Co. Ltd.

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

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

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

Pressure filters.
Davey, Paxman & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
The Eimco Corporation.
Eimco (Great Britain) Ltd.
Filtres Philippe S.A.
G. Hopkins & Sons Ltd.
Niagara Filters Europe.
The Permutit Co. Ltd.
Schumacher'sche Fabrik.
Suchar Sales Corporation.

Rotary vacuum filters.
Davey, Paxman & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
The Eimco Corporation.
Eimco (Great Britain) Ltd.
Filtres Philippe S.A.
Unifloc Ltd.

Upflow filters.
IMACTI Amsterdam.

Filter-aids.
C.E.C.A.
Dicalite Division, Great Lakes Carbon Corporation.
Dicalite Europe Nord S.A.
Dicalite Europe Sud S.p.A.
Dorr-Oliver Inc., Cane Sugar Divn.
The Eagle-Picher Company.
T. B. Ford Limited.
Haller & Phillips Ltd.
Johns-Manville International Corp.
Progress Engineers Mtd.
Scottish Diatomite Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Filtercloths.
Jeremiah Ambler Ltd.
Cotton Bros (Longton) Ltd.
Fothergill & Harvey Ltd.
Heath Filtration Ltd.
Samuel Hill Ltd.
S. H. Johnson & Co. Ltd.
James Kenyon & Son Ltd.
Locker Industries (Sales) Ltd.
Multi-Metal Wire Cloth Co. Inc.
Nordiska Maskinfilt AB.
Porritt Bro. & Austin Ltd.
Porritts & Spencer Ltd., Industrial Fabrics Export Division.
Sankey Green Wire Weaving Co. Ltd.
Tiss-Metal.

Filter-leaves.
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.
A. & W. Smith & Co. Ltd.

Filter papers.
W. & R. Balston Ltd.
T. B. Ford Limited.
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.
Fontaine & Co. G.m.b.H.
Sankey Green Wire Weaving Co. Ltd.

Flanges.
Blundell & Crompton Ltd. (*Non-ferrous*).

Flowmeters.
Bristol's Instrument Co. Ltd.
Evershed & Vignoles Ltd.
G. Hopkins & Sons Ltd.
Negretti & Zambra Ltd.
Rotameter Manufacturing Co. Ltd.
Società Applicazione Elettrotecniche.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
Wright Rain Ltd. (*Irrigation*).
Wright Rain Africa (Pvt.) Ltd. (*Irrigation*).

Fork lift trucks—Electric, petrol, diesel, L.P. gas.
Hunslet Engine Co. Ltd.

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

Fullers' earth.
The Fullers' Earth Union Ltd.

Fumigants.
Diamond Alkali Company.

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

Gas purifying equipment.
Maschinenfabrik H. Eberhardt.

Gearing, *see* Reduction gears.

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

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

Granulators, *see* Dryers.

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

Heat exchangers, Plate type.
A.P.V. Co. Ltd., Industrial Engineering Division.
Babcock & Wilcox Ltd.
Daniels (B.B.A.) Ltd.
A.B. Separator Alfa-Laval.

Heat exchangers, Tubular.
A.P.V. Co. Ltd., Industrial Engineering Division.
Babcock & Wilcox Ltd.
Blairs Ltd.
Blundell & Crompton Ltd.
Burnett & Rolfe Ltd.
Daniels (B.B.A.) Ltd.
Edwin Danks & Co. (Oldbury) Ltd.
John Dore & Co. Ltd.
George Fletcher & Co. Ltd.
Foster Wheeler Ltd.
A.B. Landsverk.
Lepage, Urbain & Cie.
Salzgitter Maschinen A.G.
S.P.E.I. Chim.
John Thompson Water Tube Boilers Ltd.
Fowler & Son Ltd.
U.C.M.A.S.
Worthington Corporation.

Herbicides.
Diamond Alkali Company.

Hydraulic controls for valves, etc.
Edwards Engineering Corp.
Duncan Stewart & Co. Ltd.

Hydraulic lifting equipment.
Cotterell & Pither Ltd.

Insecticides.
Diamond Alkali Company.

Instruments, Process control.
Bellingham & Stanley Ltd.
Bristol's Instrument Co. Ltd.
The British Rototherm Co. Ltd.
Evershed & Vignoles Ltd.
Fielden Electronics Ltd.
Hilger & Watts Ltd.
Metrimpex, Budapest.
Negretti & Zambra Ltd.
Rotameter Manufacturing Co. Ltd.
Società Applicazione Elettrotecniche
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.

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

Ion exchangers.
W. & R. Balston Ltd.
Diamond Alkali Company, Westerm Division.
Dorr-Oliver Inc., Cane Sugar Divn.
IMACTI-Amsterdam.
Paterson Engineering Co. Ltd.
The Permutit Co. Ltd.
Rohm & Haas Company.
John Thompson-Kennicott Ltd.

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

Jointings, *see* Packings and gaskets.

Juice heaters.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Honolulu Iron Works Co.
The Mirrlees Watson Co. Ltd.
Port Engineering Works Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor (V.M.F.)
Walkers Ltd.

Juice scales.
George Fletcher & Co. Ltd.
Richardson Scale Co. Ltd.
N.V. Servo-Balans.
see also Weighing Machines

Juice strainers and screens.
Ashworth & Parker Ltd.
Blairs 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.
Ferguson Perforating & Wire Co.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Fontaine & Co. G.m.b.H.
Locker Industries (Sales) Ltd.
The Mirrlees Watson Co. Ltd.
Russell Constructions Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.
Walkers Ltd.

Juice and syrup mixers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Burnett & Rolfe Ltd.
George Fletcher & Co. Ltd.
L. A. Mitchell 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-Birmingham Co. Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Fulton Iron Works Co.
Honolulu Iron Works Co.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor (V.M.F.)
Walkers Ltd.

Knives, Milling—Drives.
Siemens-Schuckertwerke A.G.

Laboratory apparatus and equipment.
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.
The British Rototherm Co. Ltd.
Evershed & Vignoles Ltd.
Fielden Electronics Ltd.
Hilger & Watts 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.

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 totor Pressings Ltd.

Lens cleaning tissues.
J. Barcham Green Ltd.

Lifting tables.
Cotterell & Pither Ltd.

Lime density meters.
Rotameter Manufacturing Co. Ltd.

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

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

Locomotives, Diesel.
Andrew Barclay, Sons & Co. Ltd.
The English Electric Co. Ltd., Electrical Plant Divn.
F. C. Hibberd & Co. Ltd.
Hunslet Engine Co. Ltd.
N.V. Locospoor.
Plymouth Locomotive Works.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.C.M.A.S.
Walkers Ltd.

Magnetic lifting equipment.
Electromagnets Ltd.

Magnetic separators.
Electromagnets Ltd.
Industrial Magnets Ltd.
Permag Ltd.
Rapid Magnetic Ltd.
Unifloc Ltd.

Massecuite heat treating equipment.
Blairs Ltd.
George Fletcher & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Pott, Cassels & Williamson Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor (V.M.F.)
The Western States Machine Co. (*Stevens System*).

Mechanical crop thinning machines.
Catchpole Engineering Co. Ltd.
S.K.H. & Son (Salopian-Kenneth Hudson & Son).

Metal detectors.
Automa Engineering Ltd.
Metal Detection Ltd.

Mill hydraulics.
Edwards Engineering Corp.
George Fletcher & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Duncan Stewart & 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.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
G. M. Hay & Co. Ltd.
Honolulu Iron Works Co.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor (V.M.F.)
Walkers Ltd.

Mill roll movement indicators and recorders.
Edwards Engineering Corp.

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

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

Molasses addition plants for beet pulp.
Amandus Kahl Nachf.

Refinery equipment—*continued*
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Honolulu Iron Works Co.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stein Atkinson Stordy Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor (V.M.F.)
Suchar Sales Corporation.
Technoexport Czechoslovakia.
Thompson Bros. (Bilston) Ltd.
John Thompson (Dudley) Ltd.
Toyo Chemical Engineering Co. Ltd.
U.C.M.A.S.

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.

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

Rotary electric vibrators.
Sinex Engineering Co. Ltd.

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

Rotary hoes.
Martin-Markham Ltd.

Rubber belt cane carriers.
Farrel-Birmingham Co. Inc.

Saccharimeters and polarimeters.
Bellingham & Stanley 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.

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

Sack filling machines.
Brecknell, Dolman & Rogers Ltd.
Librawerk Pelz & Nagel K.G.
Reed Medway Sacks Ltd.
Richardson Scale Co. 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.
The Kleen-e-ze Brush Co. Ltd.
Rotatools (U.K.) Ltd.

Scale removal and prevention—*cont.*
The Sugar Manufacturers' Supply Co. Ltd.
see also Tube Cleaners.

Screens, Centrifugal, *see* Centrifugal Screens.

Screens, Vibrating.
Büttner-Werke A.G.
Cocksedge & Co. Ltd.
The Deister Concentrator Co. Inc.
Electromagnets Ltd.
George Fletcher & Co. Ltd.
William Gardner & Sons (Gloucester) Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co. A.G.
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Russell Cnstructions Ltd.
Sinex Engineering Co. Ltd.
Spencer (Melksham) Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufactorers' Supply Co. Ltd.
Tiss-Metal.
Unifloc Ltd.
Walkers Ltd.
see also Juice Strainers and Screens.

Self-cleaning strainers.
Ashworth & Parker Ltd.

Self-regulating alternators.
Heemaf N.V.

Ship loading installations.
Babcock & Wilcox Ltd.
George Fletcher & Co. Ltd.
Spencer (Melksham) Ltd.

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

Shredder drives.
Siemens-Schuckertwerke A.G.

Silos—Pre-stressed concrete.
A/S De danske Sukkerfabrikker.
John Thompson Conveyor Co.

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

Spectrophotometers.
Metrimpex, Budapest.

Spray nozzles.
The Lunkenheimer Company.
New Conveyor Co. Ltd.

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

Stainless steel buckets and utensils.
Clifford Coupe Ltd.

Steam accumulators.
Babcock & Wilcox Ltd.
Cochran & Co., Annan, Ltd.
Daniels (B.B.A.) Ltd.
George Fletcher & Co. Ltd.
Duncan Stewart & Co. Ltd.
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'she Werke G.m.b.H., Werk Schneider & Helmecke.
The British Steam Specialties Ltd.

Steam turbines for mill drives, etc.
A. F. Craig & Co. Ltd.
The English Electric Co. Ltd., Steam Turbine Divn.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Maschinenfabrik Willi F. Grassel.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stal-Laval Turbine Co.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor (V.M.F.)
G. & J. Weir Ltd.
Stal-Laval Turbine Co.
Worthington Corporation.

Steam turbo-alternator sets.
The English Electric Co. Ltd. Steam Turbine Divn.
Escher Wyss (U.K.) Ltd.
Soc. Fives Lille-Cail.
Siemens-Schuckertwerke A.G.
Stal-Laval Turbine Co.
Worthington Corporation.

Steel flooring and handrailing.
Grill Floors Ltd.
John Thompson Motor Pressings Ltd.

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

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Thompson Bros. (Bilston) Ltd.
John Thompson (Dudley) Ltd.
John Thompson (Wolverhampton) Ltd.

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Rose, Downs & Thompson Ltd.

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

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

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Activated Carbons & Chemicals Ltd.,
Burnfield Road, Giffnock, Glasgow, Scotland.
Tel.: Merrylee 2393. *Cable:* Stedmacs, Giffnock.

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

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

The A.P.V. Co. Ltd.,
Manor Royal, Crawley, Sussex.
Tel.: Crawley 27777. *Cable:* Anaclastic, Crawley
Telex: 8737.

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

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

ASEA,
Vasteras, Sweden.
Tel.: 10000. *Cable:* ASEA, Vasteras.
Telex: 4720

Ashworth & Parker Ltd.,
Riverside Works, Bury, Lancs., England.
Tel.: Bury 5125–6. *Cable:* Kinetic, Bury.

Associated Chemical Companies (Sales) Limited.,
P.O. Box 6, Brotherton House, Westgate, Leeds 1, England.
Tel.: Leeds 29321/8. *Cable:* Aschem, Leeds.
Telex: 55–116.

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

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

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

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

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

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

F. W. Berk & Co. Ltd.,
P.O. Box 500, Berk House, 8 Baker Street, London, W.1., Eng.
Tel.: Hunter 6688. *Cable:* Berk, London, Telex.
Telex: 23796.

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

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

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

BMA Braunschweigische Maschinenbauanstalt,
(20b) Braunschweig, Bahnhofstrasse 5, Germany.
Tel.: Braunschweig 23691. *Cable:* Bema, Braunschweig.
Telex: Bema Bswg. 0952840.

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

Bristol's Instrument Co. Ltd.,
(A member of the Elliott-Automation Group),
Century Works, Lewisham, London, S.E.13, England.
Tel.: Tideway 1271. *Cable:* Ohm, London, S.E.13.

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

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

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

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

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

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

Broussard Machine Company,
see Logan Perkins.

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

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

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

Buttner-Werke A.G.,
Postfach 59, Krefeld-Uerdingen 1, Germany.
Tel.: Krefeld 43511. *Cable:* Büttner, Krefeld-Uerdingen.

Buttner Works, Inc.,
66–68 Main Street, P.O. Box 57, Madison, N.J., U.S.A.
Cable: Buttnerusa, Madison.

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

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

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.

Chemische Fabrik Stockhausen & Cie.,
Krefeld, Bakerpfad 25, Germany.
Tel.: (97)3381. *Cable:* Tefrapol, Krefeld.
Telex: 0853890.

Choquenet L. Fonderies et Ateliers—Sté. Ame,
Chauny (Aisne), France.
Tel.: Chauny 34.

Chronos-Werk, Reuther & Reisert K.G.,
Hennef-Sieg, Germany.
Tel.: Hennef-Sieg 2381/3. *Cable:* Chronos, Hennefsieg.
Telex: 88 33 04.

Charles Clifford Ltd.,
Dogpool Mills, Birmingham 30, England.
Tel.: Selly Oak 1544. *Cable:* Clifford, Birmingham.

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

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

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

George Cohen, Sons & Co. Ltd.,
600 Wood Lane, London W.12, England.
Tel.: Shepherds Bush 2070. *Cable:* Omniplant, London.
Telex: 21288/9.

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.

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

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

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

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

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

Dallow Lambert Ltd.,
Thurmaston, Leicester, England.
Tel.: Syston 3333. *Cable:* Dust, Leicester.

Daniels (B.B.A.) Ltd.,
62/63 Fenchurch Street, London, E.C.3, England.
Tel.: Royal 2361. *Cable:* Boileracs, London.

Edwin Danks & Co. (Oldbury) Ltd.,
Oldbury, Birmingham, England.
Tel.: Broadwell 2531. *Cable:* Boiler, Oldbury.
Telex: Edanks Oldbury 33–352.

Darham Industries Ltd.,
see John Thompson Ltd.

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

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

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

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

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

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

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

Dicalite Division, Great Lakes Carbon Corp.,
612 South Flower Street, Los Angeles 17, Calif., U.S.A.
Tel.: Madison 9–1611. *Cable:* Dicalite GPL–LOSA.

Dicalite Europe Nord S.A.,
66 Rue Royale, Brussels 1, Belgium.
Tel.: 11.81.50/11.81.59. *Cable:* Dicalite, Brussels.
Telex: Brussels 804.

Dicalite Europe Sud S.p.A.,
Alzaia Trento N.9, Milano Corsico, Italy.
Tel.: 8393.105. *Cable:* Dicalite, Milano Corsico, Italy.

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.

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,
Eichelkampstrasse 4–10, Hannover-Wülfel, Germany.
Tel.: Hannover 38181. *Cable:* Eisenwerk, Hannover.
Telex: 9 227 30 eisenwerk han.

Electromagnets Ltd.,
Boxmag Works, Bond Street, Hockley, Birmingham, England.
Tel.: Central 5391–3. *Cable:* Boxmag, Birmingham.

Electroweighers Ltd.,
Bickford Road, Witton, Birmingham 6, England.
Tel.: East 3216. *Cable:* Elecweigh, Birmingham.

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.,
Terminal House, 52 Grosvenor Gardens, London, S.W.1. England.
Tel.: Sloane 8101. *Cable:* Escherwyss, London.

Evershed & Vignoles Ltd.,
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.

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

Farnell Carbons,
Divn. of Forestal Industries (U.K.) Ltd.,
212 Shaftesbury Avenue, London, W.C.2, England.
Tel.: Whitehall 6777. *Cable:* Scofar, London W.C.2.
Telex: 22817/22818.

Farrel-Birmingham Co. Inc.,
Ansonia, Conn., U.S.A.
Tel.: Regent 4–3031.

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, 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.

Filtres Philippe S.A.,
P.O. Box 30, 109 Bld. Henri-Barbusse, Houilles (S. & O.), France.
Tel.: 968-79-90. *Cable:* Alfilipe, Houilles.

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

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

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

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

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

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

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

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

T. B. Ford Ltd.,
30 New Bridge Street, London, E.C.4, England.
Tel.: City 2272. *Cable:* Fordfilt, London, E.C.4.

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.

Fulton Iron Works Company,
Walsh & Ulena, St. Louis 16, Mo., U.S.A.
Tel.: PL 2–2400. *Cable:* Castiron, St. Louis.

The Fullers' Earth Union Ltd.,
Patteson Court, Nutfield Road, Redhill, Surrey, England.
Tel.: Redhill 3521. *Cable:* Fullion, Redhill.

C. J. R. Fyson & Son Ltd.,
Soham, Ely, Cambs., England.
Tel.: Soham 249.

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

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

Maschinenfabrik Willi F. Grassel,
4970 Bad Oeynhausen, Postfach 307, Germany.
Tel.: 6362. *Cable:* Grasselpumpen, Bad Oeynhausen.
Telex: 97509.

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

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

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

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

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.

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

Heath Filtration Ltd.,
Sneyd Mills, Newcastle Street, Burslem, Stoke-on-Trent, Staffs., England.
Tel.: Stoke-on-Trent 84698/87172.

Heemaf N.V.,
Postbox 4, Hengelo, Holland.
Tel.: 05400–5830. *Cable:* Heemaf, Hengelo.
Telex: 31307.

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

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

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

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

Hilger & Watts Ltd.,
98 St. Pancras Way, Camden Road, London, N.W.1, England.
Tel.: Gulliver 5636. *Cable:* Sphericity, London, N.W.1.
Telex: 23852.

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

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.

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

Humphreys & Glasgow Ltd.,
22 Carlisle Place, London, S.W.1, England.
Tel.: Victoria 8454. *Cable:* Humglas, London, S.W.1.
Telex: 28508.

Hunslet Engine Co. Ltd.,
Hunslet Engine Works, Leeds 10, Yorkshire, England.
Tel.: Leeds 32261. *Cable:* Engine, Leeds.

IMACTI, Industrieele Maatschappij Activit N.V.,
Postbus 240c, Amsterdam, Holland.
Tel.: 60153. *Cable:* Activit, Amsterdam.
Telex: 14.278.

Interbagasse Products Engineering Corp.,
P.O. Box 237, Basel 2, Switzerland.
Tel.: 247800. *Cable:* Interbagasse, Basel.

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.

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

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

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

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

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

Chas. P. Kinnell & Co. Ltd.,
Tabard House, 116 Southwark Street, London, E.C.1, England.
Tel.: Waterloo 4144. *Cable:* Kinnell, Souphone, London.

Kirk & Co. (Tubes) Ltd.,
74/82 Paradise Street, London, S.E.16, England.
Tel.: Bermondsey 3156/9. *Cable:* Kirflanges, London.

The Kleen-e-zee Brush Co. Ltd.,
Hanham, Bristol, Elgland.
Tel.: Bristol 673027. *Cable:* Kleeneze, Bristol.

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

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

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

A.B. 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.

Lepage, Urbain & Cie.,
23 Boulevard des Capucines, Paris 2e, France.
Tel.: Richelieu 15-60. *Cable:* Alepage, Paris.

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

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

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

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

The Lunkenheimer Company,
Beekman St. at Waverly Ave, Cincinnati 14, Ohio, U.S.A.
Cable: Lunken, Cincinnati.

LURGI Gesellschaft für Chemotechnik m.b.H.,
Frankfurt/Main, Lurgihaus, Leerbachstrasse 72/84, Germany.
Tel.: 55-06-51. *Cable:* Lurgitechnik, Frankfurt.
Telex: 4 11 108.

Lyddon & Co. Ltd.,
18/19 Savile Row, London, W.1, England.
Tel.: Regent 7321/9. *Cable:* Lyddexpor, London.
Telex: 2-2491.

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.

Metal Detection Ltd.,
Bickford Road, Witton, Birmingham 6, England.
Tel.: East 3215. *Cable:* Metection, Birmingham.

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

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

L. A. Mitchell Ltd.,
Harvester House, 37 Peter Street, Manchester 2, England.
Tel.: Blackfriars 7224/7824. *Cable:* Inspection, Manchester.
Telex: 66653.

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.

Multi-Metal Wire Cloth Co. Inc.,
1341 Garrison Avenue, New York 59, N.Y., U.S.A.
Tel.: Kilpatrick 2–2500. *Cable:* Multimetal, New York.

Negretti & Zambra Ltd.,
122 Regent Street, London, W.1, England.
Tel.: Regent 3406. *Cable:* Negretti, London.

Netherlands Instruments and Apparatus Manufacturing and Trading Co., A. H. Korthof Ltd.,
P.O. Box 5162, Amsteldijk 47, Amsterdam–Z., Holland.
Tel.: 020–729186. *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.: K2200–16543/4. *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.

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

N.V. Norit-Vereeniging 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 Victoria 10-7, Genova, Italy.
Tel.: 593.851. *Cable:* Basevi, Genova.

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.

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.

Podmores (Engineers) Ltd.,
Hanley, Stoke-on-Trent, Staffs., England.
Tel.: 23257/8. *Cable:* 23257/8.

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

Porritts & Spencer Ltd, Industrial Fabrics Export Division,
Broadway, Haslingden, Lancs., England.
Tel.: Rossendale 2421. *Cable:* Neotex, Haslingden.
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.,
Motherwell, Scotland.
Tel.: Motherwell 2397/9. *Cable:* Pott, Motherwell.

The Power-Gas Corporation Ltd.,
P.O. Box 21, Stockton-on-Tees, Co. Durham, England.
Tel.: Stockton-on-Tees 62221.
Cable: Tetratomic, Stockton-on-Tees.
Telex: 58–530.

Power Plant Co. 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.

Progress Engineers Ltd.,
Leek New Road, Cobridge, Burslem, Stoke-on-Trent, Staffs., England.
Tel.: 21471/4.

Pulverizing Machinery Ltd.,
1 Dover Street, London, W.1, England.
Tel.: Hyde Park 9528. *Cable:* Mikropul, London.
Telex: 23654.

H. Putsch & Comp.,
Postfach, Frankfurter Str. 5–25, Hagen/Westfalen, Germany.
Tel.: Hagen 22341. *Cable:* Putsch, Hagenwestf.
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.

Ransomes Sims & Jefferies Ltd.,
Orwell Works, Ipswich, England.
Tel.: Ipswich 54711. *Cable:* Ransomes, Ipswich.
Telex: 1874.

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.

H. Reeve Angel & Co. Ltd.,
9 Bridewell Place, London, E.C.4, England.
Tel.: Fleet Street 9833. *Cable:* Papermen, London.
Telex: 22600.

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.

Richardson Scale Co. Ltd.,
Albert Street, Bulwell. Nottingham, England.
Tel.: Bulwell 27–1441. *Cable:* Richscalco, Nottingham.
Telex: 37–625.

Richardson & Sheeres Ltd.,
Walmgate Road, Perivale, Greenford, Middx., England.
Tel.: Perivale 9941. *Cable:* Araness, Greenford.

Rohm & Haas Company,
Washington Square, Philadelphia 5, Pa., U.S.A.
Tel.: Walnut 5–9860. *Cable:* Oropon, Philadelphia.

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

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.,
43/45 Pembroke Place, Liverpool 3, England.
Tel.: Royal 6117. *Cable:* Scalewell, Liverpool 3.

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

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

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

Sandvik Steel Band Conveyors Ltd.,
Dawlish Road Works, Selly Oak, Birmingham 29, England.
Tel.: Selly Oak 1113/5. *Cable:* Simplicity, Birmingham.

Sankey Green Wire Weaving Co. Ltd.,
Thelwall New Road, Thelwall, Nr. Warrington, Lancs., England
Tel.: Grappenhall 801. *Cable:* Sanco, Warrington.

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-Schöneberg, Naumannstrasse 33, Germany.
Tel.: 71 16 25/6. *Cable:* Polarisation, Berlin.

Schumacher'sche Fabrik.
Bietigheim/Württemberg, Germany.
Tel.: 655–659. *Cable:* Schumafilt, Bietigheim.
Telex: 724217.

A.B. Separator Alfa-Laval,
Postfack 2, Stockholm-Tull, Sweden.
Tel.: 54 02 20 *Cable:* Separator, Stockholm.
Telex: 1550

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

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

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

Sigmund Pulsometer Pumps Ltd.,
Team Valley, Gateshead 11, County Durham, England.
Tel.: Low Fell 75051/10. *Cable:* Sigmeter, Gateshead.
Telex: 53137.

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

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

Richard Sizer Ltd.,
Cuber Works, Hull, England.
Tel.: 31743. *Cable:* Sizer, Hull Telex.
Telex: 52236.

The Skefko Ball Bearing Co. Ltd.,
Luton, Beds., England.
Tel.: Luton 5700. *Cable:* Skefko, Luton.
Telex: 82120.

S.K.H. & Son (Salopian–Kenneth Hudson & Son),
Prees. Whitchurch, Shropshire, England.
Tel.: Prees 331–5. *Cable:* Implements, Prees.

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

Società Applicazione Elettrotecniche,
Flli. Siliprandi, Chiesa & C., Milano (515), Via Lario No. 16, Italy.
Tel.: Milano 683783. *Cable:* Saelario, Milano.

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

Spencer (Melksham) Ltd.,
(A member of the Elliott-Automation Group),
Melksham, Wilts., England.
Tel.: Melksham 2251/3. *Cable:* Spencer, Melksham.

Spoorijzer N.V. Delft.,
Postbox 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 Turbine Co.,
Finspong, Sweden.
Tel.: 0122–120 00. *Cable:* Stalturbin, 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.

Stein Atkinson Stordy Ltd.,
Westminster House, Kew Road, Richmond, Surrey, England.
Tel.: Richmond 4861. *Cable:* Metasteina, Richmond.

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

Stephens-Adamson Mfg. Co.,
Ridgeway Avenue, Aurora, Illinois, U.S.A.
Tel.: TWinoaks 2–4311. *Cable:* Saco, Aurora, Ill.

Duncan Stewart & Co. Ltd.,
Stewart House, Park Gate, Glasgow, C.3., Scotland.
Tel.: Douglas 2966. *Cable:* Stewart, Glasgow.
Telex: 77607.

Stord Marin 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.

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

Suchar Sales Corporation.,
76 Beaver Street, New York 5, N.Y., U.S.A.
Tel.: Whitehall 4–0280. *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 Street, 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: 1440

Taylor Controls Ltd.,
75 Hale End Road, Walthamstow, London, E.17, England.
Tel.: Larkswood 5533. *Cable:* Taylortrol, London.

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.

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

John Thompson Ltd.,
Ettingshall, Wolverhampton, England.
Tel.: Bilston 41121. *Cable:* Boiler, Wolverhampton.

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 Ordnance,
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.

Tiss-Metal Lionel-Dupont, Teste & Cie.,
55 Rue la Boétie, Paris 8e, France.
Tel.: Ely 41–80. *Cable:* Tissmétal, Paris.

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.: Konohana (46) 8861–5. *Cable:* Toyokakoki, Osaka.

U.C.M.A.S. Union des Constructeurs Belges de Matériel de Sucrerie,
1 Rue Gilain, Tirlemont, Belgium.
Tel.: 016/83531. *Cable:* Ucmas, Tirlemont.
Telex: 016/28 indicatif ABR Tirlemont.

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

United Norit Sales Corporation Ltd.,
see N.V. Norit-Vereeniging Verkoop Centrale.

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

Walkers Ltd.,
23 Bowen Street, Maryborough, Queensland, Australia.
Tel.: 2321. *Cable:* Itolzak, Maryborough.

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

Weigelwerk G.m.b.H.,
Essen, Altendorferstr. 110, Germany.
Tel.: Essen 2 48 57/58. *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.

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.

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

Westfalia Separator A.G.,
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.

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 970. *Cable:* Wrightrain, Ringwood.

Wright Rain Africa (Pvt.) Ltd.,
16 Park Street, Box 3237, Salisbury, Southern Rhodesia.
Tel.: Salisbury 25810. *Cable:* Wrightrain, Salisbury.

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

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