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THE

INTERNATIONAL SUGAR JOURNAL

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NOTES AND COMMENTS

U.K. beet crop difficulties.

An extremely early cold spell was experienced in Britain at the beginning of December 1962 and this was succeeded by very much milder conditions. A thaw ensued which had a very harmful effect on the roots which had not been lifted, and yields have consequently been reduced.

Since Christmas there has again been snow and freezing temperatures which at the time of writing have not been relieved. With the ground frozen, lifting has not been possible in many places and the Wissington factory of the British Sugar Corporation has been forced to close although much sugar beet is still unharvested in its area. Two other factories, at King's Lynn and Cantley are also running short of beet and may be forced to close early, although even where factories are to close they will keep up steam for another 24 hours in case of a break in the frost. The Corporation is keeping as many factories open as possible because when lifting becomes possible it will probably be necessary to process the beet quickly if it is not to become useless.

Some growers on light land in the eastern counties have been applying salt to thaw the ground sufficiently to get the beet out, but this is only possible on certain types of soil and where salt is available[1].

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Reduction of sugar surcharge.

The surcharge on sugar levied by the U.K. Sugar Board was reduced on 3rd January 1963 by 9s 4d per cwt. of refined sugar (1d per lb).

The reduction was made possible by the rise in recent months in the world market price of sugar. This higher world price reduced the deficit incurred by the Sugar Board in purchasing sugar under the Commonwealth Sugar Agreement and selling it at world price; it also reduced the cost to the Board of financing the British Sugar Corporation Ltd.

The reduction in surcharge will permit a reduction of 9s 4d per cwt. in the first-hand (ex-refinery) selling price of sugar. Retail prices are not controlled, but in the past have in general followed any significant movement in the ex-refinery price.

E.E.C. sugar arrangements[2].

The Association of Sugar Trade Organizations in the European Economic Community has submitted a memorandum to the E.E.C. Commission setting out its views on the establishment of a Common Sugar Market.

Its most important recommendation is that there should be price protection for all sugar produced up to the limit of estimated consumption in the Common Market countries. Sugar produced in excess of this tonnage, however, would be sold at world market prices at the manufacturers' expense.

The general marketing arrangements which have already been agreed include a system of target prices which are to be maintained by the establishment of an intervention price at which stocks will be purchased if values fall below a certain level. The Association recommends that this intervention price should be set at a low figure in order that there should be no inducement to submit offers at that level.

The Association recommends that the proposed European Sugar Office should concern itself solely with the administration of the regulations and should have no commercial functions. It also feels strongly that close co-operation should be maintained with representatives of the various aspects of the trade. The proposed Sugar Advisory Committee should also include adequate trade representation.

It was recommended that, subject to the maintenance of such stocks as may be deemed necessary, there should be no hindrence to exports; imports, however, should be subject to licences to be issued by the Sugar Office and levies should be imposed to bring prices into line with E.E.C. levels. So that this arrangement might work properly the Association proposed that a daily check be made on prices outside the Common Market in order that the levies should correctly interpret the difference in price levels.

A seven-year transition period due to commence on 1st October 1964 was suggested.

Agreement has been reached between the United Kingdom and the E.E.C. countries on special arrange-

[1] *The Times*, 12th January 1963

[2] C. Czarnikow Ltd., *Sugar Review*, 1962, (590), 215.

ments to allow the exports of Bechuanaland, Basutoland and Swaziland to continue to enjoy free access into the U.K. should she join the Common Market, according to Press Agency reports. Swaziland exports include sugar.

According to the *Financial Times*[1], a number of possibilities are already being unofficially discussed about how the Commonwealth Sugar Agreement could be fitted in with Common Market regulations. One possibility is that as the target price will probably be above that of the Agreement, it could be granted to the Commonwealth suppliers. Another is that the present formula for fixing the Agreement price should remain, and that the levy should then be added to that price in order to bring it up to the Common Market's target. But whatever happens it does not look at present as if the producers have very much to be afraid of.

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World sugar prices.

At the end of 1961 sugar had reached its lowest post-war value at under £20 per ton, c.i.f. U.K. In the following twelve months the price rose to no less than £40 per ton, half of this dramatic increase having occurred in the last six weeks of 1962. During the first two weeks of 1963 the price has risen further—to £45 per ton, a figure which clearly illustrates the shortage of world market sugar.

A year ago, the sugar market had been badly affected by the failure of the International Sugar Conference and the change in the statistical position of sugar through the year as the excessive stocks disappeared was not appreciated. Towards the end of the year, the close statistical balance was emphasized by the International Sugar Council and the prospect of lower crops in Europe than had been expected earlier, as well as reduced crops in other countries, brought a sharp rise in prices, enhanced by the desire of consumers to cover their requirements and the news that among these, the U.S.A. had only been able to obtain a fraction of the 750,000 short tons of global quota required for January/May arrival.

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U.S. supply quotas, 1963.

Following the announcement[2] of proposals for 1963 and the sugar trade's reactions, the U.S. Secretary of Agriculture announced the Supply Quota arrangements on the 7th of December 1962. Total requirements were set, as proposed earlier, at 9·8 million short tons and quotas established at that level. Of the withheld Cuban quota 750,000 tons was authorized for import but the import fee was set at 1·40 cents per pound compared with the 1·80 cents which had been proposed.

Proposals made by the 20th December for this 750,000 tons were to be considered simultaneously and any balance remaining would thereafter be considered on a first-come-first-served basis; in the event only 113,658 short tons were offered and accepted—57,870 tons from Brazil, 45,388 from South Africa and 10,400 tons from the Dominican Republic. Brazil in her offer had agreed to spend all the proceeds from her sugar sale on U.S. farm products; South Africa agreed to spend only 40% on agricultural products, however, and the Dominican Republic did not offer to buy any surplus commodities.

The fact that less than one-sixth of the quantity required was offered gives an indication of the view of the statistical position taken by world suppliers, but the import fee of 1·40 cents per pound which this sugar has to pay is probably the reason why larger offerings have not been made. At current world values this fee is considered too high and it has been suggested that it would have to be reduced to attract the supplies needed. The U.S. Dept. of Agriculture has given no indication, however, of any intention or reducing the fee.

The quotas at present are as follows:

Short tons raw value	*Quota*	*Global Quota authorization*	*Total*
Domestic Beet	2,698,590	—	2,698,590
Mainland Cane	911,410	—	911,410
Puerto Rico	1,140,000	—	1,140,000
Hawaii	1,110,000	—	1,110,000
Virgin Islands	15,000	—	15,000
Philippines	1,050,000	—	1,050,000
Ireland	10,000	—	10,000
Canada	631*	—	631*
United Kingdom	516*	—	516*
Belgium	182	—	182
Hong Kong	3*	—	3*
Argentina	20,000	—	20,000
Dominican Republic	322,152	10,400	332,552
Peru	192,152	—	192,152
Mexico	192,152	—	192,152
Brazil	182,416	57,870	240,286
B.W.I./British Guiana	91,351	—	91,351
Australia	40,378	—	40,378
Taiwan	35,510	—	35,510
French West Indies	30,355	—	30,355
Colombia	30,355	—	30,355
Nicaragua	25,200	—	25,200
Costa Rica	25,200	—	25,200
Ecuador	25,200	—	25,200
India	20,332	—	20,332
Haiti	20,332	—	20,332
Guatemala	20,332	—	20,332
South Africa	20,332	45,388	65,720
Panama	15,177	—	15,177
El Salvador	10,309	—	10,309
Paraguay	10,023	—	10,023
British Honduras	10,023	—	10,023
Fiji	10,023	—	10,023
Netherlands	10,023*		10,023*
Cuba (Balance not transferred to Global Quota)	754,341	—	754,341
Balance of Global Quota	—	636,342	636,342
	9,050,000	750,000	9,800,000

* Withheld from net importing countries.

[1] 11th December 1962.

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

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.

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

PART II

Secondary Cultivation

Starting with a suitably prepared soil, there is no doubt that the most economical equipment to use for routine cultivation would be wheel mounted. At present track type tractors are used very extensively because the soil and field layout does not suit wheel type equipment. Very often track tractors have to be used for inter-row work, when planting is done in a furrow, since it is almost impossible to use wheel equipment running on top of a ridge. Even using 4-wheel drive tractors, and flat top ridges, it is very difficult to do a satisfactory, and speedy, job of inter-row cultivation. Wheel tractors are really only successful with a well defined ridge and furrow type of cultivation, and bank planted cane, when steering difficulties are reduced to a minimum.

With regard to the implements to be used for inter-row cultivation, there are several facts which must be kept in mind. Because of the high level of insolation experienced by the soil in cane growing areas, and the resultant and rapid drying of the surface soil, the period during which the soils are in an ideal moisture status for shallow cultivation is often very restricted. Accurate timing of cultivation work, in relation to soil conditions, is not often possible and it is usually necessary to do extensive inter-row cultivation work when conditions are anything but ideal. The hammering taken by inter-row equipment cultivating dry clay soils, at speed, has to be experienced to be appreciated and satisfactory equipment, to cope with high speed continuous work and large areas, must have considerable in-built ruggedness. It is not unheard-of for good quality steel discs to be broken during work and bearing troubles are often experienced, even in such robust equipment as the Rome Disc Ridger.

While there may be quite a number of applications where a tined type of implement can find a useful place in cane cultivation, it would seem likely that the most successful equipment would be based on the use of discs. There are also considerable possibilities of combining herbicide and fertilizer application with cultivation work, as well as the development of techniques such as the application of aqueous ammonia and liquid fertilizers.

The advisability of extensive ratoon cultivation is not clearly established, particularly where a trash blanket is retained. There are considerable differences of opinion with regard to the value of such cultivations, and instances have been known where actual reduction has resulted, and where the practice has, nevertheless, been continued, so that there is a good deal of sentiment attached to a lot of inter-row work and not too much factual information. Its main usefulness may well be in maintaining the field outline and in repairing damage done during mechanized harvesting. Cultivation through the trash blanket is also a possibility but much work is required before a clear understanding of the value of ratoon cultivation is obtained.

Except under tailor-made soil conditions the wheel tractor is unlikely to replace the track type machine for inter-row cultivation, since the track machine has very obvious advantages, some of which need to be kept very much in mind when designing suitable wheel type machines. Among the advantages of the track machine are very little lost time in turning and good stability at high speed, with little interference from small drainage channels or irrigation mains and, although ground clearance is often a limiting factor in their use, high clearance machines can be obtained and if it were not for high maintenance costs, plus high initial costs, there would be really little incentive to replace the track type machine, so that to be really successful the wheel tractor has to be good and well matched both as to the implements available and the cultivation technique used.

Harvesting

There is not the slightest doubt that the opinion is hardening very much against the use of any harvesting equipment which cuts and lays cane on the ground where it has to be picked up for loading, although, because of the particular circumstances involved, harvesting in Louisiana is relatively satisfactory with separate cutting and loading equipment. Elsewhere mechanical loading has almost inevitably brought trouble with increases in trash content and in the soil going to the mill, in consequence of which expensive washing plants have had to be installed, to safeguard mill throughput.

Mechanical harvesting has been developed most extensively in Louisiana and Hawaii, and it may be of interest to examine some of the features of the two systems, since the developments contrast appreciably both in the size of the operations, and in the conditions under which harvesting is carried out.

In Hawaii the development of mechanical harvesting was forced on the industry, practically overnight, by an acute shortage of labour and, initially, crude but nevertheless effective methods had to be used to collect the crop, without much reference to field layout, soil type, or subsequent operations, and it is a tribute to the resilience of the sugar cane plant that high yields of cane continued to be produced. In Hawaii the tendency has been to go for large and expensive machines with a high output and small labour requirements, in part, because agricultural labour rates in Hawaii are even higher than on the U.S.A. mainland. In Hawaii there is a diversity of conditions under which cane is grown and this has led to a diversity in the approach to mechanical harvesting. On the big island, with rainfall of 200-in or so falling in ten months, cane is grown on the flat and particular attention has to be paid to such factors as ground pressure of the equipment but, because of the flat cultivation, the development of such equipment as the "snow plough" type of cutter-dozer has been a possibility.

Fig. 1: First moulding of bank planted cane.

In contrast to the high rainfall areas there are substantial areas with about 20 in rainfall and on which irrigation is essential. Many of the Hawaiian soils have considerable stability of structure and good drainage qualities. This is very fortunate from the point of view of mechanical operations, but has led to the development of furrow irrigation with the cane planted in the furrow, and, because of the high rates of water flow being used in the furrow, the bank between the furrows tends to be high and is maintained. Such a layout has meant that the actual cane cutting equipment has to work in the bottom of the furrow, with consequent restriction of movement and difficulties in regulation of cutting height and cane pick-up. Additionally much of the land is of a rolling nature so that a good deal of contour planting is done with consequent incidence of short rows, and numerous irrigation canals.

The factors just mentioned have placed severe limitations on the direction of development of mechanical harvesting in Hawaii, and it is difficult to visualise how real progress can be made without some rather drastic changes in cultivation technique, and this in spite of the undoubted resources both in technical skill and money which have been available to the industry for a number of years.

In contrast to Hawaii, mechanical harvesting in Louisiana has been more successful. The success has undoubtedly been due, in no small measure, to the existence of a ridge and furrow cultivation technique and the level soil conditions under which most of the cane is grown. Also, because of the limited annual growth period in Louisiana, cane yields per acre are low and there is not the problem of coping with large tonnages of tangled cane, as is encountered in Hawaii.

The initial development of the ridge and furrow cultivation in Louisiana was necessary because of drainage limitations consequent upon a high water table and poor outflow, coupled with risks of flood damage, so that extensive land levelling has been done and a parallel type drainage system developed, which made mechanization of all operations, including harvesting, much simpler. Furthermore the Louisiana farmers have developed a great aptitude in the development and maintenance of equipment.

Undoubtedly much of the success of the Louisiana cutting machine is due to the fact that cane growing on a well defined bank is presented to the cutting equipment in a very satisfactory position, so that small irregularities in bank height can be followed easily and guidance of the equipment is relatively simple. The presence of the marked ridge and furrow has also facilitated the operation of cane loaders, since the piler and grab can get underneath the cane without digging into the soil. Much of the trouble experienced elsewhere, with mechanical loading equipment, has been because the cultivation systems used have not permitted the same facility of picking up the cane without collecting a lot of extraneous matter and, in many respects, mechanical loading without a similar type of cultivation to that used in Louisiana, and using the Louisiana-type loaders, is not much more satisfactory than the original bull-dozing techniques of Hawaii.

From the above considerations there is not the slightest doubt that the machine which cuts and loads, in one operation, without letting the cane come into contact with the soil has much to commend it and there are very few people who would consider that development should take place in any other direction, and this is why the reasonably successful Massey-Ferguson machine and some other types have created so much interest.

The main difficulty with a cut and load machine, particularly when the cane is reduced to small pieces during the operation, is that it will mean a complete change in the storage and handling methods at most factories, and there will be some nervousness about losses which are likely to occur when cane is cut up into short pieces. This, however, should not be a problem for the average run of factories where cane is produced close to the factory, but might well be a consideration where long distance haulage is involved and where there must be a considerable time lapse between cutting and loading.

Fig. 2: Massey-Ferguson 515 harvester in operation in Trinidad.

One of the main problems which requires consideration in connexion with mechanical harvesting is to determine the value of a trash cover. Undoubtedly burning the cane, prior to harvest, facilitates mechanical operations very much indeed. Except, however, where burning has to be done for considerations other than those purely connected with cane growth the loss of the trash is a serious limitation and, without question, the major proportion of the cane grown would benefit from the retention of a trash blanket and its retention can, undoubtedly, make a tremendous difference to cane yields and operational costs throughout the cane growing areas of the world. One has only to consider the savings resulting from the presence of trash in reducing weeding costs, in the maintenance of soil structure and fertility and saving in the costs of irrigation water, as well as conservation of rainfall where rainfall is marginal, to be convinced of its value.

Initially, therefore, it would seem most desirable, and necessary, to develop a machine which would be capable of handling green cane, and in this respect there would seem to be two lines of possible development, as regards the elimination of trash. Ideally the machine should deliver clean cane to the transport vehicles so that the cane can be fed directly to the mill without further processing. This, however, may be quite difficult to achieve with such highly mobile equipment as a cutter-loader. On the other hand it is possible that centralized cleaning might be an attractive proposition, particularly from the point of view of Estate grown cane, since a relatively elaborate plant could be installed centrally, with resulting simplification of the field equipment and it would seem that such a line of development would be very well worth considering. As very little soil would come in with the cane the disposal of the accumulated trash would not be a problem as it could be burned with the bagasse. Such a development could possibly run parallel to the development of a machine more suited to the cane farmer, to whom the delivery of a clean sample would be more important.

A further desideratum in the development of harvesting equipment is that the machine should be capable of cutting two rows at a time, in front of itself, since there are severe restrictions in using single row equipment such as opening up of the fields prior to putting in the machines, as well as limitations imposed by having to cut one way, or in "lands."

Harvesting equipment is a much wider subject than can be included in a summary of this sort, but mention has been made of a few points so as to fill in the picture a little, particularly in relation to the other factors being considered.

Discussion

From the foregoing it will be realised that the sugar cane crop is grown under a wide diversity of soil and climatic conditions, and that the present day cultivation techniques in use are very varied, and many of them are based on traditional hand and animal power methods, modified only by the availability of powerful tractors and much new equipment.

For the purposes of this summary it might be best to indicate a few points, without too much in the way of explanation, which would appear to be basic to the development of any co-ordinated, and widely applicable, system of cultivation and associated equipment.

1. Deep primary cultivation such as ripping to 18/24 inches may be necessary on heavy clay soils with poor structure and difficult internal drainage. By contrast light soils will require only the minimum of operations to facilitate the removal and killing of old stools, and sufficient working to obtain a rough tilth. Normal soils may benefit from deep cultivation, as opposed to deep ploughing.

2. Continued inversion of the soil with each replanting is of dubious value under most circumstances and may, indeed, be harmful, whilst ripping, particularly if done when the soils are dry, can provide adequate tilth depth without soil inversion, or lateral movement of the soil.

3. Purely localized accumulations of water, within a field, can create quite serious drainage problems and can cause much difficulty in devising a reasonable layout for mechanization. Land levelling and land

planing should have a high priority, where the depth of soil permits, since it can effect a permanent improvement of the facility of cultivation in all stages, and can often permit the use of a parallel drainage system which is very necessary for ease of mechanization.

4. The emphasis on the design of cultivation systems should be on the prevention of waterlogging of the maximum possible soil volume, coupled with ease of removal of excess water. With many heavy soils it is important to remember that drainage to a moisture content below the field capacity cannot be achieved and, in fact, many of the heavier soils never become fully saturated with water, owing to internal swelling and restriction of water movement within the soils before saturation is reached. With such soils adjustment of the water intake may be the main consideration in the design of a suitable layout.

5. Operations such as ploughing, mechanical planting, cultivation and harvesting are also facilitated, when there is a minimum interference by drainage and when the cane is planted on a ridge, which may vary from a few inches to 18 in or so in height, depending on soil and climatic conditions. There is considerable latitude in row width, but experience indicates that under most circumstances some yield decline is likely with widths much in excess of 5 feet, and under some marginal conditions rather closer row spacing may be optimum.

Serious consideration needs to be given to changes in technique in all areas in which furrow planting is practised, since it seems almost impossible to do a good job of cultivation and yet maintain the furrow in which the cane was planted, and it certainly is most difficult to do any cultivation work using wheeled equipment under such conditions. Undoubtedly in some areas it may be found necessary to maintain the cane in a furrow, but there are certainly very large areas indeed in which a bank type of cultivation might be more suitable, than any other system.

6. It is more than probable that some modified form of the Louisiana type of cultivation, with suitable variation in row width and bank height, may be adapted to meet existing cane areas, at least on the Estate scale and on relatively level terrain, and such a row crop type of cultivation seems to be the only logical means of achieving a reasonable chance of successful mechanization to a worthwhile degree. Many of the objections to such a technique are not very well founded, and in fact much prejudice against change can be encountered, but with a proper understanding of the particular soil conditions it may often be possible to see how a bank and furrow technique could be adapted to most sets of conditions.

7. With a row crop layout, and a well defined bank, the maximum amount of soil is protected from waterlogging, so that it is easier to maintain a stable structure in the depth of cultivated soil, and significant changes in the depth of the initial cultivation may be possible with a change-over, as a lesser depth of soil can be used more effectively.

8. Because of a generally low level of equipment maintenance, and poor quality operators, any equipment devised must be rugged, as simple as possible in design, and the initial cost should, perhaps, have secondary consideration to providing trouble-free operation and durability. The power made available should, generally speaking, be more than adequate since factors such as overheating, clutch riding and poor quality work are then less likely to be of serious consequence.

9. In view of the real value of cane trash, over very large areas of the cane producing territories, the maintenance of a trash blanket should be given priority, except perhaps during primary cultivation operations, when the presence of trash often prevents reasonable cultivation operations being done, and where excessive harrowings may be necessary to achieve good disintegration of trash. With a heavy trash cover, up to seven passes of a large Rome harrow may be necessary before satisfactory ripping can be done.

10. The presence of trash on the cane being cut can make the development of a suitable harvester more difficult, but any machine which can cope with green cane will almost certainly do a better job when handling burnt cane. On the other hand, there is no doubt that cane trash is a very valuable asset, and warrants an appreciable effort being made to conserve it.

11. There would probably be a demand for two types of harvesting machines. Large estates will require machines of high output, preferably cutting two rows at a time, and probably designed as a complete unit. The possibility of centralized cleaning, after a preliminary cleaning in the machine, might also be considered for Estate use. For farmers there may be a demand for tractor driven units, after the style of the present M.-F. 515 machine, where deliveries of 50/120 tons per day are to be made.

Conclusion

If investigation shows that there is a good chance of developing a bank and furrow type of cultivation in most sugar growing areas, and a range of suitable equipment could be made available, it is very probable that a world wide demand would arise. The future pattern seems to be that as the populations in cane growing countries become more sophisticated it will not be possible to carry on with old techniques, and growers will be increasingly willing to adopt new methods, particularly if they can develop a mechanization programme with ready-made and suitably robust equipment.

French white sugar imports[1].—French sugar refiners have been authorized to import white sugar on a "temporary" admission basis to be refined and re-exported, according to a spokesman of the Syndicat des Raffineurs de Sucres. No quantity has been fixed by the authorities, and imports could amount to "anything between 10,000 and 30,000 tons," according to market conditions.

[1] *The Times*, 27th November 1962.

UTILIZATION OF AGRICULTURAL WASTE MATERIALS

WASTE materials, both agricultural and urban, have presented problems of disposal to which varying answers have been given. In the case of agricultural wastes the readiest, answer, accepted throughout the ages, was their ultimate return to the land. To the nature of the process of disintegration, little attention was given, and later studies have shown that losses of plant food, whether in the midden or in burning, were enormous. From the study of these processes there was gradually evolved the aerobic system of composting, a system not widely adopted in latter years because, on a farm scale, it was not readily adapted to mechanization.

It was during the last war that attention became seriously directed to the alternative system of waste disintegration, anaerobic fermentation, the pressure deriving from lack of oil products as a source of power. Anaerobic fermentation not only provided a sludge containing all the plant nutrients, with the exception of a fractional loss of N, but yielded an abundant supply of gas of high calorific value—methane. This sludge, run or sprayed onto the land, or used to activate a compost heap, returns to the land a large proportion of the nutrients extracted by the crop, wile the gas provides a liberal supply of power for farm use.

At that time, under pressure of shortage of oil, serious attention was directed to the potentialities of anaerobic fermentation of agricultural wastes as a source of power and, as that shortage was more stringent in France and Germany, it was in these countries that the greatest progress was made. Development followed two broad lines, roughly corresponding to the size of the holding. Characteristic of Germany were large, expensive plants capable of compressing the gas and using it even to run mobile machinery. Characteristic of France, with its smaller holdings, were the small plants, with power used to heat and light the homestead and to run fixed machinery.

In the immediate post-war period a rapid increase in the number of plants took place; particularly was this the case in France where, for a few years, approximately one thousand plants were being installed annually. That development has, however, practically ceased for the reasons that oil is now in abundant supply, electricity is spreading into outlying areas, local generation involves labour which is everywhere becoming scarcer and more expensive, and lastly, particularly in a country like France with its close network of roads, the ease with which "Calor" gas, or butane, can be delivered. What stands out clearly from the above brief review is that there exists, in all agricultural tracts, an immense source of energy at present untapped and an immense supply of plant nutrients lost, and that the reason for the failure to tap these reserves is purely economic, for the ways and means are well known and the processes of recovery of the simplest. The problem presents itself in its most elementary form in those countries commonly, but mistakenly, termed "under-developed." It will be long before India's economic position will allow the provision of centrally-generated power to each village; here a strenuous effort should be made to digest the cattle droppings instead of using them as fuel. It will be long, too, before each African village will have ready access to an electricity or "Calor" gas supply and it is in such cases that the economic situation is most promising.

But if most has been heard of the developments in France and Germany, they are not the only countries in which the subject has been studied, and renewed attention has been drawn to the potentialities of methane gas or, as it is sometimes termed, "biogas", in a paper presented to a recent conference by L. NASZÁLYI and B. A. DÉR[1]. The economic aspect is discussed mainly as it presents itself in Hungary. In that country maize is a major crop, occupying an average of 22% of the crop land and up to 47% of the land near cities, where the demand for power is greatest. But, somewhat curiously, the potential uses of sugar cane bagasse are also discussed at some length and the paper is, therefore, of interest to the cane sugar industry. Bagasse still forms the major fuel of the factory and, according to the authors, as fed into the furnace has a 50% moisture content and they calculate that 500 kcal of a total of 2200 kcal/kg is expended in removing this moisture. With anaerobic fermentation not only is this loss prevented but the large mass of plant nutrients lost in direct burning are retained in a suitable condition for return to the land.

As has been stated earlier, the problem is, in small degree only, technical; it is primarily economic. It should not prove impossible of solution and is worthy of closer consideration than as yet has been given it.

H. M.-L.

The influence of sugar cane trash on the production and conservation of the organic content of the soil. F. M. VEIGA *et al. Brasil Açuc.*, 1962, **59**, (1 & 2), **13**, 18.—In a 4-your comparison, trash unhandled gave the highest yield, active soil microflora and highest C and N content in the soil. When trash was burned, considerable loss of soil C and N occurred with a steadily decreasing yield.

[1] World Power Conference, Melbourne, 20–27th October 1962.

A study of methods of cane quality determination for cane payment. J. J. SEIP. *Sugar J.* (La.), 1962, **25**, (2), 14–16, 36.—The advantages of knowing when to cut a field of cane at maximum maturity and the desirability of impressing the peasant cultivator of the need for adapting all cultural operations with a view to securing that maturity in his cane at harvest by paying him a bonus for quality, have offered problems not yet fully solved. Here the experiences of several countries in their efforts to find a practical solution to the latter problem are assembled and discussed.

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Sugar research in Mauritius. P. O. WEIHE. *Sugar J.* (La.), 1962, **25**, (3), 8–11.—The scope of the research is briefly reviewed.

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* * *

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FUNDAMENTAL INVESTIGATION INTO THE NATURE AND CHARACTERISTICS OF BONE CHAR

By MICHAEL LORANT

PART II

For many years, the sugar industry has treated the inorganic constituents of sugar as a single entity and has reported the results as total ash. However, research results at the Bureau have shown that a total-ash determination is not adequate for following the changes in the bone char process. Compensating changes can occur that would make such a determination worthless. True, analysis of all the major constituents of the ash is essential for basic research as all the impurities (i.e. non-sucrose constituents) not only interact during the adsorption process but also their presence modifies the sugar crystallization process and thus affects the ultimate purification of the final product. Furthermore, all inorganic ions present in a sugar liquor must be identified to understand such solution behaviour as pH changes. If the pH is too low during the sugar refining process, some sugar will be destroyed by hydrolysis; if it is too high some sugar will be lost by alkaline degradation. Bone char, besides eliminating colour and ash, helps to maintain an approximately constant pH.

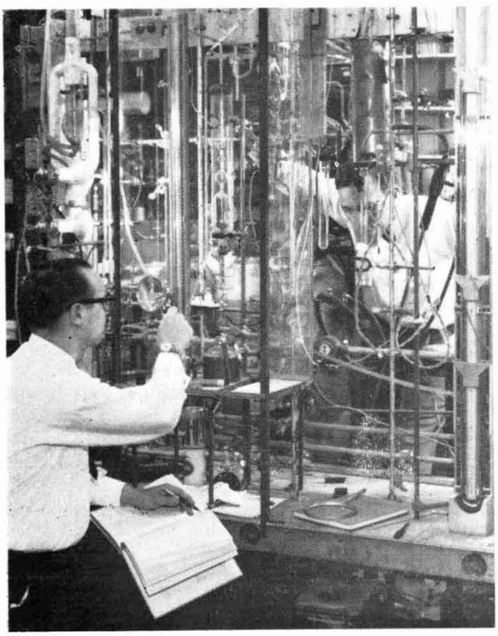

Fig. 4.

Following each kilning experiment, raw sugar liquor is passed through columns of the regenerated bone char to evaluate the influence of the previous kilning cycle. Using an ion exchange method to determine the total ions remaining in the sugar liquor, JOHN RED VI, staff scientist of the U.S. National Bureau of Standards, prepares sugar samples for analysis in an automatic chloride titrator.

Suitable methods have been developed for determining minute amounts of calcium, magnesium, sulphate, sodium, potassium, silica, and phosphate. The difficulty is the interference of sucrose; many of the available microanalytical methods are not effective in the presence of large amounts of sucrose.

Instead of "ash" as weight %, the total ionic content, either as total anions or total cations, has been suggested as a more meaningful substitute. This measurement correlates well with "ash" and presents the possibility of a more useful interpretation.

In order to study the bone char adsorption process in sugar refining, a laboratory-scale regenerating and adsorption system was devised by Bureau scientists. In this system, the char is used to decolorize a raw sugar solution and is then passed through a revivification system of washing and kilning. All the conditions and flow rates can be carefully controlled. The treatment with the test sugar liquor serves two purposes: (1) it measures the influences of the previous kilning, and (2) it forms a spent char which can be subjected to a subsequent kilning operation. The testing procedure, which is completely mechanized, has demonstrated that about five complete cycles are required to establish the effect of a new set of conditions.

When impurities from liquids (e.g. sugar liquors) are adsorbed by granular solids in beds, obtaining uniform flow throughout becomes a problem. A careful study indicated that uniformity of particle-size distribution is a determining factor. Thus, to obtain uniform flow in the laboratory system—and, in addition, almost total utilization of the char particles—the char was first sieved according to particle size and then the bed was packed in strata of the same particle size. With this arrangement, uniform flow, and thus highly reproducible results, were achieved.

In kilning, variation in temperature, oxygen concentration, rate of heating, and duration of treatment all affect the char's efficiency. To determine which parameters are the most important, and to test some of the large number of possible combinations, various statistical designs are used in planning experiments.

A surprisingly large amount of material goes in and out of the char structure during its many cycles of operation. To identify which substances actually remain on the char structure, Bureau scientists utilized radioactive tracers to differentiate between the calcium in the bone char adsorbent and the calcium in the material being purified. The results indicated an extensive exchange of calcium ions in the solution with the calcium of the char.

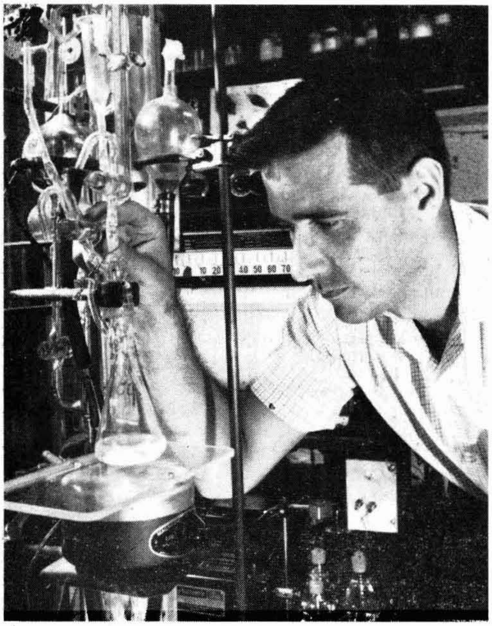

Fig. 5.

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.

In the washing phase of revivification, it has been found that more material can be washed out with cold water than with hot water. This is because calcium salts, which are the primary compounds desorbed during the washing, have greater solubility in cold water.

As a general adsorbent, bone char not only adsorbs impurities but also sucrose. It had long been supposed that all the sucrose was desorbed in the washing which is the first part of the revivification. However, studies using a pyrolysis technique and gas chromatography to analyse evolved gases have indicated that sucrose in the amount of a few tenths of one per cent by weight of the char is permanently adsorbed by the char. No amount of washing can remove this sucrose.

Bone char's adsorption of the various ions was found to be a very complex function of all the ions together. Monovalent ions are hardly adsorbed whereas polyvalent ions, including colorant anions, are strongly adsorbed. Thus, the colour removal is dependent upon the ionic balance. The key ions which most influence the performance of char with a particular sugar liquor are calcium and sulphate.

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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

Paper presented to the 15th Technical Conference, British Sugar Corporation Ltd.

PART III

We have seen from tests in a desiccator, and humidity oven, that freshly produced sugar coming from a granulator will continue slowly to give up moisture. This has nothing to do with inadequate drying plant but simply that the sugar has moisture present with requires time (and reasonably dry external conditions, of course), to be freed and carried away. The plant necessary to remove this moisture we call conditioning plant, and two factors are essential for its success:—

(*a*) It must have a capacity sufficiently large for the output of the factory, i.e. a minimum residence time.
(*b*) It must be supplied with reasonably dry air (and possibly warm air) and the volume of air should be sufficiently large to approach a fluidized bed effect, to obviate channelling.

In the U.S.A. bulk transport of white sugar on a large scale has been introduced several years earlier than in this country, and they have experienced the problem of caking in the transport vehicles. Within the last few years sugar conditioning bins have been introduced generally with about 24 hours residence time and using lithium chloride as a drying agent for the air supply. At the same time these conditioning bins are used to cool the sugar, an essential requirement when low ambient temperatures are met in transport. Now it may seem, in view of some earlier results mentioned, that 24 hours is rather a short time, and in fact the authors feel that a longer period would be preferable. Nevertheless, this duration is very much dependent on the quality of the sugar crystal, and at the same time the rate of release of moisture may be altered somewhat when dry air is actually flowing through the mass, and in theory around each crystal. The latter is not really too important a feature, however, because, as oven drying will show, the resistance to the liberation of the moisture is not simply the difference in partial pressure and vapour pressure of the water in the sugar and air respectively—the problem is one governed rather by a crystallization rate and not evaporation.

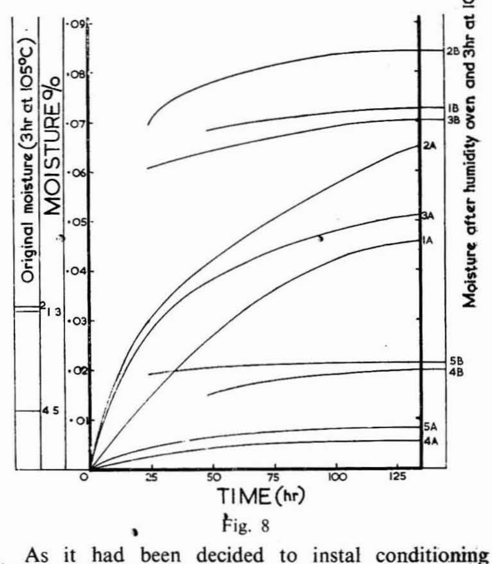

Fig. 8

As it had been decided to instal conditioning plant preparatory to bulk transport and storage at

Table VII
Moisture Loss %

	3 hr at 105°C	24 hours A	24 hours B	48 hours A	48 hours B	72 hours A	72 hours B	90 hours A	90 hours B	112 hours A	112 hours B	133 hours A	133 hours B
Normal Technique—													
1	0·032	—	—	0·027	0·07[illegible]	0·035	0·069	0·040	0·071	0·044	0·070	0·045	0·073
2	0·033	0·030	0·070	0·043	0·079	0·048	0·080	0·054	0·082	0·061	0·086	0·064	0·084
3	0·032	0·029	0·061	0·039	0·063	0·043	0·065	0·045	0·068	0·049	0·064	0·051	0·071
Forced Circulation													
4	0·012	—	—	0·004	0·015	0·005	0·017	0·004	0·016	0·005	0·018	0·005	0·020
5	0·012	0·005	0·019	0·006	0·022	0·004	0·021	0·005	0·021	0·007	0·019	0·009	0·021

one of our factories, it was decided to examine the sort of results, and their interpretation, which we may obtain. We adopted the following procedure. We did five tests in all, three using sugar produced by the normal boiling technique and two using sugar boiled by forced circulation. Each test consisted of subdividing a sample into eight representative portions. A normal moisture, 3 hours at 105°C, was done on one portion, the remaining seven put into the humidity oven at 40–50% R.H. and 40°C. After 24 hours one portion (A) was removed, re-weighed, and returned to the oven, while a second portion (B) was removed and a standard moisture determination—3 hours at 105°C—made. This was carried out again after 48, 72, 90, 112 and 133 hours, each test eliminating one portion, i.e. the one on which the standard drying procedure was used. The results are tabulated in Table VII, and illustrated graphically on Fig. 8.

Examining the graph, again we see typically that the tests 1, 2 and 3 had a much higher initial moisture, a greater amount of moisture liberated in the oven, and a higher final moisture than tests 4 and 5. The

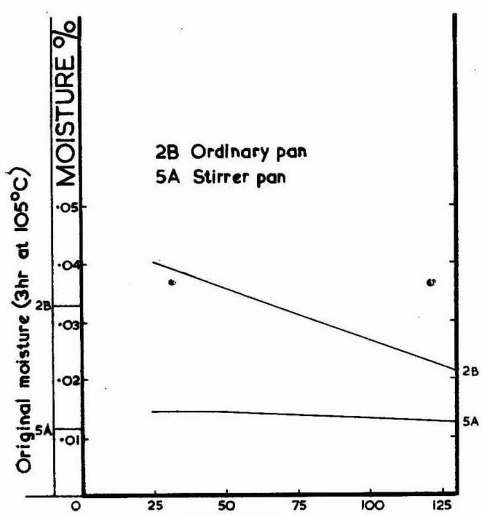

Fig. 9

significance of the graph is however that if one were using a conditioning plant, the moisture of the sugar entering would be as recorded on the left hand column. If the residence time was 24 hours (no channelling is assumed) then the apparent moisture one would measure, leaving the conditioning bins, would be the difference between the B and the A curves for each particular test at the 24 hour ordinate. Similarly at 48 hours, etc. Thus, for example, after 24 hours conditioning it would be quite possible, in fact even probable, to show an apparently higher moisture in the sugar leaving the plant than on entering—and this despite the fact that moisture has been removed in the meantime.

To illustrate the previous remarks we have constructed Fig. 9, choosing the two tests Nos. 2 and 5. On the left hand column, the original moistures, i.e. entering conditioner, are recorded.

The apparent moistures in the sugars leaving conditioning can be read from the lines 2 and 5 for any particular time of conditioning of the respective sugars. In test 2 for 24 hours conditioning, for example, apparent moisture entering is 0·033% and

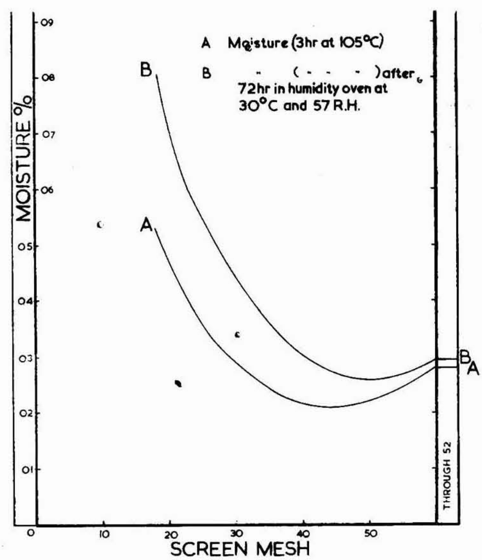

Fig. 10

apparent moisture leaving 0·040%. With this particular sugar and under the external conditions stated, its sugar moisture leaving is as low as that entering—

although we know from the previous Fig. 8 that as much as 0·047% of water has in fact been removed!

We would emphasize once again, however, that these tests with a sample remaining static in a dish, are not quite the same conditions as those existing in a bin holding possibly several hundred tons of sugar, into which air is being continually blown. Nevertheless, we do believe that the results in practice will not be much different from those achieved with the oven and it was unfortunate that the plant at Allscott (where 4 conditioning bins with a total retention time of 24 hours were installed) was not completed in time to carry out any significant practical tests. This undoubtedly would be the most satisfactory way, but care would still be necessary to eliminate any effects of channelling on the results.

In Fig. 10 we show results illustrating how the moisture in normal granulated sugar is distributed in relation to the various screened fractions. A sample of freshly produced sugar was taken and divided by screening into:— on 18, 18–25, 25–36, 36–44, 44–52, and through 52. A normal 3-hour moisture analysis was made on each fraction, and a second sample of each was placed in the humidity oven for 72 hours at 30°C and a relative humidity of 57%. A final 3-hour moisture determination was done on these latter samples. The results show similar curves for both series, and a minimum moisture—both initial and inherent—around 45–50 mesh. This is typical of a number of similar tests we have carried out on this aspect, and is appears that the high moisture in the larger particle sizes is due to the increased proportion of conglomerated crystals, while the tendency to rise again with the finer crystals (above say 50 mesh) is due to the increased proportion of total surface area to weight in these fractions. Doing a similar test but measuring % ash gives very similar curves, and for the same reason.

(*To be continued*)

BULK SUGAR TERMINAL AT GEORGETOWN, BRITISH GUIANA

Reprinted from *Commonwealth Producer*, 1962, (341), 161–2.

FOR storing and shipping raw sugar in bulk a terminal capable of loading sugar to ship at 500 tons/hr has recently been brought into use on the Demerara river at Georgetown, British Guiana. The terminal can take in sugar arriving by road at 100 tons/hour. For sugar arriving by barge or coasting ship the rate of intake is up to 200 tons/hour. All three functions can be performed simultaneously when necessary. There is also provision for transferring sugar at 200 tons/hour between the two large store buildings, which have a combined capacity of 40,000 tons. The terminal is owned and operated by Demerara Sugar Terminals Ltd., 80% of whose capital is owned by Booker Brothers (Liverpool) Ltd. (a member of the Booker Group of companies). The remaining 20% is held by Sandbach Parker & Co. Ltd., a subsidiary of the Demerara Co. Ltd. Simon Handling Engineers Ltd., in conjunction with the staff of the Booker Group, designed the mechanical handling plant and structures and supervised erection and commissioning of the installation.

Sugar brought from the mills by road vehicle is carried in containers and tipped into an intake hopper at the road intake house. It is discharged from the hopper onto an inclined conveyor by which it is carried to the top of a junction tower whence it can be delivered to either of the two stores. Sugar arriving by water also passes through this junction tower on its way to the stores from the intake jetty. The intake structure on the jetty has two fixed booms extending over the berth for barges on the landward side of the jetty. Two hinged booms extend over the berth on the river side, at which coasters as well as barges can be moored. On each pair of booms there is a traversing crab with a grab which lifts the sugar from holds and discharges it into a hopper in the base of the unloading structure. The sugar then moves by conveyor to a transfer house supported by a dolphin and then goes by a long inclined conveyor to the top of the weigher tower on the river bank. After being weighed the sugar is taken on an inclined conveyor to the top of the junction tower from which point it can be delivered to either of the stores by steel band conveyors in the same way as sugar arriving by road. Inside the stores the sugar is distributed by mobile ploughs which divert it from the conveyor at the desired points.

Sugar for shipment overseas passes through openings in the floor of each store to a central belt conveyor which delivers it to the base of the junction tower. It is then lifted to the top of the weigher tower, where it is weighed and discharged through a hopper on to a long inclined conveyor which transports it to the mid point of the loading-out gantry. A bifurcated shoot transfers it to one or both of two shuttle conveyors; each of these feeds a loading-out conveyor one on each side of the gantry so that sugar can be poured into two hatches of the loading ship at the same time. The loading-out conveyors are carried in retractable booms in a travelling crab with a telescopic chute at the end which can be positioned over any point of the hatch opening to facilitate trimming of the cargo. When either of the chutes is being moved to deliver to another hatch, the full flow of sugar can be diverted temporarily to the loading-out chute on the other side of the gantry so that loading can continue without interruption at the maximum rate while the other chute is being moved.

Corrugated aluminium sheeting, because of its resistance to corrosion, heat reflecting characteristics, ease of maintenance and appearance, has been used extensively for roofing and shedding at the terminal. Advantage has been taken of the light reflecting characteristics of aluminium to provide illumination by reflected daylight by leaving a gap between the upper edge of the wall sheeting and the roof. In addition to conventional type windows corrugated perspex lights have been fitted at various points and louvred construction in the sheeting gives additional ventilation where needed. The main electrical switch boards are located in the junction tower; a mimic diagram with indicator lights shows which conveyor is in operation. There is also a mimic diagram, for the bifurcated chute gate and the four shuttle conveyors, in the control cabin of the central tower of the shipping grantry. There are push button stations controlling the crab travel and boom extension and retraction movements.

Mechanical handling equipment for 7 of the Bookers Sugar Estates Ltd. sugar plantations in British Guiana also supplied by Simon Handling Engineers enables full use to be made of the Georgetown terminal.

Adoption of the bulk handling method for shipping sugar from British Guiana made it desirable to introduce ocean-going vessels which could make full use of the advantages which the new installation could offer and to design them accordingly. The *Booker Venture*, which made its maiden voyage in the early part of last year, is the first embodiment of this policy. In designing this bulk carrier it was necessary to take full account of the draught limitations imposed by the bar at the mouth of the Demerara river. There are only two periods of a few days in each 29-day tide cycle when there is more than 19 ft of water over the bar. The *Booker Venture* can be loaded with a part cargo of 7000 tons of sugar at Georgetown and filled up elsewhere in the Caribbean. The ship has very large hatches with a single pull cover powered by the vessel's winches and this arrangement, in combination with the rapid loading facilities afforded by the terminal, permits a very quick turn round to be effected. Shipment of sugar from British Guiana is seasonal, being restricted to the spring and autumn months, and for this reason the *Booker Venture*, by means of an ingenious design of the wing ballast tanks, can be easily adapted for use as a grain carrier.

DETERMINATION OF SUCROSE

in the impure products of the cane sugar manufacturing process by the action of boron salts

By JOSÉ A. LÓPEZ HERNÁNDEZ

Reprinted from Arch. Farm. Bioquím. (*Tucumán*), 1961, **9**, (2), 125–144.

PART I

A LONG time ago, various authors—KLEIN[1], BOUCHARDAT[2] and VIGNON[3], according to BÖESEKEN[4]—noted that when polyhydroxy or polyol-type compounds were added to boric acid its acidity increased, as for instance in the case of glycerin which gave rise to the method for titrating the acidity of this weak acid. These observations were confirmed and amplified by MAGNANINI[5], according to BÖESEKEN[4].

VAN'T HOFF[6] proposed that the origin of this phenomenon was in the formation of cyclic esters with 5 or 6-carbon atom rings, of greater acidity, by the polyols with adjacent (*cis*-position) hydroxyl groups. He quoted the case of mannitol in which not only its property of increasing the acidity of boric acid was noted, but also the modification at the same time of the optical activity of the mannitol[4,7].

1 *Compt. rend.*, 1878, **86**, 526; 1884, **99**, 144.
2 *ibid.*, 1875, **80**, 120.
3 *ibid.*, 1874, **78**, 184.
4 *Advances in Carbohydrate Chem.*, 1949, **4**, 189.
5 *Gazz. Chim. Ital.*, 1890, **20**, 428; 1891, **21**, (II), 134, 215; *Physic. Chem.*, 1890, **6**, 58; 1892, **9**, 230; 1893, **11**, 218.
6 Die Lag. Atom. Raum. (F. Vieweg, Braunschweig). 3rd Edn. 1908.
7 BÖESEKEN: *Rec. Trav. Chim.*, 1921, **40**, 553; *Ber.*, 1923, **56**, 2411; *Bull. Soc. Chim.*, 1933, **53**, 1332.

In 1911, BÖESEKEN initiated a series of studies on this subject[8] which continued until 1949, in which the mechanism of combination of boric acid was investigated and explained.

From the experiments of BÖESEKEN in 1920 emerge two fundamental aspects of the mechanism of combination of boric acid with polyhydroxylic compounds: first, that the conductivity of boric acid increases by formation of boron complexes, and second, that the greater or smaller tendency of boric acid to combine with a polyhydroxylic compound depends on the degree of closeness or proximity of the adjacent hydroxyls, the highest degree of proximity being the *cis* position and the lowest degree the *trans* position.

BÖESEKEN measured the increase in conductivity of boric acid solution when different polyhydroxylic substances were added of increasing numbers of carbon atoms. The results obtained were as follows:

Substance	*Increase in conductivity*
Glycol	0
Glycerol	+ 9
Erythritol	+ 72
Adonitol	+ 90
Arabitol	+ 357
Xylitol	+ 625
Mannitol	+ 682
Dulcitol	+ 717
Sorbitol	+ 794

This phenomenon is explained as being due to a higher or lower degree of repulsion of the hydroxyls. Thus, in the case of glycol, with only two hydroxyls, these to repel each other take up an opposed position, i.e. at 180° which coincides with the perfect *trans* position. In this case boric acid does not combine with it and consequently no increase in conductivity occurs.

In the case of glycerol there is a third hydroxyl which breaks the equilibrium of forces of repulsion of the other two and consequently in this compound there are two hydroxyls which are closer, at an angle less than 180°, and because of this some combination with boric acid is possible, which is the cause of the slight increase noted in the conductivity.

With increase in the number of hydroxyls there is an increase in the proximity of two of them and similarly an increase in boric acid combination which is expressed in the mounting increase in conductivity, as is seen in the table.

The same author has pointed out that the phenomenon is also seen in compounds where the carbon atom is replaced by another element such as sulphur, nitrogen, etc. Finally, various compounds were obtained in their two forms—*cis* and *trans*—and the conductivity increase of the boric acid determined. The following table, transcribed from his experiments, demonstrates that increase in boric acid conductivity only occurred on addition of compounds with hydroxyls in the *cis* position, that is to say that combination with boron to form compounds only took place with hydroxyls in the *cis* position.

Compound	*Increase in conductivity*
Indane-1,2-diol (*cis*)	+ 63
,, ,, (*trans*)	—
Tetramethyl sulphone-2,3-diol (*cis*)	+ 404
,, ,, ,, (*trans*)	—
2-Methyl tetramethylene sulphone-2,3-diol (*cis*)	+ 1096
,, ,, ,, ,, (*trans*)	—
1,4-Dimethyl tetramethyl sulphone-2,3-diol (*cis*)	+ 1458
,, ,, ,, ,, (*trans*)	—

These observations and proofs of the author cited give the basis of the technique for locating the spacial position of the hydroxyls in the molecule.

From 1911, BÖESEKEN made note of the changes in conductivity of a boric acid solution on addition of sugars. Thus, working with the α- and β-isomers of D-glucose, he observed that while the α-D-glucose (*cis*) produced an increase in conductivity no similar phenomenon was shown by β-D-glucose (*trans*). He noted also that the conductivity varied in accordance with the phenomenon of mutarotation of these two sugars so as to stabilise the conductivity, when the mechanism of the interconversion between the α- and β-D-glucose is completed. It indicates anew the necessity for the presence of two hydroxyls in the *cis* position for there to be a variation in the conductivity of the boric acid and in this respect, in the case of sucrose, no increase in conductivity occurs because its eight hydroxyls are positioned unfavourably (*trans*) for combining with the boron. The same author studied the influence on boric acid conductivity of the addition of D-galactose. As in the case of α- and β-glucose, he met the existence of the two isomers and their interconversion in the phenomenon of mutarotation to reach equilibrium. He also studied[9] the action of β-D-mannose, α-L-rhamnose and β L-arabinose, making note that as the addition of the sugar reduced the conductivity its optical activity also fell. The action of α-D-xylose was also studied as was that of α- and β-lactose, β-maltose, D-fructose and L-sorbose[10], it being especially noted that in the case of D-fructose it had a greater aptitude for combination with boric acid than the α- and β-glucose, establishing that, in general, combination is easier for ketoses than aldoses as a consequence of the more favourable position of the hydroxyls.

While BÖESEKEN and the earlier workers studied the variation in conductivity experienced by boric acid on addition of polyhydroxylic compounds, with the object of explaining the formation of isomers and establishing the true spacial position in the hydroxyls in the molecule, the optical modifications observed at the same time were quoted without much emphasis, only the parallel between the variations in conductivity and optical activity being noted.

[8] *Rec. Trav. Chim.*, 1911, **30**, 392; *Ber.*, 1913, **46**, 2612; *Rec. Trav. Chim.*, 1920, **39**, 186; *Verslag Ned. Akad. Wetensch.*, 1944, **50**, 9.

[9] *Rec. Trav. Chim.*, 1942, **61**, 85.

[10] *ibid.*, 1935, **54**, 865.

Other authors, on the other hand, carried out work intended to establish the change in optical activity of polyhydroxylic compounds by addition of boric acid or its salts. In 1853 BIOT[11] discovered the action of boric acid on the rotatory power of tartaric acid. This author studied and developed the subject in a series of works extending over more than twenty years (1835–1860).

DARMOIS[11] noted the effect of boric acid on the optical activity of malic acid. The same author amplified his observations[12] and established the structure of the complex formed between the boric and malic acids. DARMOIS and PEIRAUX[13] said that boric acid, even up to saturation, had no effect on the rotation of glucose while sodium borates, even with a Na:B ratio as low as 1:4, had a marked effect.

TANG and SUNG[14] noted that their results contradicted the observations of DARMOIS and PEIRAUX since they found that at a particular concentration boric acid influenced the optical activity of glucose. These authors, working with 0·55M (10%) solutions of glucose and boric acid solutions of concentrations increasing to 0·5M, observed that the optical activity of the glucose fell to a minimum and then began to increase. Working with borax, however, of concentration increasing to M/5 and 10% solutions of glucose, they observed that the decrease in optical activity is continuous and without inflexions in proportion to the borax added. The slope of the curve thus obtained indicated that for high concentrations of borax or low concentrations of glucose the optical activity of the glucose tended toward zero.

Possibly on the basis of the results of earlier work, SCIARRA and ZAPOTOCKY[15] developed an analytical method for determining the boric acid concentration, measuring the change produced by this acid on the polarization of tartaric acid. In 1927 LEVI and DOISY[16] studied the modification of the optical activity of sugars by the action of borax.

(To be continued)

PARTIAL ACETOLYSIS OF THE CANE FINAL MOLASSES BROWNING PRODUCTS

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MANY carbohydrate polymers are readily depolymerized with mild acidic reagents at moderate temperatures. However, considerably more drastic treatments are required for certain nitrogen-bearing polysaccharides, such as chitin. The cane final molasses "browning" products belong to this group. While these nitrogen-bearing polymers possess the advantage of being soluble in water, they are amphoteric and display a marked resistance to scission with either acidic or alkaline reagents. The molasses "browning" polymers have been depolymerized by hydrogenolysis at 165–170°C[17]; unfortunately, these elevated temperatures afforded little opportunity to control the extent of the fragmentation.

Acetolysis has been utilized successfully in the controlled depolymerization of acetylated cellulose at about 40°C[18]. During the preparation of needed quantities of acetylated molasses "browning" polymer for such a study, some acetolysis was observed. We wish to report herein some of our findings from the preliminary column chromatography of these acetylated fragments.

EXPERIMENTAL

Acetolysis of the Molasses "Browning" Polymer

Two g of polymer were admixed with a solution of 10 ml of boron trifluoride ethyl ether adduct in 60 ml of acetic anhydride and the polymer dissolved by heating the resulting mixture for 30 min at 85–90°C. The reaction solution was cooled to 30°C and was kept at this temperature for 27 days. This solution was poured then on 300 g of finely crushed ice

[11] DARMOIS: *Compt. rend.*, 1925, **180**, 921.
[12] *J. Chim. Phys.*, 1926, **23**, 130–156, 649–672.
[13] *Compt. rend.*, 1931, **193**, 1182.
[14] *Nature*, 1936, **137**, 275.
[15] *J. Amer. Pharm. Assoc.*, 1955, **44**, 373.
[16] *J. Biol. Chem.*, 1929, **84**, 794.
[17] BINKLEY: *I.S.J.*, 1957, **59**, 64.
[18] DICKEY & WOLFROM: *J. Amer. Chem. Soc.*, 1949, **71**, 825.

and after the resulting mixture had been stirred for about 1 hr, the precipitate became granular. Most of this precipitate settled quickly. The supernatant liquor was decanted and the remaining precipitate, finely divided, was removed by centrifugation. The granular acetylated polymer has been characterized previously[1], yield 2·52 g of product dried at 25–27°C under vacuum with phosphoric anhydride.

Isolation and Column Chromatography of the Molasses "Browning" Polymer Acetolysis Products

The supernatant liquor from the acetolysis of the molasses "browning" polymer was adjusted with 40 g of sodium bicarbonate to pH 4·6. This adjusted solution was extracted with one 50 ml and four 25 ml portions of chloroform. The combined extracts were dried with anhydrous sodium sulphate and the solvent removed at 40°C under reduced pressure to yield 0·58 g of syrup.

An amount of 565 mg of the syrup in 50 ml of benzene was added at the top of a 5·5 cm (dia.) × 23 cm column of 100 g of silicic acid ("Microcel C", Johns-Manville Co., New York, N.Y., U.S.A.), prewet with 50 ml of benzene. The chromatogram was developed with 1 litre of 500/1 benzene/ethanol (v/v) and was operated at 300 mm Hg. The extruded column was streaked with a solution of 1% potassium permanganate in 10% sodium hydroxide. Five zones were detected. The zone locations and yields of recovered material from acetone elution are presented in Table I.

Table I

Column Chromatogram of 565 mg of Acetolysis Products from the Molasses "Browning" Products

Zone	*Zone position in mm from top of column (240 mm in length)*	*Zone yield, mg*	*Nature of zone material*
T	0 — 2	38	Amber-coloured syrup
D	2 — 6	43	Deep golden-coloured syrup
C	6 — 24	67	Golden-coloured syrup
I	30 — 140	86	Interzone, yellow-coloured syrup
B	158 — 195	237	Crystalline α-D-glucopyranose pentaacetate
A	230 — 236	3	Crystalline, mostly inorganic
	Total	474	

α-D-Glucopyranose pentaacetate from Zone B

The crystalline material from Zone B was recrystallized from 2 ml of ethanol (95%); yield 48 mg, melting point 111–112°C. The melting point of these crystals was unchanged on admixture with an authentic specimen of α-D-glucopyranose pentaacetate. The mobility on Whatman No. 1 filter paper of the sugar from the deacetylation of these crystals was identical to that of D-glucose. These data identify the crystalline material from Zone B as α-D-glucopyranose pentaacetate.

Discussion

Subjection of the cane final molasses "browning" polymer to 200 atm of hydrogen at 165–170°C with Raney nickel catalyst yielded D-glucitol and D-mannitol[1] in substantial amounts. The liberation of these hexitols during this depolymerization indicated the probable presence of intact hexose units in this molasses polymer. Our subsequent acetylation studies which revealed the presence of 6 or 7 hydroxyl groups per polymer unit[3] supported these conclusions. The work herein reported is concerned with the simpler acetylated products resulting from the action of anhydride and boron trifluoride on the molasses "browning" polymer. In this instance, the boron trifluoride-acetic anhydride adduct, a typical Lewis acid[2], effected some acetolysis of this polymer under relatively mild conditions, 30 minutes at 85–90°C and then 27 days at 30°C. Column chromatography revealed that this limited depolymerization had yielded a mixture of substances (Table I). α-D-Glucopyranose pentaacetate was found to be the principal product. The presence of intact D-glucose units in cane final molasses "browning" polymer is thus established.

The formula for the repeating unit in this molasses polymer was deduced previously[3] to be $C_{17-18}H_{26-27}O_{10}N$, the probable combination of five-carbon amino-acid residue and two six-carbon units of carbohydrate origin. Intact amino-acid residues were shown to be present in the hydrogenolysis products of this polymer[1]; these residues were *not* detected among the acetolysis products. The sugar units associated with the constituent amino-acid residues appeared to remain intact in the acetylated polymer. The boron trifluoride-acetic anhydride reagent cleaved from the acetylated molasses "browning" polymer some of the constituent D-glucose as α-D-glucopyranose pentaacetate. These hexose units were bound in polymer through relatively simple links.

Summary

Partial acetolysis of the cane final molasses "browning" polymer was achieved with boron trifluoride-acetic anhydride. Column chromatography revealed that α-D-glucopyranose pentaacetate was the principle product of this cleavage. Amino-acids were not detected among the acetolysis products. These results suggest that there is present in this "browning" polymer intact hexose residues which do not appear to be associated directly with constituent amino-acid residues.

[1] BINKLEY: *I.S.J.*, 1958, **60**, 322.
[2] VANDERWERF: "Acids, Bases and the Chemistry of the Covalent Bond" (Reinhold, New York.) 1961.
[3] BINKLEY: *I.S.J.*, 1957, **59**, 178.

Restarting and cutting of pans in a vacuum sugar factory. R. SHYAM. *Indian Sugar*, 1962, **12,** 11–12.—Disturbances to the vacuum system are caused by using the valves to the vapour line and vacuum breaker valves for bringing a discharged pan into use again and cutting a pan (transferring grain from one pan to another as a footing). It was attempted unsuccessfully to evacuate the pan before reconnexion to the vacuum line by using a mechanical pump (which was of too small capacity) and with a steam ejector (which took 15 min to reach working vacuum). When the valve to the exhaust steam used for washing the discharged pan was opened instead of the vacuum breaker when cutting a pan, the massecuite transferred as readily to the second pan but vacuum was quickly restored with little disturbance to the system or other pans. A similar techanique was used when the pan was discharged; this also brought the pan into use again quickly with little vacuum disturbance and only used a small amount of exhaust steam.

* * *

A sugarcane carrier control system. S. J. LEVET. *Sugar J.* (La.), 1962, **25,** (2), 16–18.—In the system described a D.C. generator is connected to the steam turbine driving the cane knives and develops a voltage proportional to the knife shaft speed. This voltage actuates the two relays which respectively control fast-running and slow-running solenoid valves in the steam supply to the engine driving the cane carrier. The fast-running valve operates when the knife speed is its normal 600 r.p.m. and down to 500 r.p.m. The slow-running valve operates between 500 and 400 r.p.m. A second control on the solenoid valves, in series with the first, is exercised by current relays controlled from the current passing through the motor driving the shredder, while a third control, also in series, is in the form of a "feeler" plate in the chute across the crusher which measures the thickness of the cane blanket and moves within limit switches to control the carrier engine. If any one of the three points is overloaded the carrier is automatically slowed or stopped, the state of the control system being indicated by coloured lights on an operating panel. The system has indicated trouble (through a broken turbine governor) which would not otherwise have been foreseen, and its response to overloads is very much faster than that of the former manual control.

* * *

A case for plate and frame type of press. R. D. JOSHI, G. V. SIDDHAYE and M. N. GOKHALE. *Sugar J.* (La.), 1962, (2), 19–25.—An account is given of the authors' factory—a double sulphitation plant in which mud losses are low, labour is cheap and the replacement cost of bagacillo (as filter-aid for a rotary vacuum filter) is high. It is shown that under such conditions it is not economical to replace the presses by a continuous filter.

* * *

The "EimcoBelt" and cane mud. ANON. *Sugar J.* (La.), 1962, **25,** (2), 25–27.—An account is given of the operation and advantages of the "EimcoBelt" filter which is now in operation in Louisiana, Puerto Rico, Mexico, Colombia, Guadeloupe and India. The clarifier must be operated to produce a thick mud, by addition of a flocculant such as "Separan AP-30" to the juice. One 12 ft × 10 ft dia. filter has handled all the mud from a factory crushing up to 4090 tons of cane per day (average 3500 tons). Polypropylene cloth is used; it gives a clear filtrate and lasts longer than 3 months (it is expected to average more than 6 months).

* * *

Recent advances in sugar technology in India. S. N. G. RAO. *Indian Sugar*, 1962, **12,** 83–85.—A review is made of technical papers published recently in *Indian Sugar* and the *Proceedings of the Sugar Technologists' Association of India.*

* * *

Defecation melt-carbonatation process for the manufacture of superior quality sugar at lower cost. B. B. GAIROLA. *Indian Sugar*, 1962, **12,** 87–96.—The process involves the production of three raw massecuites, the *C*-sugar from which is used as a footing for *A*- and *B*-raws which are either bagged for sale or affined and remelted in sweet water (filter-cake washings). The 65°Bx melt is limed (1%CaO on sugar) and carbonatated at 80°C to pH 8·2, filtered, sulphited to pH 6·8–7, heated, filtered and three refinery crops boiled from it. The third refinery run-off is added to the raw cane syrup. Details are presented of individual stages and purities and quantities calculated as well as certain of the economics concerned.

* * *

Operating of lime kilns. M. SINGH. *Indian Sugar*, 1962, **12,** 97–101.—The process of lime burning is described and the factors affecting kiln operation are discussed (ratio of limestone to coke, quality and particle size of limestone and coke, draught, charging and withdrawal, kiln design and insulation, and gas washing). Difficulties which occur are discussed and a number of recommendations made for examination of the kiln with points to check in operation.

Control of the charging operation in the centrifuging of sugar massecuites. K. A. BORTNOVSKII. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1962, (1), 98–100; through *S.I.A.*, 1962, **24,** Abs. 463.—The basic equation giving the angular velocity ω (rev/sec) at any time t (sec) after the beginning of charging is as follows:

$$\omega = \frac{(I_o\,\omega_o + M_d'.\,t)\,t_1}{I_o t_1 + I_y\,.\,t}$$

where I_o is the moment of inertia of the empty centrifuge (kg/m/sec²), I_y is the moment of inertia of the massecuite layer forming a uniform ring, ω_o is the angular velocity at the beginning of charging, t_1 is the duration of charging, and M_d' is the torque of the motor minus the frictional torque of the bearings (kg/m). Values of ω_o and ω_k (angular velocity at the end of charging, found for $t = t_1$) are determined by the rate at which the massecuite flows from the outlet of the mingler. Further equations for t_1 are presented in terms of temperature, Brix, massecuite head, etc. The required motor torque may then be calculated; in the case of very viscous massecuites, the torque must be kept at a low value.

* * *

Sulphitation: theory and methods of continuous operation in Indonesia. T. H. LIEM. *Balai Penjelidikan Perusahaan[2] Gula. Warta Bulanan.* (Rpt. Java Sugar Ind. Exp. Sta.), 1962, (2), 37–57.—The theory of cane juice sulphitation and defecation is outlined and three systems of continuous sulphitation used in Indonesia are described. The first uses a sulphitation tank with an external circulation pump for re-circulating part of the sulphited juice, bringing the pH of the raw juice to 9. In the second, the raw juice is split into two parts; 10% goes to a saccharate tank where it is mixed with lime and used for liming; the remaining 90% portion is heated to 75°C and sent to pre-liming, and just prior to entering a sulphitation tank in which the juice is circulated by means of a curved baffle, milk-of-lime is added to bring the pH to the required value. The third system is the same as the second except that calcium saccharate is used for both pre- and main liming. Calculations are given for the curved baffle and for the tanks, as well as for juice and milk-of-lime proportioning valves. Results from the 1957 campaign are tabulated for each method of sulphitation showing the raw juice purity, juice lime salts contents, A and B massecuite purities and the colour of the white sugar. The third method gave a lower lime salts content and a lighter white sugar. The raw juice purities were not, however, identical.

* * *

Process losses in refining. E. SCHULZE. *Zuckererzeugung*, 1962, **6,** 198–201.—The work previously discussed[1] has been extended and an attempt is made to explain the causes of sugar losses in beet sugar processing. The theoretical "ash rendement" is considered completely inadequate for calculation of yield and sugar losses; formulae based on the total non-sugars in the raw sugar feed are better then those based on the ash content, but differences between calculated and true white sugar yields still fluctuate too widely. The most suitable formula for calculation of the quantities of sugar and molasses from a given raw sugar before processing is that of SCHNEIDER[2] modified to include empirical corrections for raw sugar and molasses pol and for the change in the non-sugars content during processing. Values given by the formula agree closely with determined white sugar and molasses yields.

* * *

Cane payment in Mauritius. S. STAUB. *Sugar J.* (La.), 1962, **25,** (3), 22, 24.—An account is given of the operations of the Mauritius Sugar Cane Millers and Planters Central Arbitration Board which regulates the relations between the cane growers and millers. The Board defines the supply areas for each factory, determines the price to be paid for the cane, controls planting and propagation of varieties, controls weighing of cane at delivery points, calculates the cost of cane production and sugar manufacture, fixes the rate for claiming cane transport costs, etc.

* * *

Effective working of a multiple effect in sugar cane factories. T. S. RAO. *Indian Sugar*, 1962, **12**, 175–177. Factors affecting evaporator operation are listed and briefly discussed.

* * *

Some experience in the processing of cane raw sugar. J. GEBLER and B. HOJDEM. *Listy Cukr.*, 1962, **78,** 175–179.—Problems encountered in the refining of raw cane sugar are discussed. The effect of atmospheric humidity on the caking of raw sugar in transit was established and formulae and a nomogram are presented for determination of the storage properties of the raw sugar. Various methods of continuous carbonatation, including defeco-saturation, for the raw sugar melt are discussed. The processing of white and yellow sugar massecuites is described.

* * *

Drying and cooling crystal sugar. O. BÖHM. *Listy Cukr.*, 1962, **78,** 183–187.—The fundamentals of sugar drying are outlined and the heat requirements for a given dried sugar throughput are calculated. The effect of the dried substances on the drying process, direct- and counter-flow drying and automatic control of drying and cooling are also discussed.

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Steam economy. C. G. M. PERK. *Sugar Milling Res. Inst. Bull.*, 1962, (23), 21–28.—See *I.S.J.*, 1963, **65,** 20.

* * *

Better sugar by remelting. A. VAN HENGEL. *Sugar Milling Res. Inst. Bull.*, 1962, (23), 28–34.—See *I.S.J.*, 1963, **65,** 20.

[1] *I.S.J.*, 1962, **64,** 176.
[2] O. WOHRYZEK: "Chemie der Zuckerindustrie". 2nd Edn. 1928. p. 480.

BEET FACTORY NOTES

Determination of optimum conditions for thin juice sulphitation. Z. NITSCHKE. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Laboratory and factory experiments showed that decolorization of juice increased with the amount of SO_2 used and depended on the composition of the non-sugars. Best decolorization and scale protection was attained by saturating juice first with CO_2 and then with SO_2. Sulphitation in the presence of carbonatation mud gives the best decolorization but the thin juice then contains more lime salts and causes more scaling. Colour formation during evaporation was minimized.

* * *

The return of press water to a tower diffuser. A. A. LIPETS and I. M. LITVAK. *Sakhar. Prom.*, 1962, (7), 18–21.—Details are given of the scheme for purification of press water at Salivonkovsk sugar factory before return to the tower diffusers. It was found that mechanical cleaning by the pulp trap is highly efficient (95·2%), the smaller impurities remaining in the water being removed in the settling tank. It is estimated that 1 litre of unpurified water contains 38 g of moist pulp. It was found that pH (6·2–7·4) and sugar content of the press water do not alter during the complete 20 minutes' journey from the presses to the diffusers; this fact is attributed to the heating of the water to 80°C immediately after the pulp trap and to the formalin which is added to the water. There is very little foaming owing to the close proximity of the presses and purification equipment to the diffusers. By pressing the pulp to about 15% dry solids, the sugar losses in diffusion were reduced from about 0·5% to 0·2% on weight of beet. Graphs are drawn of the actual diffusion process with and without press water return; these indicate that press water recycling has no effect on the dynamics of sugar extraction. Gravity flow is recommended for this scheme.

* * *

Results of tests on new beet unloading-piling machines. V. A. NOVIKOV and N. M. KICHIGIN. *Sakhar. Prom.*, 1962, (7), 28–34.—Details and illustrations are given of the machines, five of Soviet origin, and one, the "Silver" (manufactured by UCMAS) of Belgian manufacture. Detailed information is given in tabulated form on the results of tests and recommendations are offered.

* * *

Automatic level control at the evaporator station. E. S. ZAKREVSKII. *Sakhar. Prom.*, 1962, (7), 35–39.—Automatic level control for evaporators is discussed generally and with respect to various types of automatic control equipment used in Soviet factories. Details are given of a special electro-pneumatic primary element for juice level and density measurements. A diagram is given of a complete scheme for evaporator level control using this element combined with other electronic devices. In tests, maximum level fluctuations have been 30–80 mm, with a sensitivity of the primary element of 8–10 mm w.g.

* * *

Determination of lime particle size. N. I. GRIZODUBOV and Z. A. MIL'KOVA. *Sakhar. Prom.*, 1962, (7), 40–43.—Details are given of a device for determination of lime dust grist size, the action of which is based on the relationship between the permeability of a layer of dust to air and its dispersion. It will give readings accurate to 0·1 mm. It is considered more reliable, more rapid and cheaper than any other method such as sieve analysis, and is particularly useful for calcium saccharate preparation.

* * *

From experience with Olier diffusers. M. A. KRASNOKUTSKII and V. S. BEVZUSHENKO. *Sakhar. Prom.*, 1962, (7), 45–49.—Some information is given on various alterations made to the Olier diffusers installed at Kamenets-Podol'sk sugar factory. The major alterations concern the juice lines to the raw juice tanks and to the line carrying condensate for washing of the screens. Because of certain difficulties during the 1961/62 campaign, the performance data for the diffusers are not considered representative and therefore these are not given.

* * *

Improving 1st carbonatation juice filtration. V. E. PAVLOVSKII. *Sakhar. Prom.*, 1962, (7), 51–52.—Filtration and clarification difficulties caused by pectins in raw juice were overcome by returning 1st carbonatation juice from the second of the 2 carbonatation vessels (250% on weight of beet) to pre-defecation. In the first vessel, the juice is brought to almost standard alkalinity, then is transferred from the top of the vessel to the 2nd vessel, where it is brought to the required final alkalinity. That juice not re-cycled to preliming is sent to the clarifier.

* * *

Chemical scale removal from juice heaters. V. S. TKACHENKO. *Sakhar. Prom.*, 1962, (7), 54–55.—Scale in 2nd carbonatation juice heaters is removed by means of a 10% solution of sodium carbonate in ammoniacal water. Hydrochloric acid (2·5—3·0%) is then pumped into the heater, the total cleaning time with water flushing being 21–23 hr. The solutions are made up in a special tank.

* * *

Examination of hydrostatic settling. A. ZÁDORI. *Cukoripar*, 1962, **15**, 171–172.—The significance of the difference in levels between the settling tank and vacuum filters is discussed mathematically with a view to automatic control of juice settling. It is concluded that reducing the level difference would be advantageous.

Plastic coating for corrosion protection in the sugar factory. I. PAULIK. *Cukoripar*, 1962, **15**, 174–178.—Tests carried out on coating of various pieces of beet factory equipment (screw conveyors, beet elevators, condensers, filters, etc.) with polyvinyl chloride (PVC) and epoxy resins have shown that in some cases they were ineffective and in others highly successful. The most suitable are the epoxy resins. Emphasis is laid on thorough preparation of the surface and good pre-coating.

* * *

The ideal sugar factory. F. TESCHNER. *Zuckererzeugung*, 1962, **6**, 166–171.—The author gives his own views on the contruction and operations of an ideal sugar factory, based on his evaluation of processes and equipment introduced in recent years and in the light of East German experiences. Fifty references are given to the literature.

* * *

The processing of mechanically-harvested beet. W. STRUBE. *Zuckererzeugung*, 1962, **6**, 172–173.—Analysis of samples taken during the experimental processing of beet lifted with a beet harvester have shown that the thin and thick juice properties are inferior to those of juices from non-mechanically lifted beet, resulting in higher molasses sugar contents. Further clarification tests are advocated.

* * *

Improving second carbonatation. S. SATKIEWICZ. *Gaz. Gukr.*, 1962, **64**, 211.—To prevent blockage in pipelines, valves and pumps caused by 2nd carbonatation muds and difficulties created by $CaCO_3$ crystallizing out on filter cloths, a conical-bottomed tank was installed after the 2nd carbonatation vessel. Carbonatation was prolonged for several minutes, when the juice was fed to the tank and further crystallization of the $CaCO_3$ allowed to take place. At the end of the campaign, a 15–20 mm layer of muds was found in the conical section of the tank, and maximum sediment in the pumps was 3 mm.

* * *

Cleaning out evaporators and pre-heaters by a closed circuit method. E. MALANOWSKI. *Gaz. Cukr.*, 1962, **64**, 211–212.—Details are given of a scheme for evaporator and juice heater cleaning with sodium carbonate and HCl solutions.

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Some considerations on the construction and performance of continuous diffusers. A. S. EPISHIN. *Sakhar Prom.*, 1962, (8), 10–15.—Various factors in the design and performance of continuous diffusers are considered on the basis of factory experience and some recommendations are offered. As regards contact between juice and cossettes, the author considers that rotary diffusers cannot rightly be termed continuous, since unless the diffuser is completely filled with a juice-cossette mixture, the cossettes will not always be in contact with the juice as the drum is rotated. Since the diffuser is divided into sections, in each of which the juice is simply mixed with the cossettes, the process cannot be referred to as one of continuous counter-flow. Only by increasing the length of the diffuser (by more than 100% compared with tower diffusers) can the absence of continuous contact be compensated, when the retention time in a rotary diffuser becomes much greater than in a tower diffuser. Thus, while rotary diffusers may be considered continuous as regards cossette-charging and discharging, they are discontinuous or "cyclic-continuous" as regards the diffusion process itself. The above also applies to the De Smet type of diffuser. It is considered that spraying, no matter how intensive, cannot replace continuous counter-flow, since there will be a period, albeit brief, during which the cossettes are not in contact with the juice. Also, only one side of the cossette is washed by the juice while on the conveyor; this may be compensated by raising the temperature, length of diffuser and retention time. Tower diffusers and the DdS type, which may be regarded as true continuous diffusers, give a better quality juice and require shorter retention times. Data from TsINS and the British Sugar Corporation confirm that the purity of tower juice is somewhat higher. Results from Vic-sur-Aisne show that juice from the De Smet diffuser has a high colloid, pectin and total N content. The practice of pre-scalding of cossettes in re-cycled raw juice is criticized because of resultant drops in juice purity and sucrose degradation. Scalding of the cossettes in the diffuser itself by means of steam jackets without return of juice is considered to be one of the main advantages of the DdS diffuser. Even with tower diffusers, the retention time of 70 min is considered too long, and should be reduced to a maximum of 60 min. Forced feeding of cossettes within the diffuser, while the only suitable method, is criticized for the consequent crushing of the cossettes and because any conveyor system automatically complicates diffuser construction. Gravity feed has been found to be unreliable in a number of Soviet-designed diffusers, since the difference between the cossette and juice densities, particularly at an initial dry solids of 8–9%, is too small and foam bubbles surrounding the cossette make it float. Also, blockages occur where the floating cossettes pass below the retention screens, as in the S. F. Zhigalov diffuser. To avoid crushing, the cossettes should be thin, as in one British Sugar Corporation factory where extraction from cossettes 27–30 m/100 g long has resulted in 0·14–0·17% losses at 117–119% draught. Too high a temperature and consequent pulping of the cossettes is suggested as the main reason for reluctance to use thin cossettes in continuous diffusers, with crushing caused by the conveyor system as a secondary reason. Thorough mixing of the cossettes and juice throughout the diffuser intensifies sugar extraction and is endorsed, in contrast to the flow pattern in batteries or the Olier diffuser. Mathematical treatment of diffusion theory is considered to have no real value, because of the differences between the diffuser designs. Feeding at the bottom of a tower diffuser is better than at the top. Aeration of cossettes with resultant bacterial infection can be avoided by using high temperatures and disinfectants.

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The quality of raw juice with return of pulp press water to diffusion. I. M. LITVAK and A. A. LIPETS. *Sakhar. Prom.*, 1962, (8), 16–18.—Results of tests at Salivonkovsk sugar factory are discussed. The pectin content of the tower diffusion juice was found to be 0·39% per 100 parts of beet on average compared with 0·35% with and without press water return, respectively. The pH of the water used for diffusion should be adjusted to 6·0–6·5, since at 8·2–9·0 it was found to have a deleterious effect on diffusion and pulp pressing. The reducing sugars content of the press water was so small as to have no real effect on the raw juice quality. The purity of the 2nd carbonatation juice and of the syrup obtained from it was 0·5–0·6 units higher when press water was not returned, while the respective colours were 1·6 and 4·4°St lower. Carbonate ash and lime salts contents were almost identical with and without return. No difficulties were encountered in carbonatation, filtration or boiling of the products obtained from raw juice when press water was returned.

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Condenser water usage for diffusion. V. A. KOLESNIKOV. *Sakhar. Prom.*, 1962, (8), 23–25.—A formula is presented for calculation of the amount of condenser water to be fed to a diffuser, given the current throughput of the diffuser and the juice draught. This may be used to check the automatic controls or for manual control should the former fail. Tabulated figures calculated with the formula are given for handy reference.

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Notes on beet sugar production practices and economics. A. P. PONOMARENKO. *Sakhar. Prom.*, 1962, (8), 29–36.—An appraisal is given of the economics and efficiency of beet processing over 9 years at Lokhvitsa sugar factory. A number of recommendations are offered on methods of statistical planning, administration and chemical control.

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Experience in storage and processing of beet harvested without preliminary manual cleaning. M. Z. KHELEMSKII and B. I. KRASNOKUTSKII. *Sakhar. Prom.*, 1962, (8), 49–53.—Observations over the last 4 years have shown that beet not manually cleaned after lifting may be processed provided that the maximum leaf and dirt contents are respectively 2% and 10% on weight of beet and provided adequate equipment is available to remove the excess dirt in the factory. Storage in tall, force-ventilated piles adequately protected is as with normal beet.

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Results from processing of beet harvested by continuous methods. K. N. MUSOLIN. *Sakhar. From.*, 1962, (8), 53–58.—Tests on beet gathered continuously (the adhering soil not being removed by hand) are discussed. The results coincide with those given in the previous abstract. It is also mentioned that difficulties in processing of the beet products may be overcome by shortening the storage period.

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New device improves cleaning of beets. A. ARMER. *Sugar y Azúcar*, 1962, **57**, (8), 32.—An account is given of the development of screening devices for removal of dirt and trash from mechanically harvested beets, leading to the author's present "Nip-Roll" screen. In this, the first and third of a series of rolls inclined with an adjustable slope are fitted with double-lead helical flights and subsequent odd-numbered rolls with alternate right- and left-hand single-lead flights. The even numbered rolls are all smooth and rotate at a quarter of the speed of and in the opposite direction to the rolls with flights. Spacing between rolls is adjustable and rubber-mounted shaft bearings are fitted. The screen is self-cleaning and has a performance better than other existing screens. Beet damage loss varies from 0·25 to 1·0% on clean beet.

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Industrial electronic weighing and its application in the sugar factory. M. BONY. *Sucr. Franç.*, 1962, **103**, 489–494.—The static and dynamic (band) weighing of materials electronically by use of strain gauges, etc., is described and illustrated. Applications in the sugar industry include the weighing of beets in hoppers and of cossettes in transit to the diffusers; the simplicity of using the band weigher signal for control of the beet knives is discussed.

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Comparison of sugar diffusers. K. ADAMIK and H. MAYER. *Chem. Ing. Tech.*, 1962, **34**, 218–221; through *S.I.A.*, 1962, **24**, Abs. 429.—The industrial performances of a diffusion battery, a Paaschen "Rapid Extractor," an Olier diffuser, a BMA tower and two Buckau tower diffusers were compared from the point of view of total diffusion time T and cossette attrition α. The latter was defined as the ratio of mean cossette lengths before and after diffusion. Some results are shown in graphs and tables. Dubourg's equation has been modified to agree more closely with the actual course of diffusion by introducing terms (in accordance with Fick's 2nd law) for diffusion time T (hr) and hydraulic diameter d_h (mm) of cossettes, as follows:

$$ln\left(\frac{mx + nT/d_h}{mx_o + nT/d_h}\right) = -\alpha.m.l$$

where l = distance of a given point from the head of the diffuser, x_o, x = sugar content of cossettes at entry and at the given point respectively, $m = (A-1)/A$, $n = x_n/A$, x_n = sugar content of exhausted cossettes, and A = draw-off ratio. It is pointed out that an initial "burst" of sugar into the fresh water takes place at the tail of the diffuser, analogous to the initial phase of heat transfer. Sugar transfer and heat transfer between cossettes and solution were shown to proceed in a similar manner, but at different absolute rates. The Buckau tower enables diffusion to be carried out more rapidly than in the BMA tower, but the latter can be used with thinner cossettes.

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Control of carbonatation in the baryta separation of sugar. L. G. KALINENKO and I. M. LITVAK. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1962, (1), 134–137; through *S.I.A.*, 1962, **24**, Abs. 437.—The residual barium in the filtrate obtained after carbonatation of a barium saccharate suspension is normally removed by precipitation with an equivalent amount of ammonium sulphate. Flame photometry is recommended as an accurate and rapid control method for determining the residual barium. The operation of a flame photometer is described. Comparative determinations of the barium content of sugar juices by flame photometry and by acidimetric titration showed that there was no systematic difference between the two methods and that the photometric method was more accurate. After treatment with sulphate, the filtrate contained 0·2% of dissolved $BaSO_4$ on dry solids; this amount, which is below the toxic level, is still greater than its solubility in water, owing to the presence of sucrose.

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Chlorination of barometric water cooled in overflow ponds at Michałów sugar factory. S. GODWOD and T. PIETRZYKOWSKI. *Prace Inst. Lab. Badawczych Przemyslu Spozywczego*, 1961, **11**, (4), 1–13; through *S.I.A.*, 1962, **24**, Abs. 462.—The water is cooled in six shallow rectangular tanks connected in series, of which the first and last are more extensive than the remainder. Before the chlorination, the bacterial count of the cooled water was over 1,000,000 per ml. Trials were carried out in which chlorine was added to water passing from the fourth to the fifth tank at an average rate of 5·7, 7·3 or 9·4 mg of Cl_2 per litre. The characteristics of the water at different points in the system are tabulated. The counts were reduced to 1000–3000/ml, but complete control was not effected owing to mixing with "dead water" in the large tanks. It was therefore decided to introduce one or two dykes across the direction of flow in the large tanks and to move the chlorination point to the outlet of the first tank.

A flow diagram showing the system of water circulation through the whole factory is reproduced. The amount of water passing through the cooling tanks was 600% on beet. It was recommended that the amount should be reduced to 400% with consequent savings in Cl_2, since it was shown that the total quantity of water in circulation was excessive.

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100 years of Robert diffusion. W. VON PROSKOWETZ. *Zucker*, 1962, **15**, 401–403.—A brief outline is given of the early development of the diffuser invented by JULIUS ROBERT.

Afterproduct boiling with calcium acetate. O. TISZAVARY and G. VAVRINECZ. *Cukoripar*, 1962, **15**, 196–201.—To overcome difficulties in the boiling of after-product massecuites, particularly when the beet quality is low or shutdowns occur, a small quantity of Ca acetate is added to the pan in order to reduce viscosity. This causes a considerable increase in the crystallization rate, the cooling period in the mixers is shortened, molasses purity is reduced and the curing time is cut, resulting in a higher quality yellow sugar. Tabulated data are given.

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A milk-of-lime feeding device for the sugar industry. T. ZÁGON. *Cukoripar*, 1962, **15**, 218–222.—A milk-of-lime feeder designed at the Hungarian Sugar Industry Research Institute is described and illustrated. It consists basically of a drum rotating at constant speed in the milk-of-lime tank; scoops on the inside circumference of the drum take up the lime and direct it to a proportioning baffle located on the central shaft. This directs some of the lime into a trough from which it passes to defecation, while the remainder is returned to the bottom of the drum. The proportioning of the lime is controlled by the angle of the baffle which in turn is dependent on the raw juice flow. The device is provided with signal lamps. No maintenance is necessary.

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Anomalies in discontinuous pressure filtration of beet juice. M. BOLEK. *Listy Cukr.*, 1962, **78**, 145–147.—The theory of pressure filtration is outlined mathematically and the dependence of the volume of filtrate on time of filtration is discussed. Observations were carried out at a sugar factory equipped with six filter-presses; a graph is presented of dt/dV *vs.* volume of filtrate, where dV = the volume of filtrate flowing in time dt. It is shown that filtration can be divided into three distinct stages and that the 1st and 3rd of these are contrary to the filtration theory. In the first step, the value of dt/dV falls to a minimum as the resistance of the filter-cloth decreases, permitting a lengthy filtration cycle. In the second stage there is a gradual rise in dt/dV, while in the third stage there is a sharp climb in the value of dt/dV (an almost vertical line on the graph) and the filtration rate falls.

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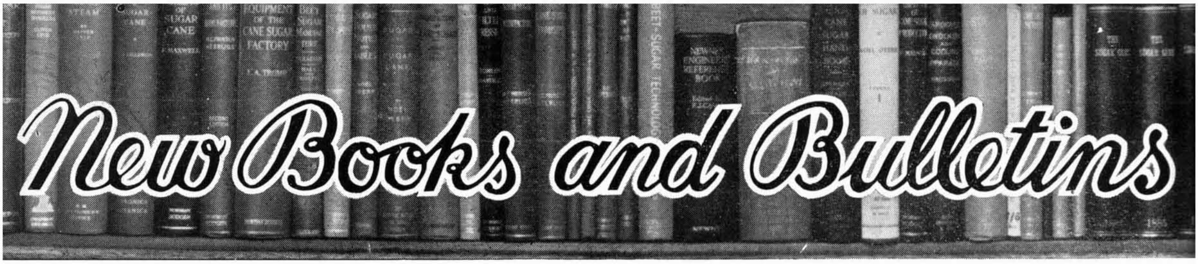
Calculation of the products of combined processing of raw (cane) sugar and beet in a factory with a refining section. I. F. ZELIKMAN. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1962, (2), 93–97; through *S.I.A.*, 1962, **24**, Abs. 523.—The quantities of products and materials in process are calculated (as percentages on beet) for the more complex case of a beet factory which boils two additional refined sugar massecuites from the 1st product massecuite sugar, and returns the run-off from the second refined massecuite to the 1st product massecuite together with affined raw sugar melt liquor. The calculations relate to the product house only, and the materials balance within the refining section is not considered.



The technological value of the sugar beet.—Proceedings of the XIth Session of the C.I.T.S. 319 pp.; $6\frac{1}{2} \times 9\frac{1}{2}$ in. (Commission Internationale Technique de Sucrerie, 1 rue Aendoren, Tirlemont, Belgium.) 1962. Price: 500 Belgian francs.

The XIth Session of the C.I.T.S. was held at Frankfurt on the 13th and 14th September 1960. It was devoted to the general topic "The technological value of the sugar beet" and various aspects of this were presented in the 18 papers read. It becomes apparent how not only the sugar content and yield per acre are concerned, since beet size, shape and skin thickness are among the other factors contributing to the "technological value".

The papers are published in the language in which they were read—English, French or German—as are the questions and answers of the discussions. The closing speech of the late Dr. J. DEDEK is presented and also a toast offered by M. J. PAUL, President of the Commission, besides a summary by Dr. A. Carruthers of the discussion which took place at the meeting of the C.I.T.S. Scientific Committee in Brussels in February 1961. An index is also provided.

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Structural Carbohydrate Chemistry. 2nd Edition. E. G. V. PERCIVAL, revised by ELIZABETH PERCIVAL. 360 pp; $5\frac{1}{2} \times 8\frac{3}{8}$ in. (J. Garnet Miller Ltd., 13 Tottenham St., London W.1.) 1962. Price: 40s. 0d.

This book, and the original 1950 edition[1], have been prepared especially for students of chemistry and for those starting research in the carbohydrate field. It nevertheless contains much material of interest to those sugar chemists concerned with the basic chemistry of the sugars involved in the processing of cane and beet. As before the principal emphasis is on the derivation of structure of mono-, di- and poly-saccharides as well as uronic acids, polyuronides, natural glycosides, polyols and ascorbic acid. Original material published as recently as 1960 has been included, and the modernity of the treatment is thus beyond question. The illustrations are clear and ample, and full and satisfactory indexes to authors and subjects are included.

New material has been added throughout the book, but certain fields in which great strides have been made during the past twelve years have had to be rewritten entirely, or new chapters added, for instance in the account of the raffinose family, nitrogen glycosides, etc., the text being increased by 109 pages in consequence.

Die Zuckerwirtschaft in Belgien, Frankreich, Italien und den Niederlanden 1961/62. (The Sugar Economy in Belgium, France, Italy and the Netherlands.) P. MEIMBERG and W. SCHUBERT. 155 pp.; $5\frac{3}{4} \times 8\frac{1}{4}$ in. (Verlag Dr. Albert Bartens, Berlin 38-Nikolassee, Lückhoffstr. 16, Germany.) 1962. Price: 12.-- DM.

This is a further volume in the series of paper-backed reports produced by the Marktforschungsstelle Zucker, Bonn, and is devoted to an examination of the sugar economies of each of the four countries mentioned in the title. An introductory section includes an analysis of European beet agriculture and sugar production and its position relative to the world market. The other structural elements in a European sugar economy (sugar consumption and supply, and market regulations) are also considered. For each of the four countries the authors give data on beet agriculture, the pattern of the sugar industry, sugar production and consumption, and beet sugar prices. Eighty tables and seven graphs are presented plus a short bibliography with a few explanatory notes on raw sugar conversion and exchange rates.

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Zuckerrüben-Lagerung. (Sugar beet storage.) S. VAJNA. 271 pp.; $6\frac{1}{4} \times 9\frac{1}{4}$ in. (Verlag Dr. Albert Bartens, Berlin 38-Nikolassee, Lückhoffstr. 16, Germany.) 1962. Price: 44.-- DM.

While numerous articles have appeared in some of the world's sugar journals on the subject of beet storage, this is the first book to deal with the subject in any detail. The eleven chapters cover: general notes (optimum start and finish of campaigns, and the aims, development and importance of beet storage); the properties of lifted beet; the behaviour of beet during storage; quantitative measurement of losses in storage; control of the storage temperature by ventilation; theory of ventilation (natural and forced) with mention of the equipment required for forced ventilation and the power consumption of fans; long-term storage (choice of method, protection, site preparation, etc.); short-term storage; storage control (temperature measurements, tarehouse organization, storage tests); special methods suitable for beet storage (freezing, drying, etc.); and finally the conveying, transporting and piling of beet. Summaries of the 11 chapters are given in French and English at the end of the book. A bibliography containing 619 references is given together with an author and subject index.

[1] *I.S.J.*, 1950, **52**, 281.

LABORATORY METHODS AND CHEMICAL REPORTS

Provisional standards for Barbados bulk storage sugars. SIR JOHN SAINT. *Proc. B.W.I. Sugar Tech.*, 1960, 228–233.—The major factors affecting the handling properties and keeping qualities of raw sugar stored in bulk are discussed and the following standards proposed for Barbados where a bulk sugar store of 80,000 tons capacity was brought into use in 1961: minimum Mean Aperture of 0·7 mm; maximum Dilution Indicator of 40 with penalties imposed on sugar of 40–50 D.I. and none accepted with a D.I. higher than 50; maximum temperature of incoming sugar 110°F; maximum content of insoluble substances in sugar 70 mg/100 g sugar.

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Auto-inversion of sucrose and its technical importance. S. Z. IVANOV. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The kinetics of sucrose decomposition in homogeneous and heterogeneous systems containing water and sucrose have been studied at temperatures of 70–120°C and at various pH values. The decomposition is autocatalytic, the catalyst being the acid products of decomposition. Sucrose decomposition in sugar factory products is also autocatalytic but the presence of buffer substances extends the induction period of the reaction. In the refinery buffering is less and the autoinversion has only a short induction period before passing to the second stage: that of rapid decomposition.

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Application of electrical conductivity control to the crystallization process. P. HONIG. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Crystallization control consists in checking the degree of supersaturation of the mother syrup. Conductivity control can be used to prevent undersaturation and excessive supersaturation and is simple, reliable, economical and easily applied in sugar factories and refineries. The principle of the method, the essential parts of a control instrument, and factors affecting its reading are described. The complicated theoretical relationship between conductivity, purity, non-sugar composition, crystal content and supersaturation of the massecuite is considered.

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Colloid content during raw sugar refining. S. SZYBALSKI and P. FILAR. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—The colloid contents of various production stages during a five-boiling refining scheme for raw cane sugar and a standard refining scheme for raw beet sugar were determined by alcoholic precipitation at pH 4·5. The colloid content of melted raw beet sugars was 1·0 to 1·4% on dry substance, while the corresponding figure for raw cane sugars was 1·3–1·8%. Cane refinery molasses contained 6–15% of colloids while beet refinery molasses contained 4% of colloids.

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Viscosity of mother syrups and massecuites. W. DREWNOWSKA. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Measurements of viscosity using a Brookfield HF viscometer were made with seven samples of final molasses and with corresponding massecuites and mother syrups. Attempts were made to correlate the results with the analyses (R.D.S., sucrose, apparent purity, ash, lime salts and crystal content). It was concluded that in the case of Polish molasses the viscosity range is very wide (7–188 poises at 40°C) and cannot be correlated with the analytical data. The proportion between massecuite viscosity and the viscosity of the mother syrup was found to be approximately constant but its value depended on whether it was a 1st, 2nd or 3rd boiling. The higher the crystal content of a massecuite, the greater was its apparent viscosity.

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Colour standard series for white and raw sugars evaluation. W. STRUBE. *Paper presented to the 1st Int. Conf. Chemistry and Technology of Sugar* (Lodz, Poland), 1962.—Apart from polarization, moisture and ash content, several other criteria are used for evaluation of white sugar quality. Although visual evaluation can lead to errors, the Halle Institute series of colour standards has been used successfully and corresponds in high degree to the way the housewife evaluates the sugar. Preparation of the standards consists mainly in matching the components empirically. The relation between the dyes used, the sort of sugar and the colour of the resulting standard is very loose. In the course of investigations, the exact position of each standard in the series was checked by means of remittancy measurement with a leucometer at 614, 522 and 459 mμ. An attempt was also made to define the standards by computing their trichromatic coordinates. A new series of white sugar standards is to be introduced as an extension of the 1954 series for high-quality sugar; the 1954 series will continue to be used for evaluation of raw sugar after affination under standardized conditions.

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Variability of sugar beet constituents as influenced by year, location, variety and nitrogen fertilization. D. R. MCALLISTER, R. L. HURST, D. H. WOOLLEY, H. M. NIELSEN, L. E. OLSON, D. A. GREENWOOD, H. M. LEBARON and W. H. BENNETT. *J. Amer. Soc. Sugar Beet Tech.*, 1961, **11**, 547–564.—Beets grown over three years in Utah and one year each in California and Michigan were cleaned, weighed, measured and analysed for glutamate, amino-nitrogen, total nitrogen, malic acid, oxalic acid, anionic constituents, galactinol, raffinose, marc and sucrose. Statistical analysis of the data showed negative correlations between sucrose and the other constituents except galactinol and marc. Sucrose was the only constituent consistently changed (downward) by increased N fertilization. Glutamate was the most variable constituent and sucrose the least. Varietal differences were inconsistent and not great.

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Effects of Beet Western and Beet Yellows viruses on amino acids in sugar beets. J. E. DUFFUS and J. M. FIFE. *J. Amer. Soc. Sugar Beet Tech.*, 1962, **11**, 629–631.—Paper chromatography was applied to the examination of amino-acid concentrations in leaves from beets affected by the two diseases. Both reduced aspartic acid and glutamic acid concentrations equally, while they increased the concentrations of citrulline plus alanine, the beet yellows virus having the greater effect. When both viruses were present the reducing and increasing effects, respectively, were enhanced.

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Measurement and control with isotopes in the sugar industry. A. SCHLECHT. *Zucker*, 1962, **15**, 374–380. The fundamentals of the radiation energy concept are discussed followed by the various applications of radio-isotopes, in particular radio-caesium (^{137}Cs) for the measurement of density using ionization chambers. The most important factors in the measurement (absorption, decay of the preparation, dispersion, measuring time, solubility and accuracy, null point and sensitivity, and adjustability of the measuring range) are considered. The regulations governing radiation protection are discussed. Two specific uses described are: control of thick juice density in the evaporators, and beet diffusion control. Details are given of ancillary equipment with flow-sheets. Other applications in the sugar industry are also described.

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The "Saccharomat", a new automatic polarimeter. H. HIRSCHMÜLLER. *Zeitsch. Zuckerind.*, 1962, **87**, 352–354.—Details are given of the Schmidt & Haensch automatic photo-electric, quartz-wedge compensated polarimeter, two versions of which are undergoing tests at the Berlin Institut für Zuckerindustrie. Optically both models are identical, but the "Saccharomat I" is self-compensating and indicates the polarization of the sample using a large projected scale. It has a range of −30 to +105°S and comprises two units, one for the optical measurements and the other a mains transformer supplying current to the white light sources and to the electronic components. The rate of compensation is about 14°S/sec, being slightly lower for dark solutions, which must, however, have a transmittancy of at least 1%. A special model, the IA, enables information to be recorded and transmitted over a distance. The "Saccharomat II", built as a console, is suitable for solutions from 0° to 99·9°S and is provided with an analogue computer for conversion of the quartz wedge displacement to a number of pulses corresponding to the rotation in units of 0·1°S. In comparison with the Institute's standard instrument, no reproducibility difference greater than 0·05°S was observed. A 200 mm tube can be used with either model, there is no harmful heating up, and no zero shift, disregarding a short stabilization period.

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Determination of pectins in sugar beet. T. K. GAPONENKOV and Z. I. PROTSENKO. *Sakhar. Prom.*, 1962, (8), 27–29.—A procedure for pectin determination is described, in which 50 ml alcohol is added to 0·5 g brei, boiled for 30 min to remove sugars and other alcohol-soluble substances, and filtered. Distilled water (50 ml) is added to the precipitate and the solution heated for 1 hr at 50°C before filtration. The filtrate is used for determination of free galacturonic acid, while 100 ml N H_2SO_4 is added to the insoluble matter and heated for 1 hr on a boiling water bath. The proto-pectin is thus hydrolysed and passes into solution; the volume of the solution is determined after cooling to room temperature and is then made up to 100 ml with distilled water. The liberated galacturonic acid content is determined colorimetrically using a calibration curve of optical density *vs.* concentration; this is established by adding 6 ml H_2SO_4 of 1·84 s.g. with cooling to prepared 1-ml galacturonic acid solutions of 5 to 100 γ concentration[1], heating on a hot water bath for 20 min, and after cooling to room temperature, adding 0·2 ml of 0·15% carbazole in alcohol. The optical density of the mixture is determined photoelectrically with a green filter and a 20-mm cell. The carbazole gives a rose colour, which reaches maximum intensity after about 2 hr. The galacturonic acid content is multiplied by 1·37 to give the corresponding pectin content. Some test results are given.

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Action of amino-acids on glucose. Y. CAMPAGNE. *Ind. Alim. Agric.*, 1962, **79**, 529–536.—Spots containing 10 and 20 µl of M/100 solutions of amino-acids in 10% aqueous *iso*-propanol were deposited on a filter paper, a third 20 µl spot also being deposited and a further 20µl of a M/100 solution of glucose in 10% aqueous *iso*-propanol added to it. After maintaining at various temperatures for various times the amino acids were displaced by downward chromatography using 4:1:5 butanol:acetic acid:water as solvent for 18 hr, when the chromatograms were dried and then soaked in a 0·5% solution of ninhydrin in a mixture of equal volumes of acetone and sodium phosphate:citric acid buffer of pH 7. Alternatively electrophoresis was used, employing 350V D.C. for 3 hr and an aqueous pyridine:acetic acid buffer of pH 3·9. The spots were cut out and the colour measured with an electrophotometer, so indicating the proportion of amino acid which had reacted with the glucose. These are tabulated for 5 days reaction at 25°C, 21 days at 18–20° and 1 day at 105°; the last figures are much the greater. The

[1] *Zhurn. Priklad. Khim.*, 1958, **31**, 2, 319.

reaction with glucose was more complete the more basic was the amino acid, the proportion reacting decreasing in approximately the same order as the iso-electric point of the acid. Small proportions of amino acids formed substances detectable with ninhydrin which would be bound to the glucose. Reactions involved appear to include decarboxylation, dehydration, de-amination and, in the case of cysteine, elimination of sulphur.

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A study of methods of cane quality determination for cane payment. J. J. SEIP. *Sugar J.* (La)., 1962, **25**, (2), 14–16, 36.—A review is made of the systems used in various parts of the world to determine the quality of cane samples in terms of the chosen criteria, i.e. the Java ratio system in South Africa, c.c.s. in Queensland, etc.

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New colour reactions of sugars for paper chromatography. L. REICHEL and H. SCHIWEK. *Naturwiss.*, 1962, **49**, 37; through *S.I.A.*, 1962, **24**, Abs. 450.—Titanium tetrachloride forms coloured complexes with urea and sugars (but not polyols) in alchoholic solution. Two spray reagents are proposed: (a) 2 g of urea, 1 ml of $TiCl_4$, 1 ml of piperidine and 2 ml of glacial acetic acid in 10 ml of methanol; (b) 0·5 g of *p*-phenylenediamine, 1 ml of $TiCl_4$, 2 ml of piperidine and 4 ml of acetic acid in 20 ml of methanol. Both reagents give characteristic colours after spraying and drying at 120°C for 3·5–4 min which enable glucose, fructose, sucrose, raffinose and some other sugars to be distinguished. The colours and fluorescence colours are tabulated.

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The effect of alkaline copper salt solutions on sucrose and invert sugar. W. SCHIEBEL. *Zucker*, 1962, **15**, 345–352, 395–401.—The nature of the reaction between Fehling's solution (and Müller's and Ofner's solutions) and the sucrose and invert sugar in the test solutions is discussed with 44 references to the literature. The variants of Fehling's solution used for invert determination are described in chronological order and the compositions of Fehling's, Müller's and Ofner's solutions are compared (per litre of stock solution and per 100/110 ml test reagent). It was found that while SPENGLER *et al.*[1] discovered an increase in the copper oxide precipitate with increase in the copper concentration in the reagent and a decrease in copper reduction with decrease in the pH, there was no such decrease with increase in the volume of Müller's solution. Addition of sodium phosphate with Fehling's and Müller's solutions was found to have no effect on the sucrose value, in contrast to the results of other workers. It was found that the determination of invert sugar is made difficult by its decomposition; the higher the alkalinity the greater was the invert sugar destruction and thus the smaller was the value given by the copper oxidation. To this is attributed the difference in values of consumed iodine solution at different pH values. The question of the effect of catalysts, e.g. traces of iron in the reagent, on the reaction is discussed. Titration in a water bath at below boiling temperature is also cited as a factor in fluctuating values. It was found that the Ofner solution is preferable to Müller's, although two factors must be considered: the limits of error with Ofner's solution under identical heating conditions have to be determined, and whether the advantages of Ofner's solution outweigh the high salts content. Various guidances are given throughout the article on the use of the reagents.

* * *

Scattering of light in aqueous solutions of sucrose. A. R. SAPRONOV. *Izv. Vysshikh Ucheb. Zaved. Pishch. Tekhnol.*, 1962, (2), 30–34; through *S.I.A.*, 1962, **24**, Abs. 557.—The optical density of pure sucrose solutions was measured in a 10 cm cell at a range of wavelengths between 420 and 260 mμ. The results are tabulated for solutions of 5·7—70·4 g/100 ml concentration. An analysis of the results by means of Rayleigh's formula shows that the increase in optical density with decreasing wavelength is mainly due to scattering and not to absorption of light. Since the optical density is already appreciable at 420 mμ, a pure sucrose solution should be used as a "blank" when measuring the colour of sugar solutions. The optical density did not increase linearly with the concentration of sucrose but was relatively less in the more concentrated solutions. It is concluded that the radius of the sucrose molecules diminishes with increasing concentration, because of a decrease in their hydration. The evidence is contrary to the idea of molecular association in sucrose solutions.

* * *

The influence of temperature on the density and volume of pure sucrose solutions and technical sugar solutions. H. THIELE. *Zeitsch. Zuckerind.*, 1962, **87**, 362–367, 424–434.—A dilatometer method was used to determine the variation with temperature of the density and expansion of pure sucrose solutions and of juices and press-water. The sucrose solutions (1–122·86 g sucrose/100 ml) were measured at 20–95°C and the liquors at 20–100°C. All the results are tabulated and the values of the ratio $V_t:V_{20}$ (volume at a given temperature: volume at 20°C) are compared with those of Plato and Gerlach. Graphs are also given of density and of $V_t:V_{20}$ *vs.* temperature for the sucrose solutions. Differences of $\pm 0{\cdot}01\%$ and of $\pm 0{\cdot}12\%$ were found between the measured values and those of Plato and Gerlach respectively. Comparison of the values for the technical sugar solutions with those for the sucrose solutions show that at corresponding dry solids contents the relative error is no greater than 0·2%, indicating that the purity and the type of non-sucrose and non-sugar do not have any significant effect on the measurements. The values for the sucrose solution may be used for factory sugar solutions with sufficient accuracy.

[1] *Zeitsch. Wirtschaftsgr. Zuckerind.*, 1936, **86**, 138.

BY-PRODUCTS

Sucrose benzoate pilot unit goes on stream. ANON. *Chem. Eng. News*, 1962, **40**, (21), 94, 96; through *S.I.A.*, 1962, **24**, Abs. 353.—Sucrose benzoate (approx. 7·4 benzoate groups per sucrose unit), now being produced in semi-commercial quantitles by Tennessee Products & Chemical Corp., is a clear, odourless, tasteless, almost colourless, brittle solid at room temperature. It is an "organic glass" (non-crystalline) which softens at about 200°F. With ester plasticizers it can form flexible supported films of high lustre. It is almost insoluble in water and aliphatic hydrocarbons, and is stable in water at 100°C; dilute HCl and Na_2CO_3 solutions hydrolyse only small quantities at this temperature. It is soluble in aromatic solvents, many esters, ethers, ketones and glycols. It has excellent resistance to ultraviolet light. It is compatible with most polymers, plasticizers, etc. It can act as a plasticizer for polyvinylchloride, and can be used in adhesives, lacquers, etc. to give improved properties.

* * *

Butanol-acetone fermentation of sugar cane juice. A. ARELLANO C. *Bol. Azuc. Mex.*, 1962, (154), 34–41.—The fermentation processes developed for production of acetone and butanol from carbohydrate sources are reviewed and a description given of a proposed anaerobic technique for their production from cane juice. The organism is *Clostridium acetobutylicum* and cultures are subjected to thermal shock (heating to 100°C for 1–2 min) to kill vegetative cells and weak spores. Subcultures are then allowed to sporulate and subjected to further thermal shock; the process is repeated until the culture is of adequate fermentative capacity. Optimum fermentation temperature is 37–42°C and pH is 5–7. Presence of $CaCO_3$ causes a reduction in yield of both solvents and an increase in volatile (acetic and butyric) acids, but suppresses alcohol formation. The solvents are producted in a ratio of 5 parts of butanol to 4 parts of acetone and 1 part of ethanol. Laboratory tests are described in which cane juice, diluted to 5°Bx and at pH 5·7, is fermented, among other media, to produce acetone and butanol. Isolation and selective development of *Clostridium saccharobutylicum* organisms is described; these will give a yield of 30% on sugar if the initial concentration is low (5%). Incubation temperature is 20–40°C and optimum pH 5·2–6·2. They can use ammonia or degraded (but not undegraded) protein as nitrogen source, and are anaerobic.

* * *

The composition of scums and heat coagulates from cane juice in relation to their nutritive value to animals. D. H. PARISH. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1961, 97–104.—The use of filter-cake as animal fodder is discussed on the basis of the nitrogen content, fibre and insoluble carbohydrates, ash and lipids. The nutritive value of the heat coagulate from the cane juice is also discussed. The protein of the scums is rather low and the fibre content rather high, although where these factors are not significant the cake could be used as direct feed for cattle. The use of scums as fertilizer is also considered. Detailed work on the composition and feeding value of filter-cake is to be carried out as well as research on the production of a high-protein coagulate from juice[1].

* * *

The extraction of cane juice protein and the assessment of its value as a feeding stuff. J. DUPONT DE R. DE ST. ANTOINE and E. C. VIGNES. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1961, 104–109.—See *I.S.J.*, 1962, **64**, 277.

* * *

Production of levulinic acid and some of its derivatives from sucrose. W. DANIEWSKI. *Prace Inst. Lab. Badawczych Przemyslu Spozywczego*, 1961, **11**, (4), 15–19; through *S.I.A.*, 1962, **24**, Abs. 438.—The effect of varying conditions on the yield of levulinic acid from sucrose heated with acids was determined in the laboratory. The maximum yield (60% of the theoretical yield, 41% by weight) was obtained by heating a 20% sucrose solution with ~5% of conc. HCl for 2 hr at 162°C and 7 atm pressure. The separation and purification of levulinic acid and the preparation of sodium, calcium and ethyl levulinates are described.

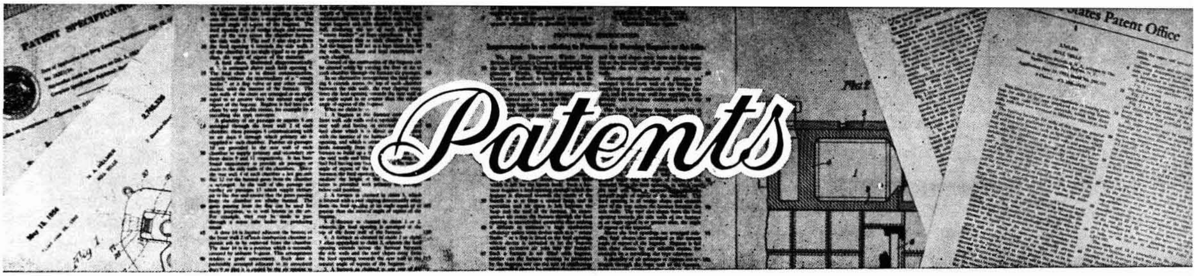
* * *

Improved pig rations. Sucklings show marked preference for feeds high in C-sugar. G. E. COMBS, C. E. HAINES and H. D. WALLACE. *Sugar J.* (La),. 1962, **25**, (2), 30–31.—Pigs which had access to creep rations containing *C*-sugar found them more palatable than rations without, the preference being for the higher levels (30 and 40%) of *C*-sugar. The pigs also gained more weight (15·7 lb more at 56 days old).

* * *

Recovery of betaine using ion exchange resins. G. B. AIMUKHAMEDOVA, M. I. DAISHEV and K. P. ZAKHAROV. *Izv. Akad. Nauk Kirgiz. S.S.R., Ser. Estest. i Tekhnich. Nauk*, 1961, **3**, (2), 139–141.—Betaine may be recovered by treatment of molasses solution or vinasse with a strongly-acid cation exchanger in H^+-form and eluting with ammonia solution. The betaine is recovered from the eluate by evaporating to 60–65% dry solids and treating with active carbon after adjusting to pH 2·5–3·0 (for removal of humins and colouring matter). The solution is brought to pH 0·8–1·0 with HCl, converting the betaine to its hydrochloride which is recovered by evaporating, crystallizing and centrifuging the crystals, which are then washed and dried. Although the betaine hydrochloride is somewhat coloured it does not contain ash or ammonia. Recrystallization and active carbon treatment with additional washing with alcohol is sufficient to give a high purity product suitable for medicinal purposes. The applications of betaine are listed.

[1] *See also* STAUB and DARNÉ: *I.S.J.*, 1962, **64**, 213.



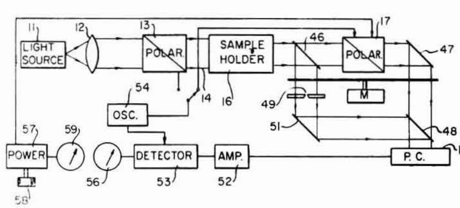
UNITED STATES

Continuous process for the production of yeast. H. N. SHER, *assr.* THE DISTILLERS CO. LTD., of Edinburgh, Scotland. **3,032,476.** 21st July 1958; 1st May 1962. The process uses at least two (at least 3) (3–6) fermentation vessels, into the first of which is introduced yeast, nutrients and water. Growth and addition of nutrients and water continue, and when a certain volume is reached in the first vessel, yeast-containing medium is withdrawn at the same rate (so keeping the volume constant) and transferred to the second vessel. Nutrients and water are added to this continuously, while after the volume reaches a certain level it is maintained constant by continuous withdrawal of yeast-containing medium. This may be sent either to a subsequent fermenting vessel in its turn, or to a yeast-ripening tank before recovery of the yeast cells. The conditions in the vessels are such as to provide a "growth modulus" (g/hr of yeast produced per g yeast) of 0·05 to 0·020 (0·075–0·175). Water at <25°C may be added to one or more vessels to provide cooling. Eventually the feed to the first vessel is reduced while the withdrawal is maintained, this continuing until the vessel is empty; the same is then carried out with the succeeding vessels.

* * *

Polarimeter. E. G. PICKELS and G. K. TURNER, *assrs.* BECKMAN INSTRUMENTS INC. **3,041,921.** 17th November 1958; 3rd July 1962.

A monochromatic light source 11 supplies light to the collimating lens 12 which forms parallel rays. These are applied to a polarizer 13 which forms plane-polarized light rays 14 which are transmitted through the sample contained in the holder 16,



impinging on the partially transmitting mirror 46. A predetermined portion of the rays travel through the mirror and through the analyser 17 where they impinge on a mirror 47 and are reflected through a partially transmitting mirror 48 to the photocell 18. A portion of light reflected by mirror 46 travels through an adjustable slit 49 to a reflecting mirror 51 to the mirror 48 where it is diverted to provide a steady source of light or light bias to the photocell 18. Thus the photocell 18 receives light which has travelled through the analyser 17 and also an adjustable amount of light which has not, the latter being unaffected by the deflection of the analyser. A suitable light chopper alternately interrupts the light beams from the mirrors 46 and 47 so that these beams impinge alternately on the photocell.

The output of the latter is applied to an amplifier 52 and the amplified signal to detector 53. An oscillator 54 serves to dither either the prism 13 or prism 17 as the case may be. The output of the oscillator is also applied to detector 53, the output of which is indicated on a meter 56. A source of power 57 controlled by knob 58 serves to rotate the analyser 17, the amount of power used being indicated on meter 59. Alternatively, the mirrors may be omitted and the light passing through analyser 17 received by a photo cell 18 the signal being amplified and applied to a phase detector which detects the part of the signal which is synchronous with the vibration of the analyser; its output is amplified and added to the output of an oscillator, the combined signal being applied to a means for rotating and vibrating the analyser which seeks the minimum transmission angle which corresponds to the polarization of the sample.

* * *

Continuous purification of the lime milk used in sugar mills. M. CZIRFUSZ of Petohaza, Hungary, assr. LICENCIA TALALMANYOKAT ERTÉKESITÖ VÁLLALAT. **3,042,209.** 17th December 1958; 3rd July 1962.—Impure milk-of-lime containing solid impurities is introduced continuously into a space where these impurities settle out and are continuously removed while the substantially solids-free milk-of-lime is continuously withdrawn into a receiving space. From this it passes to a cycloning zone where it is separated into pure milk-of-lime and a sludge; the former is withdrawn into a receiving space from which it is fed to the sugar factory, while the sludge is returned to the first settling space.

Sugar factory for Ecuador[1].—A new sugar mill, Ingenio Tababuela, with a daily crushing capacity of 700 tons of cane, is under construction at Ibarra, in Ecuador. It is planned to start operations in June 1964.

[1] *Sugar y Azúcar*, 1962, **57**, (12), 75.

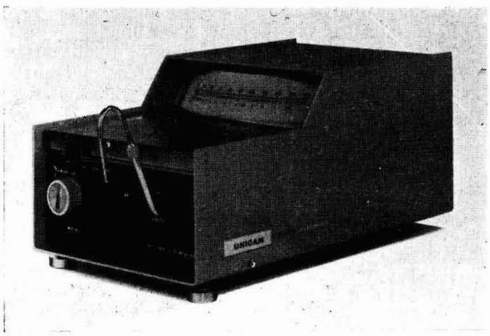
Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 4s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

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.

New high sensitivity low-cost colorimeter. Unicam Instruments Ltd., York Street, Cambridge.

This new Unicam SP. 1300 colorimeter has a technical specification which incorporates many of the latest advances in colorimetry. It is compact, sturdy and easily transportable. Outstanding features



include: (*a*) "Autofil" cell—automatic system of filling and emptying cells, saving time and avoiding spillage (minimum volume of 10 mm glass sample cell—2 ml); (*b*) single lever control for three stages of analysis, and (*c*) instant selection of filters by rotation of filter disc.

The SP. 1300 is suitable for a very wide range of colorimetric analyses but will be supplied at present with operating instructions and methods of analysis for sixteen separate clinical determinations, although other "method sheets" will be made available shortly to the users.

* * *

Modern water cooling towers. Film Cooling Towers (1925) Ltd., Chancery House, Parkshot, Richmond, Surrey.

Considerable progress in reducing the size of water cooling towers has been made in recent years with the development of the induced draught tower incorporating the "Film Flow" packing system. This produces a compact and economical unit, the ground required for such a tower being half to one-third of that required for a natural draught tower.

Film Cooling Towers (1925) Ltd. have now produced several new units designed to help the architect give a modern treatment to this normally rather drab structure, achieving this effect by the use of cement-asbestos sheets in natural finish or with durable surface coatings of the complete British Standard colour range, resistant to acidic atmospheres and to fading.

PUBLICATIONS RECEIVED

CONDUCTIVITY INDICATOR. Electronic Switchgear (London) Ltd., Hitchin, Herts.

Leaflet EE-002 describes the Type "C" conductivity meter for water purity measurements. Its light weight, compactness and sturdy construction make it ideally suitable for portable use in factory and laboratory, and it is expected to find much use with small water demineralization or distillation plants, boiler feed water control, etc. A variety of cells are available for use with the meter, the 0–10 scale of the latter corresponding to 0–10 or 0–100 conductivity units depending on whether the cell has a constant of 0·1 or 1·0.

* * *

"POLY-V" DRIVES. Turner Bros. Asbestos Co. Ltd., Rochdale, Lancs.

Two new booklets describe, respectively, Turner's "Poly-V" drives for small machinery and larger machinery, the latter under the title "Pictorial proof." In each are provided illustrations of applications of these drives which use numbers of small grooves on the pulleys each corresponding to one of the Vs of the single belt, the pulley side of which has a corrugated appearance. Advantages claimed for the drives are quiet running, lack of vibration, space saving, lower wear and longer life, easy installation, etc.

* * *

MORRIS CONVEYORS. Herbert Morris Ltd., P.O. Box 7, Loughborough, Leicestershire.

Book 242 provides illustrations of various industrial conveying schemes engineered by Herbert Morris Ltd. who claim that their conveyors, combined with other Morris products (cranes, hoists, telphers, etc.), provide complete handling schemes for all industries. The range varies from simple overhead conveyors to fully automatic equipment, light and heavy-duty, and includes all types of conveyor.

* * *

"ENERPAC" HYDRAULIC TOOLS FOR INDUSTRY. Applied Power Industries Inc. (U.K.) Ltd., 717 Tudor Estate, Abbey Rd., London N.W.10.

Bulletin BE-100 provides illustrations, specifications and descriptions of the components which go to make up hydraulic power equipment, e.g., hand-, air- and motor-driven pumps, hydraulic rams, gauges, valves, hoses and fittings, etc. as well as complete sets of pump and ram units, push-pull assemblies, presses and cranes, etc.

* * *

RIGID THERMOPLASTIC PIPES AND FITTINGS. Durapipe & Fittings Ltd., Winnock Road, West Drayton, Middlesex.

A brochure giving full details of the rigid thermoplastic pipes produced by Durapipe & Fittings Ltd. is now available from the manufacturers. The brochure also deals with the Company's extensive range of fittings and their recently introduced range of valves and strainers. Sections deal with recommended jointing methods, notes on installation, chemical resistances and working pressures. A convenient chart showing all relevant dimensions of the fittings is included.

* * *

Richard Sutcliffe Engineering Systems Limited.—A new company, Richard Sutcliffe Engineering Systems Ltd., of 28/29 Savile Row, London, W.1, is to provide a comprehensive service in the field of bulk materials handling equipment. The new company will take over the complete marketing of all the products of Richard Sutcliffe Ltd. of Horbury, Sutcliffe Hydraulics Ltd. of Castleford and Craven Electronics Ltd. of Bingley, which companies have worked in association for some considerable time. In addition it will provide a service as main contractor for mechanical handling plant incorporating electronic controls and hydraulic drives and other mechanisms where these are appropriate.

WORLD SUGAR CROP ESTIMATES

Estimates of sugar production in 1962/63 have recently been published by three important sources—C. Czarnikow Ltd.[1], F. O. Licht K.G.[2], and the U.S. Department of Agriculture[3]. We believe it of interest to reproduce these estimates below; Czarnikow's figures are to the nearest 1000 long tons while the original Licht figures were given to the nearest 100 metric tons—these have been converted to long tons and are given to the nearest 100. The U.S.D.A. figures were given to the nearest 1000 short tons; they have been converted to long tons and are again given to the nearest 1000. It should also be pointed out that the U.S.D.A. figures are for centrifugal sugar only and exclude khandsari-type sugars.

	(LONG TONS, RAW VALUE)		
BEET SUGAR	*Czarnikow*	*Licht*	*U.S.D.A.*
Europe			
Albania	13,000	12,800	13,000
Austria	260,000	260,800	230,000
Belgium-Luxembourg	323,000	324,800	329,000
Bulgaria	180,000	177,200	177,000
Czechoslovakia	850,000	866,100	837,000
Denmark	205,000	203,700	197,000
Finland	44,000	43,700	49,000
France	1,600,000	1,604,300	1,471,000
Germany—East	620,000	674,200	650,000
West	1,510,000	1,510,800	1,588,000
Greece	25,000	23,600	26,000
Holland	444,000	460,600	524,000
Hungary	415,000	426,200	314,000
Ireland	130,000	132,900	146,000
Italy	930,000	1,033,400	935,000
Poland	1,400,000	1,476,300	1,279,000
Roumania	280,000	280,500	345,000
Spain	540,000	547,200	580,000*
Sweden	225,000	222,400	296,000
Switzerland	29,000	28,800	25,000
Turkey	395,000	395,700	412,000
U.K.	763,000	787,400	760,000
U.S.S.R.	6,750,000	6,987,900	6,429,000
Yugoslavia	230,000	231,300	227,000
Total Europe	18,163,000	18,712,600	17,839,000
Other Beet Sugar			
Afghanistan	—	5,400	—
Algeria	—	1,000	—
Canada	137,000	147,600	138,000
Chile	72,000	80,700	72,000
China	—	344,500	—
Iran	150,000	137,800	156,000
Israel	—	37,400	—
Japan	185,000*	139,800	163,000*
Syria	—	11,800	—
Uruguay	36,000	39,400	—
U.S.A.	2,366,000	2,310,900	2,366,000
TOTAL BEET SUGAR	21,109,000	21,968,900	20,734,000

	(LONG TONS, RAW VALUE)		
CANE SUGAR	*Czarnikow*	*Licht*	*U.S.D.A.*
Europe			
Spain	30,000	29,500	—
Madeira & Azores*	12,000	14,500	18,000
North & Central America			
British Honduras	} 940,000 (British Honduras to Other B.W.I.)	20,700	26,000
British West Indies—			
Antigua		31,500	—
Barbados		157,500	160,000
Jamaica		440,900	438,000
St. Kitts		44,300	45,000
Trinidad		244,100	202,000
Other B.W.I.		4,900	50,000
Costa Rica	—	93,500	80,000
Cuba	4,000,000	4,133,700	4,107,000
Dominican Republic	804,000	984,200	804,000
El Salvador	—	65,000	63,000
French West Indies—			
Guadeloupe	} 250,000 (Guadeloupe and Martinique)	167,300	168,000
Martinique		88,600	83,000
Guatemala	—	123,000	120,000
Haiti	56,000	64,000	56,000
Honduras	—	22,600	—
Mexico	1,600,000	1,771,600	1,600,000
Nicaragua	—	83,700	76,000
Panama	—	29,500	37,000
Puerto Rico	985,000	846,400	982,000
U.S.A.—Mainland	768,000	846,400	857,000
Hawaii	985,000	984,200	982,000
Virgin Islands	10,000	13,300	10,000
South America			
Argentina	751,000	787,400	751,000
Bolivia	—	52,600	46,000
Brazil	3,012,000	2,952,600	3,527,000
British Guiana	323,000	319,900	325,000
Colombia	396,000	393,700	396,000
Dutch Guiana	—	10,100	11,000
Ecuador	—	137,800	147,000
Paraguay	—	35,900	31,000
Peru	837,000	816,900	837,000
Uruguay	—	6,900	47,000*
Venezuela	246,000	278,500	246,000
Other Central & South America	652,000	—	—
Africa			
British East Africa	170,000	196,800	176,000
Congo (ex-Belgian)	31,000	43,300	31,000
Egypt	304,000	383,800	304,000
Ethiopia	61,000	49,200	61,000
French Equatorial Africa	—	16,700	—
Madagascar	85,000	88,600	85,000
Mauritius	530,000	531,500	540,000
Portuguese East Africa	185,000	185,500	167,000
Portuguese West Africa	65,000	65,400	—
Réunion	185,000	185,000	200,000
Rhodesias	—	39,400	82,000
South Africa (incl. Swaziland)	1,148,000	1,146,600	1,161,000
Asia			
Burma	49,000	49,200	49,000
China	1,250,000	935,000	—
Pakistan*	} 3,375,000 (Pakistan and India—white sugar)	201,800*	170,000*
India—white sugar		3,051,100	3,686,000
khandsari	1,670,000	295,000	excluded
Indonesia	700,000	689,000	699,000
Philippines	1,553,000	1,555,000	1,553,000
Taiwan	715,000	787,400	714,000
Thailand	130,000	127,900	129,000
Vietnam	45,000	19,700	65,000
Oceania			
Australia	1,850,000	1,801,100	1,747,000
Fiji	210,000	249,000	240,000
TOTAL CANE SUGAR	31,008,000	29,620,700	29,187,000
TOTAL CANE & BEET SUGAR	52,077,000	51,589,600	49,921,000

* signifies beet sugar *and* cane sugar

* * *

Cane pest in Swaziland.[4]—It is reported that considerable damage to immature standing cane has been caused in the Northern area of Swaziland as the result of an infestation of the cane lands by a frog hopper, *Numicia viridis*.

[1] *Sugar Review*, 1962, (590), 218.
[2] *International Sugar Rpt.*, 1962, **94** (11), 177–178
[3] *Foreign Crops and Markets*, 29th November 1962.
[4] *Overseas Review* (Barclays D.C.O.), December 1962, p. 20.

BREVITIES

Jamaica sugar crop, 1962[1].—The final tonnage for the sugar crop in Jamaica is estimated at 437,067 tons, of which 206,379 tons have been shipped to the U.K., 87,738 to Canada, and 72,571 to the U.S.A. A further 8200 tons is still to be shipped to the U.S.A. It is estimated that the 1963 crop will be 442,100 tons.

* * *

South African consortium gains control of Hulett's.—A consortium of seven Natal sugar companies announced in November that it had acquired more than half of the shares in Sir J. L. Hulett & Sons Ltd. The Companies concerned are The Tongaat Sugar Co. Ltd., Reynolds Bros. Ltd., Gledhow-Chaka's Kraal Sugar Co. Ltd., C. G. Smith & Co. Ltd., Crookes Bros. Ltd., The Umzimkulu Sugar Co. Ltd. and The Pongola Sugar Milling Co. Ltd. In obtaining control of Sir J. L. Hulett & Sons Ltd., the consortium also takes over The Natal Estates Ltd., control of which passed to Huletts in October after a take-over bid, and the other members of the Hulett group, including Mhlume (Swaziland) Sugar Co. Ltd., Triangle Ltd., Ngoye Paper Mills (Pty.) Ltd., Zululand Sugar Millers and Planters Ltd., Refined Sugars & Syrups S.A. (Pty.) Ltd. and George Clarke & Son (S.A.) (Pty.) Ltd., etc. The consortium announced that there would be as little interference as possible with the management of Huletts; however, Mr. GUY M. HULETT retired almost immediately from the position of Chairman of the Company and has been replaced by Mr. R. M. ARMSTRONG.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at* 17*th January* 1963)	
Anglo-Ceylon (5s)	14/–
Antigua Sugar Factory (£1)	6/3
Booker Bros. (10s)	22/9
British Sugar Corp. Ltd. (£1)	24/–
Caroni Ord. (2s)	3/3¾
Caroni 6% Cum. Pref. (£1)	14/–
Distillers Co. Ltd. (10s units)	31/4½
Gledhow Chaka's Kraal (£1)	54/9
Hulett & Sons (R1)	35/6
Jamaica Sugar Estates Ltd. (5s units)	4/1½
Leach's Argentine (10s units)	14/9
Manbré & Garton Ltd. (10s)	44/6
Reynolds Bros. (£1)	15/–
St. Kitts (London) Ltd. (£1)	11/–
Sena Sugar Estates Ltd. (10s)	8/9
Tate & Lyle Ltd. (£1)	45/3
Trinidad Sugar (5s stock units)	3/9
United Molasses (10s stock units)	28/10½
West Indies Sugar Co. Ltd. (£1)	11/6

CLOSING MIDDLE

New York Stocks (*at* 16*th January* 1963)	$
American Crystal ($10)	46
Amer. Sugar Ref. Co. ($25)	44
Central Aguirre ($5)	22⅜
Cuban American ($10)	14⅛
Great Western Sugar Co.	36¾
South P.R. Sugar Co.	34
United Fruit Co.	24¾

Tate & Lyle Central Agricultural Research Station in Trinidad

MR. J. A. C. HUGILL, Managing Director of Caroni Limited and a member of the Technical Policy Committee of Tate & Lyle Ltd. (London) has announced that the Company is to support fundamental and applied research in Trinidad, relative to the agronomy, physiology, entomology, and microbiology of sugar cane.

As of 1st January 1963 the Company's agricultural Research Station at Carapichaima will be re-named the Tate & Lyle Central Agricultural Research Station. Representing one of the few private institutions of its kind, the Tate and Lyle Agricultural Laboratories in Trinidad will be devoted to the acquisition of new scientific knowledge and to the application of such knowledge to those practical agronomic problems facing the cultivation of sugar cane on the island.

The Research Policy of the Company has been, and will continue to be, a free exchange of scientific information with the small cane grower, with other local Research Institutions, and with similar fundamental research groups in Australia and Hawaii.

Scientific staff at the Tate & Lyle Agricultural Research Station will consist of the Director (Dr. A. J. VLITOS), an Entomologist (Dr. D. W. FEWKES), a Plant Physiologist (Dr. B. H. MOST), a Plant Pathologist (Dr. J. T. MILLS), and two Agronomists (I. D. LAWRIE and F. B. LITTLE).

Long-range programmes of research are already in progress on the naturally-occurring gibberellins of sugar cane, the physiology of froghopper blight, the ecology and physiology of *Aeneolamia varia saccharina* (froghopper), and on the chemical regulation of cane ripening. Agronomic research has been centred on the selection of newer, higher-yielding varieties of sugar cane, the evaluation of more effective methods for controlling froghopper and weeds, the formulation of a mineral nutrition programme based on foliar and soil analyses and fertilizer trials, and related field problems. The long-range and applied programmes are being continued but the Tate and Lyle group also contemplates the initiation of additional studies on the physiology of plant growth, soil chemistry, and sucrose metabolism.

The Company is confident that the support of a progressive agricultural research programme will eventually benefit not only the sugar grower but also other members of the Trinidad and Tobago agricultural and scientific community.

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U.S. supply quotas, 1962[2].—On the 12th December the U.S. Dept. of Agriculture announced an additional deficit of 90,000 tons in the 1962 sugar quota—50,000 tons in the domestic beet area and 40,000 tons in Mexico. Of this, 15,000 tons was prorated to the Philippines and 75,000 tons to the Western Hemisphere countries as a group, to be allocated to these countries on a first-come-first-served basis.

[1] *Overseas Review* (Barclays D.C.O.), December 1962, p. 67.
[2] *Lamborn*, 1962, **40**, 258.