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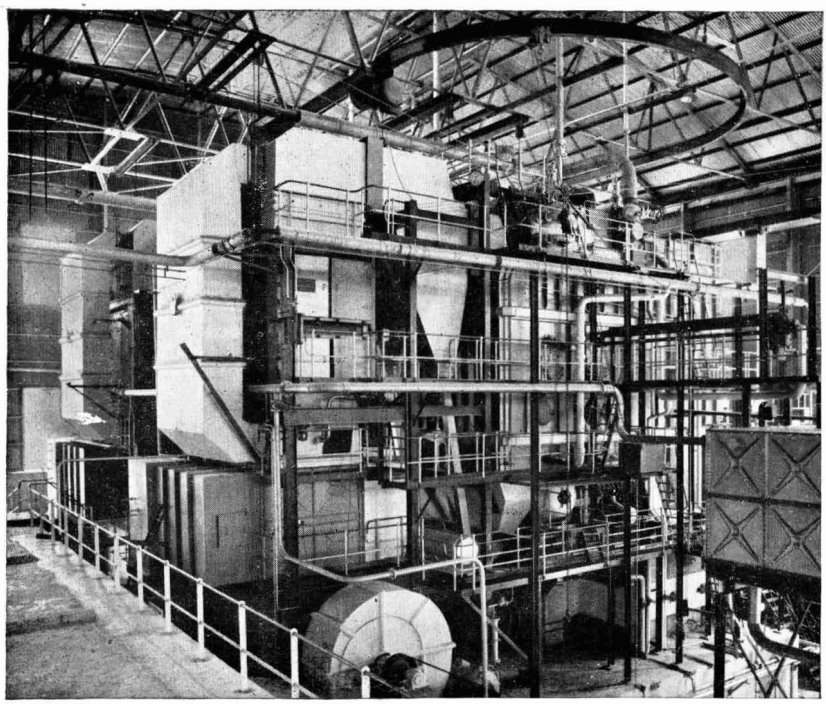

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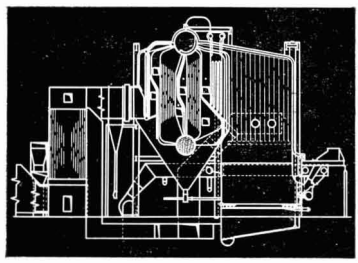
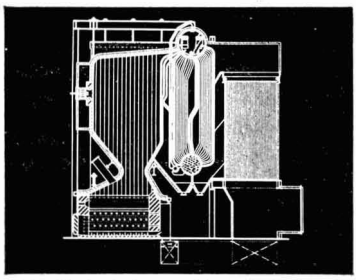


Bi-drum boiler for bagasse firing with Babcock-Detroit spreader stoker, and auxiliary oil-firing.



Bi-drum boiler for bagasse firing, with Ward furnace and auxiliary oil firing.

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THE
INTERNATIONAL SUGAR JOURNAL

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NOTES AND COMMENTS

Sugar consumption promotion.

Referring to the International Sugar Council, C. Czarnikow Ltd. write[1]: "In the past it has been the Statistical Committee which has received most attention because its findings have influenced export quotas and hence the income of members. Nevertheless, without consumption there are no exports and without increased consumption there can be no increased exports, and we believe that in a new Agreement it will be necessary—indeed, fundamental if the health of our commodity is to be restored—to give to the Consumption Committee the task of these problems and also enable it to call on the finance which will thereby be required.

"Quite apart from the need of the Consumption Committee to tackle what may be regarded as these rather special problems it is important that it should also examine how best to achieve an improved offtake in those parts of the world where consumption is unduly low.

"Countries where offtake is already in excess of some 40 kilos per head may be regarded as approaching saturation point with any future growth largely limited to population expansion. It is those areas where sugar usage is below this level—and particularly where it is below 20 kilos per head—where the limiting factors must be sought and where remedial action, if possible, should be taken.

"In some parts of the world the lack of transport facilities are undoubtedly holding back sugar consumption but the speed of development of transportation methods in recent years leads one to hope—and, indeed, to believe—that the situation cannot long remain where potential users are unable to make their purchases because, physically, sugar cannot be got to them.

"This brings us to what is undoubtedly the main limiting factor, the lack of money both at national level and in the hands of the individual. The shortage of purchasing power on the part of the would-be consumer is an obvious limiting factor which needs no elaboration. It is not always so readily realised, however, that the individual's difficulties in the way of obtaining sugar are frequently heightened by the action of his own government, as in many countries particularly in those where demand exceeds supply, the authorities have found duties on sugar to be one of the most attractive means of raising revenue. This, of course, further limits offtake, which is already held within bounds by low per capita incomes.

"It is clear that considerable difficulties will be encountered in any attempt to raise sugar consumption in many areas of the world before their gradual transition from developing to developed countries brings its own solution. Nevertheless steps in the right direction have already been taken with the setting up of the new U.N. Trade and Development Board and, if it can be borne in mind in that quarter that it is not only the exporter who needs financial help but in many cases his customer also, it might be possible to devise ways of adding to the per capita consumption of sugar in these countries without any detriment to their currency situations. It is not automatic, incidentally, that part of this development should include the expansion of a high cost local sugar industry!"

* * *

International Sugar Conference.

The Sugar Conference held in Geneva under the auspices of the United Nations ended on the 14th October after nearly four weeks of discussions. It has been decided to convene a second session in the spring of 1966 or as soon after as a successful outcome appears likely. Meanwhile consultations are to be arranged both on the technical and policy levels with governments of countries participating in the Conference, in the framework of the International Sugar Council and by other means. In its press release after the Council meeting in Geneva on the 15th October the Council noted the Resolution of the Conference and requested its Executive Director to give all assistance to the Secretary-General of the United Nations Commission for Trade and Development (UNCTAD) in carrying out the consultations and other necessary work in preparation for the next session of the Conference.

[1] *Sugar Review*, 1965, (725), 141–2.

Invitations to 124 Governments were sent by Dr. RAÚL PREBISCH, Secretary-General of UNCTAD, and attendance at the Conference was heavy. While it is disappointing that no Agreement has emerged from the discussions, it was perhaps too optimistic to expect this in view of the need for reconciliation of different interests, and the preliminary Session has clarified the nature and extent of the difficulties concerned.

The Conference elected Mr. BENGT ODEVALL of Sweden as its Chairman and he stated at the adjournment[2] that the major result had been agreement by all delegations that there should be a higher free market price for sugar. It had been agreed in Committee that sugar dealings should be within a minimum and maximum price range of about 1·5 cents per lb while the lowest minimum price mentioned during the Conference was 4 cents per lb (the current price is about 2·20 cents per lb). The Conference did not reach the question of setting export quotas and Cuba had not submitted a specific quota request.

* * *

London Terminal price basis.

In April 1956 the United Terminal Sugar Market Association published a definition of the London Daily Price and appointed six of the active sugar brokers in London, who between them handle annually over 5,000,000 tons of sugar internationally, to form an official price establishment committee to meet and publish a price daily in accordance with terms and conditions laid down by the U.T.S.M.A. Because, internationally, raw sugar has been traded and shipped in bulk for some time, the London Daily Price Committee has decided to amend the basis of establishing the London Daily Price from "sugar in bags" to "bulk sugar in hold, cost of discharge for Buyers account". This basis for the L.D.P. will become effective on and after 1st January 1966.

The London Daily Price is a price for world market actual sugar in a prompt position. When establishing the price the Committee include all International Sugar Agreement origin sugars. Consideration is given to values of any business negotiated all over the world. The shipping period covers six to eight weeks from establishment, thereby avoiding the influence of any local freight squeeze. After 1st January 1966 it will be expressed in £ sterling per ton of 2240 lb, basis 96°, delivered in bulk, c.i.f. U.K., with cost of discharge for buyers account.

It is interesting to note that, although no one is obliged to use the L.D.P., records show that it has been used on a voluntary basis for contracts by all the main raw sugar sellers under Article 14 of the International Sugar Agreement and by a wide variety of buyers.

* * *

Brazil sugar plan, 1965/66[3].

The sugar plan of the Brazilian Sugar and Alcohol Institute for the 1965/66 crop provides for a record sugar production of 65·3 million bags (3,918,000 metric tons). Of this quantity, 51·25 million bags (3,075,000 metric tons) are provided for domestic consumption, while 14·05 million bags (843,000 tons) are to be available for exports. Sugar production in the 1964/65 season is estimated[4] at 3,475,758 metric tons.

* * *

U.S. sugar quotas, 1965.

On the 14th September[5] the U.S. Dept. of Agriculture allocated to the Dominican Republic the 31,769 short tons, raw value, which it withheld earlier wher the Puerto Rican deficit was reallocated among Western Hemisphere countries.[6]

On the 22nd September, the Department announced an increase of 100,000 tons in the 1965 Supply Quota, bringing it to a total of 9,300,000 short tons, raw value[7], and on 8th October deficits were declared of 125,000 tons in respect of Puerto Rico and 10,000 tons in respect of the Virgin Islands[8]. Of these amounts, 40,804 tons will be allotted to the Philippines while the balance will be shared among Western Hemisphere suppliers. Changes in individual countries' quotas bring the latest figures as follows:

	(*Short tons, raw value*)
Domestic Beet	2,650,000
Mainland Cane	895,000
Hawaii	1,127,970
Puerto Rico	815,000
Virgin Islands	5,232
Philippines	1,155,216
Argentina	68,367
Australia	200,307
Belgium	1,937
Brazil	255,346
British Honduras	4,851
British West Indies	140,935
Colombia	32,417
Costa Rica	40,268
Dominican Republic	445,025
Ecuador	57,114
Fiji	48,823
France	6,103
French West Indies	49,551
Guatemala	40,528
Haiti	21,437
India	103,919
Ireland	2,398
Madagascar	7,871
Mauritius	16,008
Mexico	450,501
Nicaragua	46,866
Panama	16,743
Peru	277,775
Réunion	2,373
El Salvador	20,003
Rhodesia	9,542
South Africa	103,862
Swaziland	9,648
Taiwan	72,436
Turkey	1,574
Venezuela	2,858
Deficits not yet reallocated	94,196
	9,300,000

[2] *Public Ledger*, 16th October 1965.
[3] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (21), 16.
[4] C. Czarnikow Ltd., *Sugar Review*, 1965, (723), 135.
[5] *Lamborn*, 1965, **43**, 147.
[6] *I.S.J.*, 1965, **67**, 319.
[7] C. Czarnikow Ltd., *Sugar Review*, 1965, (731), 168.
[8] *ibid.*, (734), 180.

SUGAR CANE AGRONOMY

Papers presented to the 12th I.S.S.C.T. Congress in Puerto Rico, 1965

PART I

THE very large number of papers presented at this Congress, by contributors from all over the world, included many relating to sugar cane agronomy. As an indication of the widespread interest in mechanical harvesting of sugar cane at the present time there were no less than 9 papers devoted to this subject, 8 dealt with the fertilizing of cane and 7 with weeds and modern chemical weedkillers, while some half-dozen were concerned with some aspect or other of the physiology of the sugar cane plant. There can be few crops that receive more, or as much, close attention from the scientist today as the sugar cane. Separate sections of the Congress were held to discuss sugar cane breeding, pests and diseases.

Mechanical Harvesting

An informative and an appropriate paper for the Congress is that entitled "Harvesting, loading and transporting sugar cane in Puerto Rico in the past, present and future" by L. R. PARTRIDGE *et al.* The authors draw attention to the now ruinous cost of hand-harvesting sugar cane in Puerto Rico, costs having gone up 355% in the last 30 years. Various factors are considered to account for the paucity of mechanical harvesting in the country, such as the nature of the terrain and soils, the human element on the part of the grower, the resistance to mechanization on the part of the unions and labour, and the rapid growth and resultant recumbency of the cane. If the industry is to continue it is considered that mechanical harvesting must be pressed forward and other work found for the cane cutters. Loading is done with the Louisiana-type cane loader and haulage by rubber-tyred tractors, the light railways having largely disappeared. Another Puerto Rican paper by W. H. KAHL is entitled "A method of statistically determining the mechanical harvestability of sugar cane in Puerto Rico."

Three papers deal with mechanical harvesting in Queensland. J. K. GAUNT reviews the subject in its broader aspects in his paper on "Considerations in the mechanical harvesting of sugar cane." He rightly points out that mechanical harvesting is not just a matter of purchasing a suitable machine. For the harvester is only one component of a complete system of mechanized cane culture and usually quite substantial modifications to the existing cultural system and practices are necessary to provide conditions in which machines can work efficiently. The basic principles of construction of sugar cane harvesting machines are discussed, as are the conditions which affect their performance. The need for large blocks of cane free from surface irregularities is stressed. The two other Queensland papers are "Mechanical harvesting in the Bundaberg district" by E. H. CHURCHWARD and "Mechanical harvesting in Australia and its effect on the sugar content of cane" by C. W. WADDELL and R. A. PRICE. In a paper on mechanical harvesting in South Africa (by G. S. BARTLETT) it is pointed out that almost the entire sugar belt in Natal has rolling terrain, some of the slopes being too steep for any present type of mechanical harvester. Nevertheless it is expected that mechanical harvesting will make great strides during the next decade in the more favourable areas. Natal producers are more likely to favour whole cane harvesters, rather than chopper harvesters, as they would more easily fit in with existing transport, transloading and stockpiling procedure.

A paper likely to attract wide interest is that by R. M. RAMP entitled "Progress in the development of a successful Louisiana sugar cane de-trasher." Experiments are described to determine the rates of sugar loss after harvest and before milling due to (*a*) inversion of sucrose (*b*) loss of cane weight and (*c*) changes in milling qualities. Results show that loss in cane weight and change in milling qualities can have an important effect on the rates of recoverable sugar from fresh cane.

Fertilizers

A paper by P. DOUCHEZ "Should fertilizers applied to sugar cane be changed after the first ratoon" raised a question that is always of interest to the sugar cane grower. It is based on experiments carried out at 9 experiment stations in Guadeloupe over a period of 6 years. The conclusions reached confirm opinions usually held regarding ratoons, viz. that nitrogen fertilizer is all-important to obtain good yields, especially with old ratoons. Phosphate is all-important with plant cane and first year ratoons while reaction from potash depended very much on the type of soil. The effects of lime on yields of sugar cane and sugar on acid soils in Louisiana are discussed by L. G. DAVIDSON. Some Louisiana soils are very acid (pH 5–6) and ammoniacal nitrogenous fertilizers are now much used. Liming experiments showed that yields of cane and sugar on such soils were generally increased and sucrose percent juice generally decreased: 3 tons of lime per acre gave a sucrose reduction of 0·25% with a yield increase of 2·59 tons of cane and 373 lb of sucrose per acre.

Sugar cane fertilizer usage in Puerto Rico is discussed by G. SAMUELS. He points out that Puerto Rico uses large amounts of fertilizer in growing sugar cane, being second only to Hawaii in the amount applied per acre. A review of fertilizer usage during the period 1944–1964 is given. Ammonium sulphate (locally made), is the most popular nitrogen source but recently aqueous ammonia and urea have been used. Application by hand remained the most popular method of application.

In a paper by W. H. KAHL *et al.* an ingenious new machine which cuts cane trash and applies anhydrous ammonia in a mole drain in one operation is described.

The machine has been designed for the rather special conditions applying in Mexico (heavy clay soil and need for a trash blanket with the relatively low rainfall), but it may well be of interest to cane growers in other parts of the world. Mexico has an adequate supply of anhydrous ammonia for agriculture derived from its national oil industry. In a paper on the efficiency of nitrogenous fertilizers by D. H. PARISH of Mauritius the author points out that the efficacy of nitrogenous fertilizers in terms of "nitrogen applied/nitrogen recovered" is generally low, round about 50% with sugar cane. The possible causes of loss are discussed. The entire application of fertilizer nitrogen may be lost from the soil in less than one month during the rainy season in the tropics. Laboratory studies indicate that de-nitrification losses may not be important and there is some evidence of non-symbiotic nitrogen fixation.

Weeds and Weed Control

Three papers on chemical weed control in sugar cane have been given by workers in the south-eastern United States where this aspect of weed control is well advanced. They are: "Shield sprayer application of 'Dalapon' and other herbicides in sugar cane" by J. R. ORSENICO and T. W. CASSELMAN, "Chemicals used as herbicides for Johnson grass seedlings, other weeds and grass control in Louisiana sugar cane" by E. R. STAMPER, and "Chemicals and combinations of different chemicals used for weed and grass control in Louisiana sugar cane fields" by E. R. STAMPER.

A truly selective post-emergence grass herbicide which will effectively eliminate pest grasses from sugar cane has not yet been developed. "Dalapon" is the most effective at present available. Varieties of cane differ in their susceptibilities to it or in physiological tolerance. Injury to cane from it can easily occur. The shield-sprayer here described and illustrated was developed by the Everglades Experiment Station and Dow Chemical Company. With regard to Johnson grass, the worst grass pest with sugar cane, the authors of the above papers stress the value of "Silvex" against Johnson grass seedlings, used at 1 lb per acre in pre- and post-emergence sprays. It has proved more effective than 2,4-D. The erratic growth response of the cane plant to "Silvex" is not yet understood but is being studied. TCA and "Silvex" used in combination have given good control of weeds and grasses. Long residual chemical herbicides are needed to control weeds and grasses in Louisiana sugar cane.

With regard to weed control in cane in other countries, E. ROCHECOUSTE of Mauritius discusses preliminary observations on the use of substituted uracils for the control of weeds in sugar cane fields, while J. M. GOSNELL and G. D. THOMPSON of Natal describe the effect of "Paraquat" on the growth and yield of sugar cane.

Physiology and Flowering of Sugar Cane

Some half dozen papers are in the broad category of physiology of the sugar cane. Interesting results of work on the flowering of cane (tasseling or arrowing) in Hawaii are given by T. TANIMOTO and L. G. NICKELL in a paper on the field control of sugar cane flowering in Hawaii with "Diquat". A current method of control in Hawaii is foliar application of "Monuron" or "Diuron" at the rate of 4 lb per acre during the period 6th–14th September. With "Diquat" effective tassel control and increased sugar yields in the heavy tasseling variety H 37-1933 was obtained with a concentration of 0·25 lb of the cation per acre. The reduction in cost per acre for control was substantial.

"Factors affecting photosynthesis in sugar cane" is the title of a lengthy paper by C. E. HARTT and G. O. BURR, also of Hawaii. It deals with the effects of the following factors on the rate of photosynthesis in sugar cane blades—the age of the plant, its chlorophyll and moisture content, the CO_2 content of the air, light, fertilization with N, P, K and Ca, and the accumulation of end-products. Two papers are concerned with growth promoting or gibberellin-like substances, namely that by K. T. GLASZIOU and T. A. BULL of Australia on the relationship between total invertase activity and internode expansion in sugar cane stalks and the paper by B. H. MOST and A. J. VLITOS of Trinidad describing studies on endogenous gibberellin-like substances in sugar cane. In a paper on the export of mineral elements in cane juices Y. LEMAIRE *et al.*, of Guadeloupe, show how variations in fertilizer applications may be distinctly reflected in the mineral composition of the juice. Nitrogen application may have an important influence on the content of mineral elements in the juice. Results of large applications of potash are seen in the potash content of the juice and the author wonders to what extent this may hamper processing.

Radio-isotopes in Sugar Cane Physiology

A paper on this subject was presented by C. E. HARTT and H. P. KORTSCHAK of Hawaii. It gives an account of experiments on sugar cane with the following radioactive isotopes—carbon ^{14}C, phosphorus ^{32}P, potassium ^{42}K, calcium ^{45}Ca and sulphur ^{35}S. The translocation of sucrose in the plant and ripening are only two of many of the processes studied. L. E. GOLDEN discusses "The uptake of fertilizer phosphorus by sugar cane in Louisiana as measured by radio-isotope methods". A study was made of the effect of rainfall and of placement of fertilizer on P uptake by sugar cane, as measured by radio-isotope methods.

Ripening of Cane

Ripening and maturity-control progress at Ingenio Los Mochis, Mexico, is the subject of a paper presented by R. P. HUMBERT *et al.* Evidence is given of how yields were increased by a controlled irrigation programme. Withholding of irrigation at the right period also drastically reduced tasseling.

Soils and Mineral Deficiency

With the increasing use of very heavy machinery on cane fields and of the transporting of very heavy loads of cane the question of soil compaction assumes

greater significance. In "Effects of soil compression on the development of sugar cane roots", A. C. TROUSE JR. of Alabama reports interesting greenhouse or laboratory studies on this subject. "With increasing soil bulk density, roots of sugar cane develop quite normally until a density is reached at which proliferation is reduced. At greater densities roots and rootlets gradually become more distorted. Roots are incapable of penetrating a soil compressed above a critical bulk density which is specific for a particular soil material."

"Sulphur deficiency in the sheath related to sugar cane yield decline in Puerto Rican soil" is the subject of an interesting paper by J. A. BONNET. "Values that approached 0·2% sulphur in the sheath indicated sulphur deficiency (in variety PR-980). An application of about 300 lb sulphur per acre produced a highly significant increase of about 45 more tons of cane or about 6·39 more tons of sugar per acre, with sheath values, at 7 months, varying from 0·5 to 0·8% of S." Other papers relating to mineral content describe the effects of silicate on the growth and leaf freckle of sugar cane in Hawaii, use of plant sodium as a guide to improving the reliability of foliar diagnostic technique, by R. T. BISHOP; and one discusses some factors affecting the phosphorus content of leaf tissue from sugar cane grown on organic soils by J. R. ILEY *et al.* of Florida.

Soil Salinity

How a saline desert soil was restored to fertility and cane growing by leaching (river irrigation) and a tile and drainage system at the Haft Tapeh sugar cane project, Iran, is described by K. SHOJI and K. A. SUND. A paper with a less happy ending is that by R. A. WILKINS and K. H. ATHESIAN of British Guiana on the relationship between ground water, salinity and sugar cane at Rose Hall Estate. They conclude "Rose Hall Estate, surrounded on three sides by sea and river containing salt water, is similar to an oceanic island where a lens of fresh water is held in balance by the surrounding salt water. A lowering of the ground water table level is likely to encourage salt water intrusion, especially in the depression area."

Irrigation and Water Relationships

In a paper on the overhead irrigation of sugar cane in Natal T. G. CLEASBY and J. N. S. HILL point out that overhead irrigation schemes can only be satisfactorily designed when actual figures are known regarding the water requirements of the crop and the infiltration rates and moisture holding property of the soil. They point out that the evapotranspiration concept has shown itself to be important on the Natal coast. Two other papers on evapotranspiration were given at the Congress, viz. "Evapotranspiration research in the Hawaiian sugar industry" by J. CHANG *et al.* and "The relationship potential evapotranspiration of sugar cane to environmental factors" by G. D. THOMPSON.

Other papers on irrigation record the response of sugar cane to fertilizer application as influenced by irrigation, by G. SAMUELS of Puerto Rico, and consumptive use and replenishment standards in irrigation by G. Y. EWART of Hawaii. Two authors (K. H. ATHESIAN and R. A. WILKIN) discuss the estimation of rainfall and sugar yield in British Guiana, having reference to 9 factory areas and a production of 270,000 tons.

Germination

Minimum temperatures for sugar cane germination are the subject discussed by H. F. CLEMENTS and S. NAKATA (Hawaii) who set out to ascertain the lowest continuous temperature at which germination of setts will occur. This was 49·2°F for the most vigorous buds. One had begun to germinate at 47·4°F. R. R. PANGE referred to the dry season difficulties of germination in parts of India and how these were being overcome.

Freezing

The effects of freezing temperatures on the 1963–64 sugar cane crop in Haft Tapeh, Iran, are described by K. A. SUND. Although frosts have occurred in the agricultural areas of Khuzestan before, the freezing weather during January 1964 was one of the coldest winters on record and destroyed about a third of the cane crop. Details of the freeze are given.

Rôle of Aircraft

Two papers refer to this subject, R. A. WILKINS and R. A. BARNARD dealing with the development of an aircraft loader for use with aerial dusting operations in British Guiana, where Bookers Sugar Estates Ltd. are responsible for 100,000 acres of cane and operate two aircraft for the application of fertilizers, herbicides, rat bait, etc. The loader, which saves the tedium of manual loading and operates in a fraction of the time, functions in conjunction with a tractor. In the second paper A. RIOLLANO and F. DUPRE describe the rôle of aircraft in Puerto Rican sugar cane culture. There has been a remarkable increase in the use of fixed-wing aircraft for applying fertilizers, insecticides, herbicides, etc., and recently helicopters have been used.

Sugar Cane Breeding

Many different aspects of sugar cane breeding were discussed at the Congress with some 8 or 9 papers devoted to the variety selection programmes of various cane growing countries, including Jamaica, Dominican Republic, British Guiana, Louisiana, Taiwan and Queensland.

The threat of mosaic disease to the Jamaican sugar industry some years ago called for a change in the variety selection programme and meant that less dependence could be placed on Barbados varieties as mosaic was not serious in that country. At present about 350 varieties and sufficient fuzz to produce an average of 30,000 seedlings are received each year. The varieties raised from this fuzz are called the BJ's to indicate they were bred in Barbados and selected in Jamaica. Describing some practical aspects of

sugar cane production in British Guiana, G. D. WATKINS points out that between 50,000 and 70,000 seedlings are available for selection each year at the cane experiment station and that good ratooning ability is a prominent character under British Guiana conditions.

Cold tolerance is one of the characteristics considered in the breeding programme of Louisiana, unlike most other cane-growing countries where cold is not a serious consideration. At Houma from 300,000 to 500,000 seedlings are screened annually for disease resistance and agronomic quality and about 100,000 seedlings at Baton Rouge. Low yield, low sucrose and poor ratooning are the principal weaknesses for which varieties are eliminated. In Taiwan, where climatic conditions are not unlike those of Hawaii, an entirely different set of conditions faces the cane breeder. Economic and sociological conditions, notably the competition for land for food crops with a dense and rapidly rising population, present special problems. Sugar cane is less profitable than many crops on good or irrigated land and the urgent need is for greatly increased production per unit area.

The grading system used for sugar cane selection in Queensland is described in detail by J. C. SKINNER. Each new variety is graded on a scale ranging from 1 (extremely poor) to 20 (excellent) in comparison with the standard commercial variety, which is always graded 10. It is thought the system of grading varieties in replicated trials, developed by the author, may be a novelty to breeders in other countries. Another Queensland worker, J. H. BUZACOTT, discusses selection criteria for cane varieties to be harvested mechanically and their likely effect on yield. In some areas, particularly northern Queensland, severe lodging may occur with existing varieties under unfavourable weather conditions and the need for more erect varieties in these areas is a prime consideration.

(*To be continued*)

RAIN MAKING AND SUGAR CANE

AN account of experimental artificial rain making in certain sugar cane areas of Louisiana has recently appeared in a contemporary sugar journal[1]. Although artificial rain making by "cloud-seeding" is by no means new and has been tried in many parts of the world it is of interest to hear of its being tried in sugar cane areas. The information given was from a letter from the Secretary of the South Louisiana Improvement Association, an organization which has been financing experiments in "cloud-seeding" to increase rainfall in the western part of the Louisiana sugar district. He states "In the last two years we had a cloud-seeding project to increase rainfall in the above two parishes from June 1 through September 30. In most of the target area, rainfall was above normal during the cloud-seeding period in both years. The firm which did the work calculated that the seeding increased rainfall about 20%.

"We believe there are strong indications that cloud-seeding has given us more rain, and we want to continue the project this year. All cane growers are asked to contribute 20 cents per acre of cane to finance the cloud-seeding. Processors will handle the collections. The cloud-seeding firm which we hire is Irving P. Krick, Inc. of Texas, whose headquarters is at Denver, Colorado. This is a large reputable company which does work in many parts of the United States and in many foreign countries.

"The actual seeding of the clouds is done with ground-based silver iodide generators located in and around the target area. Last year there were 10 generators used and this year there will be 11. When the switch on a generator is turned on, silver iodide crystals are produced by an electric arc. These particles are very small—much too small to be seen with the naked eye. One grain of silver iodide produces 10,000,000,000,000,000 crystals. They rise with the air currents to the clouds where each little crystal acts as a nucleus or centre about which a rain drop forms.

"The temperature of a cloud must be right before it will rain. This means the cloud must be at the right height—not too low and not too high. For instance, in that portion of a cloud where the temperature is between +5°F and —40°F, rain may occur without the addition of silver iodide. Silver iodide may be needed to create rain in the lower portion of the cloud where temperatures range from +25°F to +5°F. In some instances the entire cloud may be too low and its temperature too warm for silver iodide seeding to create rain.

"Krick places the generators with people who live here in Louisiana—people like storekeepers, firemen, etc. The person with whom a generator is placed turns it on when he gets a phone call from Krick in Denver. Krick does not have to come to Louisiana to know at any given moment what kind of clouds we have, the height they are, the direction and speed of our winds, and other weather conditions. Meteorologists here, in Denver, and around the world keep each other constantly informed about complete, up-to-the minute weather data. Therefore Krick, sitting in Denver, can determine the proper time to turn on generators in Louisiana and which ones should be turned on to do the most good.

"Adequate rainfall is needed to make cane grow fast, and we believe you will agree that the cloud seeding project should be continued in an effort to get enough rain for the cane."

F.N.H.

[1] *Sugar Bull.*, 1965, **43**, 167–170.

Relation of hydrolytic enzyme activity with the virulence of strains of *Colletotrichum falcatum* (red rot). G. P. SINGH and A. HUSAIN. *Phytopathology*, 1964, **54,** 1100–1101; through *Rev. Appl. Mycology*, 1965, **44,** 157.—The most virulent of 3 strains in the conidial state produced large quantities of polygalacturonase and small amounts of pectinmethylesterase in liquid culture; the moderately virulent one produced significantly less polygalacturonase, and the weakly virulent strain the least.

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Physiology of sugar cane. VII. Effects of temperature, photoperiod duration, and diurnal and seasonal temperature changes on growth and repening. K. T. GLASZIOU *et al. Australian J. Biol. Sci.*, 1965, **18,** (1), 53–66.—Effects of day and night temperature, length of daylight and diurnal thermoperiodicity were studied on sugar cane grown under controlled environments. During the first 3 months of growth, day and night temperature effects were mainly additive, but at 6 months the interaction effects of all variables were numerous and complex. Sugar production per plant and sugar concentration in the stalk were highest at the optimum temperature (30°C) for dry matter production. The results are discussed in relation to the ripening process in sugar cane.

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Aphids on sugar beet and some weeds in England and notes on weeds as a source of beet viruses. G. D. HEATHCOTE, R. A. DUNNING and M. D. WOLFE. *Plant Pathology*, 1965, **14,** (1), 1–10.—An extensive survey was made on aphids of sugar beet in spring and early summer and of those overwintering on weeds common around beet fields, particular attention being paid to those weeds known to be hosts of beet viruses. The following occurred frequently—*Macrosiphum solanifolia*, *Myzus persicae*, *Myzus ascalonicus*, *Aulacorthum solani*, *Aphis fabae*.

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Mechanical sugar cane harvesting in Australia. A. M. ATKINSON, G. QUAID and R. DEICKE. *World Crops*, 1965, **17,** (1), 46–50.—The history of mechanical harvesting in Australia and its development problems are briefly outlined. Details are given of the following harvesters in use in Australia—Fairymead, Massey-Ferguson, Venton, Crichton, Toft, Don-Mizzi and Cannavan.

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Selected CAC seedling clones and their performance in the Luzon area. M. T. ILAGA and B. L. LIT. *Sugar News*, 1964, **40,** 534–545.—The 4 varieties CAC 57-2, CAC 57-11, CAC 57-60 and CAC 57-76, produced by the College of Agriculture and Central Experiment Station, Laguna, are described and their field performance in selected areas in Luzon given.

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Reclamation of tidal lands for sugar cane. R. H. TSENG. *Taiwan Sugar Quarterly*, 1964, **11,** (3), 24–28. With the rising population of Taiwan and need for more food crops the only feasible way of obtaining more land for sugar cane cultivation is to reclaim tidal lands. This has been done to some extent. The difficulties and expense of such projects, which are long-term, are discussed.

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Import and export of cane varieties to and from Taiwan. B. C. MOK. *Taiwan Sugar Quarterly*, 1964, **11,** (3), 32–34.—Lists are given of the sugar cane varieties imported during 1962–64 and of those exported during 1961–64.

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Chemical investigations on growth development of sugar beets. A. NIEMANN. *Zucker*, 1964, **17,** 686–691. This deals with further pot experiments with sugar beet. In addition to sugar and ash content several nitrogen-containing compounds were investigated. With regard to the latter two distinct phases or periods of growth are recognisable. In the first phase, when leafage is being formed, high molecular nitrogen compounds predominate. During the second phase intensive production of reserve substances in the root commences.

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The effect of soaking setts in molasses and other nutrients prior to planting. S. C. SEN and S. P. SHUKLA. *Indian Sugar*, 1964, **14,** 487–490.—This is a continuation of earlier work. The soaking medium consisted of 5 gal 35% molasses with 2 lb ammonium sulphate and 2 lb superphosphate, neutralized with lime, setts being soaked overnight. The treatment is claimed to improve growth, yield and quality of cane.

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Sugar cane selection work at Tucumán. H. J. ANTONI and M. L. BRUZZO. *La Ind. Azuc.*, 1964, (852), 385–387.—A general account is given of the selection work carried out with cane at the Experiment Station.

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Variety trials with sugar cane at Santa Fé (Argentina). W. KENNING. *La Ind. Azuc.*, 1964, (852), 397–399. Yield figures (from 1961) are given. The more promising varieties are considered to be CP 44-101, CP 44-155, CP 48-103, CP 52-68, NA 56-30, NA 56-40, N:Co 310 and VA 57-1.

Experiments with chemical fertilizers. D. ONTIVEROS H. *Bol. Azuc. Mex.*, 1964, (183), 3–8.—Results are given of experiments with trial plots in various parts of Mexico. The significance of N, P, K, Mg and Ca are discussed.

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Leaf scald disease in Argentina. ANON. *La Ind. Azuc.*, 1964, (853), 427–428.—The existence of two forms of this bacterial disease in South America is referred to and symptoms described. The distribution of the disease is discussed in some detail.

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Phosphate studies in sugar cane soils of Bihar. A. P. GUPTA and S. C. SEN. *Indian Sugar*, 1964, **14**, 551–554. Profile studies for vertical distribution of total or available P showed that surface layers of almost all the soils examined were richer in total and available P_2O_5 compared with lower layers. The surface layers had sufficient available P_2O_5 for healthy plant growth.

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Ten years of experimental work with sugar cane in Mexico. D. ONTIVEROS H. *Bol. Azuc. Mex.*, 1964, (184), 4–13.—Sugar cane varieties grown in Mexico during the last 10 years are discussed. These include many importations. Selection work in Mexico in recent years is dealt with at length.

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Agronomic characters of Australian commercial canes. A. GONZÁLEZ G. *Bol. Azuc. Mex.*, 1964, (184), 14–16. Altogether about 3 dozen different sugar cane varieties are described.

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The quality of flowering cane. J. A. LÓPEZ H. *Sugar y Azúcar*, 1965, **60**, (2), 41–42.—Extensive flowering of sugar cane in parts of Argentina in 1963 made possible this study. Weight of cane, sugar yield, % sucrose, % fibre, etc., were recorded for several varieties. The total actual yield of flowered cane averaged 0·98% more than that of unflowered cane.

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Improved field practices at Santa Isabel. F. E. TORMES. *Sugar y Azúcar*, 1965, **60**, (1), 40–42.—Increased sugar cane production of 150% in 5 years is the enviable record of Ingenio Santa Isabel, Oaxaca, Mexico. It is explained how this was brought about, viz. by a programme aimed at producing high quality cane using advanced planting, cultivating and harvesting techniques. Future plans are outlined.

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The effect of freeze damage on some of the non-sugar constituents of sugar cane. J. J. FRILOUX, N. A. CASHEN and S. J. CANGEMI. *Sugar y Azúcar*, 1965, **60**, (1), 43–46.—Changes that take place in carboxylic acids, starch, gums, pH and titratable acidity of sugar cane juice following both mild and severe freeze damage are reported. The main change is in the production of acetic and lactic acids. A mild freeze reduces starch content. Gum or dextran increases only after severe, stalk-splitting freeze damage.

Depth of planting of sugar cane. G. N. MISRA. *Indian Sugar*, 1964, **14**, 619–622.—Results of experiments at the research station at Shahjahanpur are reported. Shallow planting was found preferable under high soil moisture conditions. Under normal or deficient soil moisture conditions deeper planting was better. The likelihood of shallow planting being a cause of lodging later is stressed.

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Irrigation and nitrogen responses of sugar cane in Eastern Uttar Pradesh. K. KAR and A. NATH. *Indian Sugar*, 1964, **14**, 633–637.—Experiments at the Gorakhpur Sugar Cane Research Station from 1956 to 1959 are reported. Nitrogen up to 200 lb/acre improved tillering and growth. Higher doses at planting affected germination adversely. Increasing levels of irrigation gave better tillering and cane yields. Twelve irrigations and 100 lb N/acre was considered the most economical combination for the conditions.

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Erosion control with a cane weed. ANON. *Producers' Review*, 1965, **55**, (1), 19–20.—The possible control of river banks against erosion during floods in Queensland is discussed. *Phragmites* (common reed) is suggested, as are dwarf bamboos which are used in some other tropical countries. Wild canes of the *spontaneum* type have been suggested but are not recommended lest they become infected with disease transmissable to sugar cane.

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The biosynthesis of sucrose in sugar cane. A. G. ALEXANDER. *J. Agric.* (Univ. Puerto Rico), 1964, **48**, 265–283.—In these sucrose synthesis experiments all plant material was obtained from the sugar cane variety M 336. At least two mechanisms appeared to be involved in uniting glucose and fructose to form a molecule of sucrose. These included the enzyme sucrose phosphorylase and a series of reactions involving uridine compounds. The former appear to be the dominant system.

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Influence of size of fruit and seed on germination of a monogerm sugar beet variety. G. J. HOGABOAM and F. W. SNYDER. *J. Amer. Soc. Sugar Beet Tech.*, 1964, **13**, 116–126.—It is pointed out that for complete mechanization a sugar beet variety that produces uniformly sized and shaped fruits, each containing a single seed, that germinates rapidly, would be the ideal. An X-ray technique was used to determine the diameter of the seed within the fruit. Partial correlation of seed diameter with germinating time was obtained.

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Levels of total N, P and Na in petioles and in thin juice of sugar beets. M. G. PAYNE *et al. J. Amer. Soc. Sugar Beet Tech.*, 1964, **13**, 127–137.—These levels were found to differ in different populations of sugar beet. This suggests that sugar beet might be bred with high levels of these elements in the tops rather than the roots, thereby increasing sucrose content and purity.

Influence of prolonged association of sugar beet nematode and tomato on intensity of parasitism. A. E. STEELE. *J. Amer. Soc. Sugar Beet Tech.*, 1964, **13,** 170–176.—Reproduction of the sugar beet nematode (*Heterodera schachtii*) on tomato was increased during a brief period of association of host and parasite. It is thought an adaptation of the beet nematode to tomato occurred.

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Effect of ratoon stunting disease on the growth and nutrient absorption of N:Co 310 on various soils. S. S. WANN and Y. J. HSIA. *Taiwan Sugar Quarterly*, 1964, **11,** (4), 16–20.—N:Co 310, the most important variety in Taiwan, is unfortunately easily infested with RSD, which causes an average loss of 20%. Four different cane soils were used (in lysimeters). Cane plants in all 4 were early infected and no clear-cut conclusions regarding soil were reached. Evidence points to the disease being more severe under conditions of extreme drought or wetness than under optimum soil moisture conditions.

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Cuban fly. *Proc. 10th Ann. Convention Philippines Sugar Technologists*, 1962.—Three papers on the Cuban fly (*Lixophaga diatraeae*), a larval parasite of the sugar cane borer recently introduced to the Philippines, appear in these Proceedings. They are: The introduction and propagation of the Cuban fly by J. N. GIBE (pp. 48–50); Culture of the Cuban fly under *Philsugin* laboratory conditions, by B. R. ESTIOKO (257–258); and Observations on the field performance of the Cuban fly in Negros, also by B. R. ESTIOKO (259–260).

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The effects of lime and organic matter on sugar cane planted on two soil types. M. T. ROBENIOL. *Proc. 10th Ann. Convention Philippines Sugar Technologists* 1962, 246–250.—Many of the Philippine cane soils are very acidic (pH 5·50 and below) and lime is regarded as beneficial by cane growers. It is also believed to reduce iron and aluminium toxicity and increase availability of a phosphate. Tests on two soil types, a sandy loam and a clay soil, are reported. Liming (5 metric tons/ha) increased millable stalks on both soils, more noticeably on the sandy clay loam. This soil was also more responsive to organic matter.

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Resistance of some varieties and hybrids to smut of sugar cane. J. R. RIVERA. *Proc. 10th Ann. Convention Philippines Sugar Technologists*, 1962, 51–57. Results are given of a series of smut (*Ustilago scitaminea*) resistance tests carried out on different varieties from 1958 to 1961 at the La Granja Sugar Cane Experiment Station. Among 30 commercial and breeding varieties tested 9 were rated highly resistant (including N:Co 310 and CP 29/116).

A review of variety trials in Central Luzon. C. R. MORA *et al. Sugarland* (Philippines), 1964, **1,** (11), 6–21. From 1956 to 1964, in the 4 milling districts of Central Luzon, 17 variety tests were harvested. An account is given of them. H 37-1933 was one of the best yielders. Among local varieties Phil.53-33 appeared to be the most outstanding and is now in commercial cultivation. Among Coimbatore varieties Co 421, Co 453, Co 527 and Co 617 were promising.

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The distribution of sugar in raw sugar beet and its biochemical control. E. HEINISCH. *Zeitsch. Zuckerind.*, 1964, **89,** 671–673.—A survey is presented of the literature on the distribution of sugar in the sugar beet (32 references). The results published by various workers have given the erroneous impression of a uniform distribution scheme, whereas others such as STEHLIK[1] have pointed to the wide differences in results due to the influence of light intensity on carbohydrate formation and to the effect of temperature, the optimum of which was found by LUNDEGARDT to be 22–28°C. Not only is the amount of sugar formed and fed to the "storage organ" irregular, but the amount stored is subject to fluctuations, e.g. when heavy rainfall causes a weight increase and the sugar proportion falls. The major water intake is through the fibre roots, which are distributed over the surface of the beet in a completely irregular manner. The question of representative core sampling has been considered by various authors, and the sector sample found to give better results than the usual core sample. The possibility of checking the conformity of the distribution of substances in different beet samples is demonstrated with the aid of two examples.

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Atomic energy in the beet sugar industry. K. KAINDL and M. ROSNER. *Zucker*, 1965, **18,** 33–36.—A survey is given of the literature (63 references) on the uses of radio isotopes in beet production (both experimental and practical) and beet processing. Low level irradiation of seed has been found to increase sugar content and beet weight as well as the seed yield, while higher levels of irradiation have increased the mutation rate. Treatment of mother beet gave a higher seed yield and considerably inhibited sprouting. Trials with $^{14}CO_2$ have helped explain aspects of sugar synthesis. Studies using fertilizers labelled with ^{32}P and other isotopes have led to greater economy in use. Chemical or biochemical conversions and processes during sugar production have been studied with radio-isotopes, which may also be used for level measurement in filling, fault finding in pipelines, etc.

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Independent selection of sugar cane varieties for gur (jaggery) manufacture in Madras State. P. SUBRAMANIAN and S. VAIDYANATHAN. *Madras Agric. J.*, 1963, **50,** 440–442; through *Hort. Abs.*, 1965, **35,** (1), 226.—Among 4 varieties investigated Co 740 proved to have the best juice and gur quality. It also had a soft rind.

[1] *Zeitsch. Zuckerind. Tschechosl.*, 1923, **47,** 449–463, 465–470.

CRYSTAL HABIT MODIFICATION

By HAROLD E. C. POWERS

IT is quite understandable that the practical man may be tempted to dismiss the subject of crystal habit as of academic interest only, having no practical significance or importance. This, unchallenged, would be regrettable, for much constructive co-operation would thus be in jeopardy, to say the least.

With VAVRINECZ's Atlas[1] fresh in our minds, perhaps this may be the appropriate opportunity to record some few thoughts on the whole, much broader, subject. It is my personal view that the really great advances in scientific achievement are increasingly the result of man's understanding of the molecular world, within which forces and activities are very different from those with which we are familiar in our macroscopic world. Molecules have their "likes and their dislikes," their affinities, attractions and repulsions, which are controlled with a superb degree of accuracy and reproducibility. They exhibit an orderly gregarious nature, and "of their own initiative" form up into characteristic patterns in which the component molecules achieve as nearly as possible positions of least free energy—literally at rest, after the whirling activity of molecules in solution. This is how crystals form, each molecular pattern, or lattice, being peculiar to that particular kind of molecule. The external habit is merely the indication of internal order, and may vary greatly, within certain limits.

Intensive study of natural crystal "architecture" reveals many existing possibilities in which new physical abilities became possible. Inevitably man has endeavoured to synthesize these rarities, and even to improve upon them. The results have been so revolutionary and rewarding that now some of the world's biggest commercial companies are vying keenly with one another in the production of even better synthetic crystals. These may be worth as much for a few grams as our sugar crystals are per ton! Naturally they are not destined to sweeten a cup of tea, but to be used as lasers, transducers, diodes and other devices of this rapidly developing space age science.

The modern scientist is in fact learning how to use molecules consciously as units of construction, in what I have called crystal architecture, and are thereby able to achieve hitherto unbelievable possibilities of transmission, reception, measurement, and so forth. Moreover all these are being carried out with increasing confidence, producing such compact, relatively simple, apparatus as to have brought the new word "miniaturization" into common use. None can foresee the limit to this remarkable development.

Many years ago sucrose was indeed seriously studied for this sort of work, as a piezo-electric crystal, by N. SHEFTAL who gave it some attention over twenty five years or so, but he found great difficulty in growing large crystals free from faults, and A.D.P. (ammonium dihydrogen phosphate) is now widely used for this purpose. Quite a few workers have studied the growth of sucrose crystals in a variety of ways, and it is now proclaimed as one of the more useful and informative substances for such studies.

In terms of annual tonnage these scientific applications are insignificant, but in terms of annual value they are comparable with the sugar industry. Nevertheless ours is still one the largest and most world-widely spread of crystallization industries, and I am keen that it should not only not be blind to the rapid advance of knowledge of crystal science, but that it should take an active part in this development. It is becoming abundantly clear that the inter-relationship of the nucleation and growth mechanisms of all substances is such that an advance of knowledge in any one branch offers at least some degree of parallel possibilities with many other substances.

The presence or the absence of certain faces of sugar crystals seems far removed from the above, and, whilst finding this interesting in itself, I personally consider the study of dynamic growth incomparably more exciting. The study of the static end-product *per se* appears to me somewhat like a post-mortem! Nonetheless I do not undervalue this information, for without the century of intensive X-ray mapping by the VON LAUES, the BRAGGS, and countless other researchers we should not be in the position we are today regarding crystal architecture. Devoted workers at the Royal Institution and elsewhere would not even now be exploring the constitution, for example, of the complex proteins which hold Nature's computer data for heredity and for life itself.

However, I will now develop my line of thought, commencing with crystal habit as a starting point. As VAVRINECZ has indicated, every pan boiled is likely to show marked variation in crystal habits, but such minor variations are not likely to cause much discomfort. However, when some of the more marked variations occur, production is quite likely to suffer. Acicular crystals ("needle grain") invariably are unwelcome in the sugar industry, being normally accompanied by practical difficulties. Increase of surface area per unit weight, alone, must render affination less efficient, holding, as it inevitably must, an increased proportion of impure mother syrup. Moreover this type of grain will not "pack down" so well, so giving a lower bulk density. From these aspects one might favour a compact type of crystal with axis ratios approaching 1:1:1. BUCKLEY, in a private communication, quoted his experience that the usual sucrose crystal habit gave $100 \geqslant 110 \geqslant 110 > 1\bar{1}0 > 0\bar{1}1$. I certainly think a somewhat rectangular habit more common than that resembling a cube in general appearance. We shall later refer to a crystal with spherical habit, but if for the moment we

(1) VAVRINECZ: Atlas of Sugar Crystals. (Bartens, Berlin). 1965; *See I.S.J.*, 1965, **67**, 280.

assume plane faces to be inevitable, then a cube will present minimal surface area to weight.

Let us now consider for a moment what is the cause of habit variation? It is the result of varied growth mechanisms, which cause, or allow, molecules from the solution to build up the surface of the crystal. We now know that there are many factors involved, and that the rate of attachment of molecules per unit area of crystal face may—and does— vary between wide limits, even in the same system. It is this variation which leads to habit modifications. From the point of view of rapid growth of crystals it is unfortunate that the most rapidly growing faces normally "grow themselves out"[2] and the largest faces are those whereon molecular deposition is slowest, this lowering the overall rate of growth.

I would like here to insist that instead of referring to the rate of growth of the sugar crystal, we should always make a habit of referring to the *mean* rate of growth, for not only does the rate of molecular placement vary from face to face, but may also vary from one crystal to another, even with neighbouring crystals. This is a highly significant factor acting against the production of uniform size of crystal from one boiling. How else can one account for the presence in every boiling of a significant quantity of grain larger than the peak size, which latter must result from the planned nucleation and had maximal growing time (see Fig. 1)?

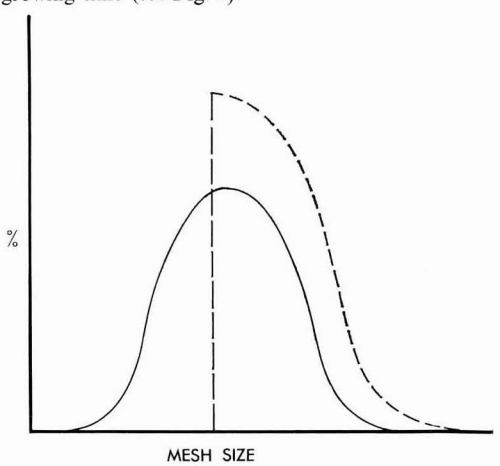

Fig. 1. Sieving of grain from a pan boiling.
—— normal curve ; – – – curve which would be the more probable result of uniform growth from a single initial seeding.

We now know that a perfect flawless crystal is almost non-existent, that molecular deposition is aided to an enormous degree by any "fault" on the growing surface, also that some faults are more efficient than others in this respect. One might conveniently look upon these faults as local catalysts aiding individual molecules to join the vast "complex molecule" which we call a crystal. It is highly probable that we could do something to influence this, given knowledge. Conditions on the fluid side of the growth interface are also vitally significant—and perhaps even less understood. One might regard the supersaturated solution as presenting individual molecules at various "pressures", according to the degree of supersaturation. If we examine this supersaturation more closely, again we find lack of uniformity, this being minimized by efficient mixing or stirring, but within the practical limits of commercial operation almost certainly local variation in concentration occurs around the crystal faces. Note the advised use of the term concentration, instead of supersaturation, this latter being far too indeterminate owing to the effect of crystal size and to surface fault variation when considering rate of growth on micro-areas of the growing crystal surface. We are no longer dealing with mean overall rate of growth, but are rather trying to grapple with the local extremes of growth rate which in fact determine crystal habit.

Hitherto it has been widely considered, within the industry, that habit variation is due to the presence of certain impurities in the mother syrup, these depositing on certain of the growing faces and, as it were, blocking the way for the later deposition of molecules. BUCKLEY[3] has recorded many striking examples of this sort of action, particularly with the interference by certain dyes upon the growth of various inorganic substances. In the later years of his life HAROLD BUCKLEY was kind enough to apply his special know-how to sucrose crystallization modification by means of dyes. He found it remarkably unresponsive as compared with some of the mineral substances. However, his sad decline in health and death did not permit him to carry these investigations very far. Without having spent much time on the subject myself, I yet have found some evidence of effect under certain circumstances. Less well known, in fact, is the influence of physical circumstances, as distinct from chemical interference. In a recent article[4] I reported examples of the production of striking variations in habit resulting from variations of concentration and of conditions of growth, even with solutions of high purity.

So, it is my present opinion that the habit modification occurring in commercial sugars may quite possibly be due to a combination of the above quite different influences. This is not a mere quibble, for in time it may prove possible to diminish unwanted abnormality merely by changing something in the operative conditions. In exploring this possibility it may be desirable to operate upon a few grams each from a range of massecuites exhibiting extreme aberrations in crystal habit. The sample should be dissolved entirely in distilled water, then a film thereof evaporated in a humidator to an R.H. of say 76 or 81, then nucleated under standard conditions. This procedure could be duplicated using any normal massecuite, and comparison made of the crystal

[2] LYLE: "Technology for Sugar Refinery Workers" 3rd Edn. (Chapman & Hall, London) 1957, p. 593.
[3] "Crystal Growth" (Chapman & Hall, London).
[4] *I.S.J.*, 1964, **66**, 287–290.

habit developing in the two cases. I have tried this tentatively with several samples and would welcome further samples for comparison, before pronouncing upon the result and inferences to be drawn.

So far we have considered implications and deductions which may be made from such habit variation as we already know to occur. Let us now look beyond the sugar industry and consider whether there is any practical evidence of deliberate "planned" habit modification, anything offering sufficient inducement for industry to produce such forms in quantity. There is indeed such evidence with some crystalline substances. Sodium chloride provides perhaps the best example. The normal form as it is grown in open pans, varies from light flakes to quite thick "hopper" shapes, or as grown in the more modern pans is in the form of small cubes. As the result of quite extensive researches a wide variety of substances and techniques were found to affect the crystal habit in profound degree. In British Patents 667,101, (1952) 822,893 (1959) and 848,328 (1960) many of these are listed, together with properties of the resulting salt crystals, e.g. bulk density, etc. For example, several parts per million of ferro- or ferricyanide added to the dissolved salt results in the crystallization therefrom of quite striking dendritic crystals of low density. Again crystals grown in the Oslo continuous crystallizer are spherical, and roll like tiny ball bearings. At first this caused surprise and was disconcerting to purchasers, but later, with increasing familiarity in handling, the spherical crystals were found preferable to the cubic form for many users. The addition of traces of lead salt to brine results in the growth therefrom of remarkably clear crystals with a minimum of faults. Whisker or hair like crystals of sodium chloride may readily be grown from salt solution under appropriate conditions, and I have been able to take some remarkable cinemicrography films of the growth of this strikingly unusual crystal form. To date I am not aware of this having been found a commercial application, however.

Water when freezing into ice crystallizes in quite a variety of different crystal habits, according to the conditions reigning, including plates, columns, needles, dendrites and spheres. These varied ice crystals play quite a significant part in our weather, forming as they do in the clouds, which in their form and appearance indicate the type of ice crystals likely to be present.

Many other examples are recorded in the literature. Two further cases which come to mind are ammonium nitrate for explosive, and silver bromide in photographic film. The speed of reaction is often of major importance and this is affected not only by crystal size, but also by its habit. The need for compacting and pelletization has also led to considerable interest in crystal habit in the fields of both fertilizer and medicine.

The whole subject is as yet in its infancy. Far more evidence will be required before we can hope to systematize our knowledge and "control crystal architecture" to the point from which we may hope to guide seekers to the likely catalyst, or conditions, for any particular substances and any particular crystal habit.

Since the crystal is known to be packed full of a variety of faults, and faults are the potential starting places for cracks, it would appear highly probable that it should be possible to affect the hardness of a crystal, and this subject has received an enormous amount of attention in the case of various metallic crystals, but remarkably little with such substances as sugar. To date the position with regard to the surface hardness of sugar crystals remains as I reported in 1959[5] in spite of considerable later study under Professor TOLANSKY, as then envisaged. It will be seen that it is unlikely that any immediate developments regarding crystal habit are likely to have an impact upon the industry comparable to that produced by conglomeration in recent years, although there are many possibilities calling for long term study. It may therefore be appropriate to conclude this essay with some mention of the above phenomenon. Looking back over the past half century in industrial sugar boiling perhaps the outstanding effort was for speed of production. Now crystallization has a very powerful time factor, the molecules need at least certain minimal time to achieve the crystal lattice anyway, and even given this bare minimal time they tend to "jerrybuild". The more rapid the growth, and the less efficient the mixing, the greater the tendency to the building of inclusions, to malformation, and even to multiple aggregation—or conglomeration. This is a vicious circle, for it is evident that the centrifugal will not be able so efficiently to discard mother syrup from multicrystal groupings, fjords of such syrup being inevitably held between every two or more neighbouring crystals. Further, when this "jerrybuilt" collection of crystals passes on to the granulator or dryer, the time factor is so brief that the residual layer of mother syrup does not have time for crystallization to keep pace with surface evaporation[6]—bear in mind that evaporation proceeds essentially in the surface layer to merely a few millimicrons depth, i.e. several molecular layers. Underneath layers of syrup can only lose water molecules by diffusion, which is a relatively slow process. Before the water molecules can escape from the inner syrup, particularly that in the fjords between neighbouring crystals, a surface "glaze" has been formed, as described in an earlier article, this temporarily sealing in much of the inner syrup. Only slowly does this unhappy molecular jam resolve itself, gradually changing towards equilibrium, meantime releasing the temporarily bonded water molecules at higher vapour pressures as the impeded crystallization is resumed. This unhappy state was reasonably well compensated when the sugar was packed in hessian, paper, or card, which with their high buffer

[5] "Principles of Sugar Technology", Ed. P. HONIG. (Elsevier, Amsterdam). 1959. Chapter I.
[6] POWERS: *I.S.J.*, 1960, **62**, 307–312.

capacities for holding moisture, were able to absorb the moisture thus released without much difficulty. When bulk handling and automatic high speed packing came into action after the war, the released moisture in its migration through the surrounding crystals led to concreting, and this really demanded action.

Many of us in the industry had felt that agglomerated grain was the active reason why some sugars were termed "soft" when rolled between the fingers, and the Swedish finding that agglomeration was a major factor in dust generation in the refinery came as a logical and powerful augmentation in the campaign to minimise conglomeration.

So we may conclude by stating that the "molecular architecture" of sugar crystals is indeed of great significance to the industry, and deserves our attention from both short and long term points of view.

FILTRATION-IMPEDING MATERIALS IN RAW SUGARS OF VARIOUS ORIGINS.

By TAKEO YAMANE, Sc.D., KAZUMASA SUZUKI, Sc.M., and TOSHIO KAGA, Sc.M.
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Introduction

NEARLY one and a half million tons of raw sugars are imported every year from various areas and processed in Japan. Among the properties of raw sugars the filtrability and colour content of affined raw sugars are the matters of greatest concern nowadays to Japanese sugar refining factories.

The slow filtering quality of Natal raw sugars and some Australian and Taiwan raws have been the cause of complaints in the last two or three years from Japanese refineries. This paper is concerned with the relation between the filtrability of raw sugars and of affined sugars from various areas and the filtration-impeding impurities contained therein.

Twenty-six sugar samples were taken at the Shibaura Sugar Company's refinery when raw sugars were being processed, while four samples of Cuban raws were provided by the Japan Sugar Refiners' Association.

As the greater proportion of raw sugars processed in Japan are imported from Australia, South Africa and Taiwan, and in view of the co-operation between the manufacturers of raw sugars and their processors, the methods for filtrability testing and analysis of the filtration-retarding substances were chosen as follows: the filtrability test was carried out according to the method of NICHOLSON and HORSLEY[1] (the method adopted by Colonial Sugar Refining Co. Ltd. of Australia) and the filtration-impeding materials in raw sugars—gums, starch, silica, wax and phosphates—were analysed according to the methods adopted at the Sugar Milling Research Institute, South Africa. These methods, including the method of affination, are outlined in an Appendix to this paper.

Results

The filtrability figures and analytical figures for raw sugars and affined sugars are listed in Table I. Comments on the filtrability of each sugar sample, experienced during factory processing, are added in the last column in Table I.

Discussion

The effect of individual impurities on the filtrability is considered below, although, strictly speaking, the filtrability figures listed in Table I express the composite effects of all the impurities.

Gum.—Gum has been known as one of the filtration-impeding impurities since this was pointed out by PRINSEN GEERLIGS[2]. The term "gum" is defined in this paper as follows: Gum = Total gums — Starch.

The filtrability of raw sugars and affined sugars is plotted against the gum content, as shown in Fig. 1.

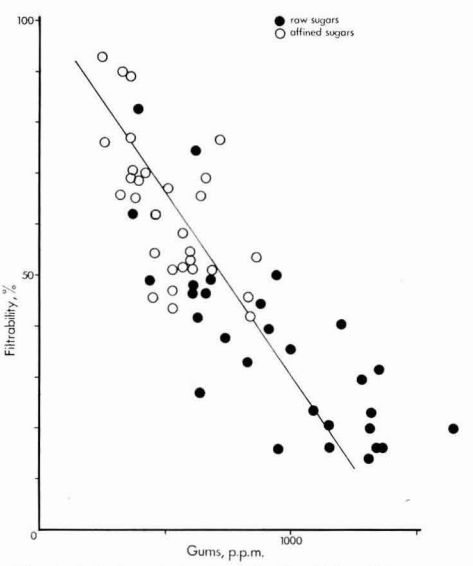

Fig. 1. Relationship between the filtrability of raw sugars and affined sugars and their gum contents.

[1] *Proc. 9th Congr. I.S.S.C.T.*, 1956, (2), 271–287.
[2] "Cane sugar and its manufacture." 2nd Edn. (Rodger, London). 1924, pp. 273–274.

Table I

The filtrability of raw sugars and affined sugars and the contents of filtration-impeding materials

		Raw Sugars						*Affined Sugars*					
		Test	*Filtration-impeding materials, p.p.m.*					*Filtra-*	*Filtration-impeding materials, p.p.m.*				*Factory*
Samples		*filtrability %*	*Gum*	*Starch*	*SiO_2*	*Wax*	*P_2O_5(total)*	*bility %*	*Gum*	*Starch*	*SiO_2*	*Wax*	*P_2O_5*	*filtrability*
Australia	A	50·0	940	270	56	82	88	69·0	660	180	32	60	34	
	B	49·0	680	180	141	53	122	68·5	390	140	54	34	38	
	C	48·0	610	160	238	26	116	70·0	420	110	61	29	40	
	D	46·5	610	200	175	32	124	65·5	320	120	109	34	32	
	E	44·5	880	280	124	75	88	65·5	640	190	57	63	28	
	F	31·5	1350	240	98	138	100	53·5	860	190	60	79	20	good
	G	23·5	1090	620	197	96	86	53·0	600	410	79	86	26	poor
	H	23·0	1320	480	205	112	120	51·5	570	350	105	101	24	poor
Cuba	A	27·0	640	150	94	51	68	54·5	460	120	66	50	32	
	B	20·5	1150	250	197	54	92	51·0	530	100	150	77	33	
	C	20·0	1310	100	218	95	36	52·0	680	110	148	72	24	good
	D	16·0	950	200	218	290	76	54.5	600	140	158	77	34	
	E	14·0	1310	170	184	104	96	47·0	530	150	165	62	33	
India		33·0	830	400	218	43	92	58·0	570	310	103	35	16	good
Natal	A	35·5	1000	710	170	74	124	51·0	610	480	89	92	42	
	B	29·5	1280	710	255	81	116	51·0	680	570	101	100	50	
	C	20·0	1650	500	193	134	136	45·5	830	440	77	85	34	poor
	D	16·0	1340	660	282	256	97	45·5	450	460	178	84	40	poor
	E	16·0	1360	660	244	190	136	42·0	840	460	133	103	44	poor
Taiwan	A	76·5	710	330	43	trace	23	89·0	360	190	26	8	16	good
	B	74·5	620	100	47	trace	18	90·0	330	60	24	trace	16	good
	C	62·0	370	230	137	33	66	77·0	360	170	60	20	24	
	D	49·0	430	640	86	20	74	76·0	260	430	53	9	24	
	E	42·0	630	510	176	20	76	65·0	380	340	81	12	32	
	F	40·5	1200	480	120	32	92	62·0	460	420	45	21	20	medium
	G	39·5	910	520	120	120	61	69·0	360	330	17	22	32	poor
	H	37·5	740	240	163	39	72	67·0	510	200	54	32	20	poor
	I	16·0	1160	540	99	122	108	43·5	530	370	81	64	56	poor
Thailand	A	82·5	390	40	trace	14	16	93·5	260	60	trace	3	4	good
	B	46·5	660	110	124	40	80	70·5	370	80	71	43	28	good

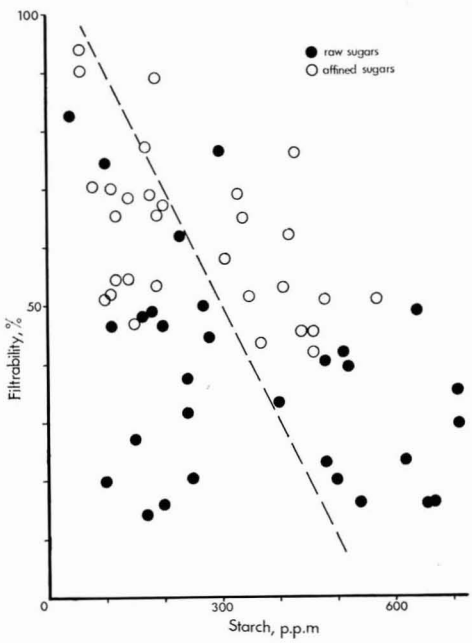

Fig. 2. Relationship between the filtrability of sugars and the starch content.

The existence of a fairly good relationship between them was observed, and a correlation coefficient —0·833 was obtained.

The gum content in Natal sugars was a little higher than others, while Taiwan and especially Siamese sugars contained less gum.

Starch.—Starch has won an unfavourable reputation as being associated with raw sugars of poor filtrability[3] and in Natal it has been confirmed that starch is the most important filtration-impeding impurity[4].

As shown in Fig. 2, some relationship between the filtrability and the starch content was observed to exist, although the correlation coefficient figure, —0·535, is lower than those for other impurities. J. B. ALEXANDER[5] and J. F. CHU & F. C. CHU[6], however, have stated that they found little or no correlation between filtrability and starch content.

The starch content in Cuban sugars was remarkably low and that in Natal sugars was high.

Silica.—A significant correlation between the filtrability and the silica content of Taiwan raw sugars has been found[6] and silica was thought to be among the impurities affecting filtration of Natal raw sugars[7].

[3] DAVIS: *I.S.J.*, 1959, **61**, 300; NICHOLSON: *Proc. 10th Congr. I.S.S.C.T.*, 1959, 213.
[4] DOUWES DEKKER: *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 159.
[5] *Proc. 31st Congr. S. African Sugar Tech. Assoc.*, 1957, 68.
[6] *Taiwan Sugar*, 1961, **8**, (1), 18.
[7] DOUWES DEKKER: *Proc. 11th Congr. I.S.S.C.T.*, 1962, 869.

As shown in Fig. 3, good correlation was observed between the filtrability and the silica content of sugars tested here and a correlation coefficient —0·757 was obtained. The silica content in Taiwan sugars and especially in Siamese sugars was quite low, while that in Natal and Cuban sugars was rather high.

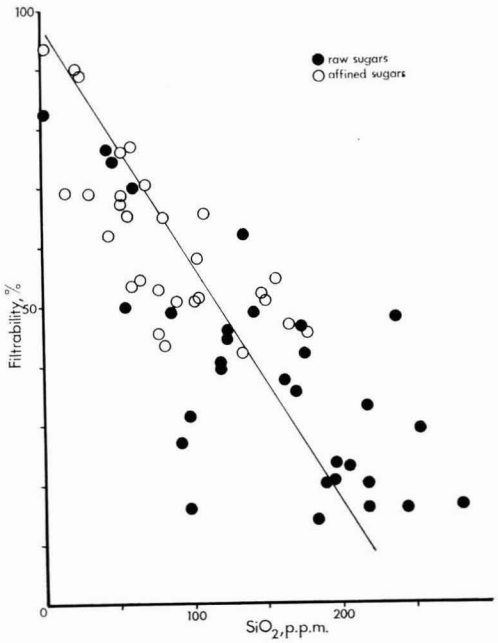

Fig. 3. Relationship between the filtrability of sugars and the silica content

Wax.—There was observed some, but not significant, correlation between the filtrability and the cane wax content of Taiwan raw sugars[6], while in the case of Natal raw sugars, wax and silica were deemed as important filtration-retarding impurities[7].

As shown in Fig. 4, sugars of lower wax content showed better filtrability; the effect of wax in sugars on the filtrability was remarkable and a correlation coefficient —0·716 was obtained. As the filtration tests were carried out at 20°C, a temperature far below the melting point of cane wax, the effect of the presence of wax on the filtration rate seems especially exaggerated. The wax content in Siamese sugars was extremely low.

Phosphates.—In Australia a marked effect of soluble phosphates in raw sugars on the filtrability of sugars has been confirmed[8], while also in Natal the effect of total P_2O_5 on the filtrability of sugars has been examined in relation to the raw sugar manufacturing processes[7].

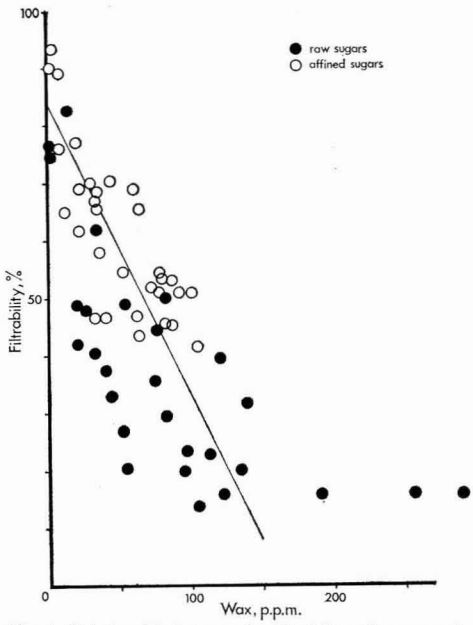

Fig. 4. Relationship between the filtrability of sugars and the wax content

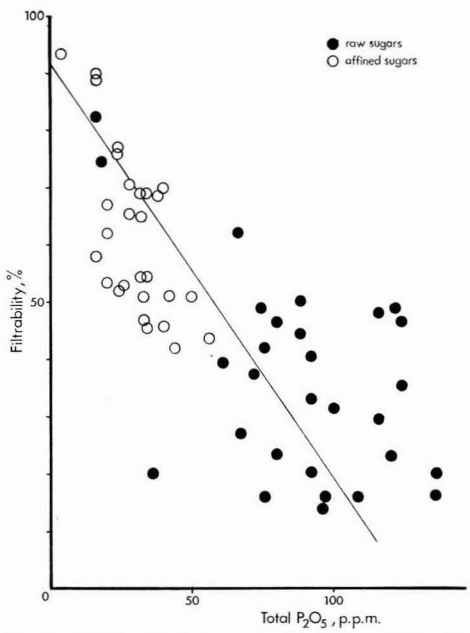

Fig. 5. Relationship between the filtrability and the P_2O_5 content

As shown in Fig. 5, a positive relationship was observed to exist between the filtrability and the P_2O_5 content and a correlation coefficient —0·746 was obtained.

The filtration-impeding impurities occluded in sugar crystals.—The impurities removal % of raw sugars by means of affination is listed in Table II, which also shows colour, ash and reducing sugar removal % in the last three columns.

The relationship between the filtrability of raw sugars and that of affined sugars.—Fig. 6 shows this relationship. When the filtrabilities of various sugars are to be compared, the filtrability may be measured before *or* after affination, since nearly the same results are obtained.

The removal % figures of filtration-retarding impurities are far lower than those of colour, ash and reducing sugar. It is concluded, therefore, that the

Table II. The removal % of filtration-retarding impurities by affination of raw sugars.

Samples		*Removal % of filtration-retarding impurities*					*Colour removal %*	*Ash removal %*	*Reducing sugar removal %*
		Gum	*Starch*	*SiO_2*	*Wax*	*P_2O_5*			
Australia	A	31	33	43	27	61	87	81	89
	B	38	22	62	36	69	87	75	91
	C	31	31	74	—	66	86	78	91
	D	46	40	38	—	74	86	82	91
	E	28	32	54	16	68	86	82	90
	F	34	21	39	43	80	83	88	90
	G	41	34	60	10	68	82	84	88
	H	49	27	49	90	80	84	81	90
Cuba	A	27	20	30	2	53	80	75	83
	B	55	60	24	—	45	79	72	87
	C	44	—	32	24	33	81	82	87
	D	36	30	28	74	55	79	78	89
	E	54	12	10	40	66	81	69	87
India		28	23	53	19	83	86	82	90
Natal	A	36	32	48	—	66	84	80	89
	B	37	20	60	—	57	84	85	89
	C	24	12	60	37	75	87	84	90
	D	55	30	37	67	59	83	77	92
	E	36	30	46	46	68	88	88	90
Taiwan	A	46	37	40	—	30	89	75	90
	B	46	40	48	—	11	92	73	91
	C	12	26	56	39	64	80	76	91
	D	36	33	38	55	68	88	81	92
	E	37	33	54	40	58	85	75	89
	F	48	13	62	34	78	86	74	92
	G	52	37	86	82	48	81	72	92
	H	28	17	67	18	71	83	71	90
	I	47	32	18	48	48	80	50	90
Thailand	A	26	—	—	79	75	90	87	93
	B	42	27	43	—	65	88	95	91

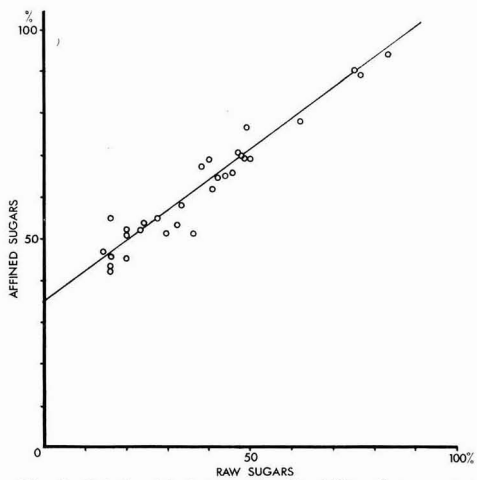

Fig. 6. Relationship between the filtrability of raw sugars before and after affination

filtration-affecting substances are retained in the crystals, the greater part of the gum and starch, especially, in raw sugars being occluded in crystals.

The filtrability of Cuban sugars.—Cuban raw sugars have won a high reputation in Japan regarding their filtrability. As seen in Table I, however, the filtrability figures obtained by the test filter were quite low. With respect to sugars from various areas other than Cuba, the test filter figures were well concordant with the factory comments on their filtrability. Further study will be made on the exceptionally low test-filter figures of Cuban sugars.

Summary

Thirty samples of raw sugars and affined sugars from various areas were examined as to their filtrability and the filtration-retarding impurities contained in them. Relative filtrabilities of sugars were estimated, using a Nicholson-Horsley test filter, and gum, starch, SiO_2, wax and P_2O_5 contents in sugars were determined. Significant correlations were found between the filtrabilities and individual above-mentioned impurities. A rather large quantity of filtration-retarding substances was contained inside

the crystals. When the filtrabilities of sugars are compared, the filtrability may be measured before or after affination, nearly the same results being obtained.

ACKNOWLEDGMENTS

The authors have to express their sincere thanks to Mr. C. W. DAVIS, Colonial Sugar Refining Co. Ltd., Australia, who kindly arranged the gift of the Nicholson-Horsley test filter used in the authors' experiments. Sincere thanks are also due to Dr. K. DOUWES DEKKER, Sugar Milling Research Institute, South Africa, who provided information on the methods of analysis of the filtration-impeding substances adopted by the Institute.

APPENDIX

The method of affination of raw sugars

After thorough mingling of 1000 ml saturated sugar solution with 1200 g of the raw sugar, the magma is centrifuged in a laboratory centrifugal, with no washing.

Filtrability measurement

This is carried out by means of a Nicholson-Horsley test filter[2,8]. Using the above-mentioned filter, approximately 250 g of 60°Bx sugar solution, of pH 9·0, is filtered at 20°C under a pressure of 50 p.s.i., using 0·48% "Celite 505" on solids as filter aid. The filtrate is discarded for the first two minutes of the run and collected for the next five minutes.

Methods of analysis of filtration-impeding substances in sugars

Gum[9].—150 ml acidified alcohol (prepared by adding 30 ml 1:1 HCl to 150 ml 95% alcohol) is added to 30 g of 50% sugar solution. The precipitate produced is filtered and weighed after drying. The dried substance is ignited, when the loss in weight represents the weight in total gums*.

Starch.—The method used is based on that of R. T. BALCH[10].

SiO_2 and phosphate.—Determined using techniques based on the methods described in "Colorimetric Methods of Analysis (3rd edition)" by F. D. SNELL and C. T. SNELL.

Wax[9].—200 g of 50% sugar solution is boiled and to this is added 2 ml 10% $KAl(SO_4)_2$ solution, 2 ml 10% KH_2PO_4 solution and 4 g kieselguhr. After standing overnight, the precipitate produced is filtered and washed. The filter cake plus filter paper is dried and wax is extracted with chloroform.

INFLUENCE OF THE DECOLORIZATION OF SUGAR JUICES AND PRODUCTS ON THE CRYSTALLIZATION RATE IN IMPURE SOLUTIONS

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(Dept. of Sugar Industry and Food Technology, Lodz Technical University)

PART II

DISCUSSION

Referring again to formula (1), let us consider the value of η, i.e. the coefficient expressing the reduction in the crystallization rate in the test solution relative to pure sucrose solutions. On the basis of the tests, η can be expressed as the product of the effect of the non-sugars in the solution and the effect of the colouring matter: $= \eta_1 \cdot \eta_2$.

Then $$\frac{dS}{dt} = -DF\frac{C - C_s}{l}\eta_1 \cdot \eta_2$$

where η_1 is the reduction in the crystallization rate caused by the non-sugars not adsorbed by the active carbon, and η_2 is the reduction in the crystallization rate caused by the colouring matter and other compounds, particularly colloidal compounds, which were adsorbed by the active carbon in column decolorization.

The formula permits calculation of the values of η_1 and η_2 from the test results for typical non-sugars occurring in factory sugar solutions. According to the graph in Fig. 3, the logarithmic values of the reduction in crystallization rate lie along a straight line. Hence the relationship can be expressed between $\ln \eta_1$ and η_2 and the quantity of non-sugars in the solution.

Calculations from the experimental data gave the following formulae:

$\ln \eta_1 = -0{\cdot}1015$ non-sugars, so that $\eta_1 = e^{-(0.1015 \text{ non-sugars})}$

$\ln \eta_2 = -(0{\cdot}76 - 0{\cdot}01765$ non-sugars), so that $\eta_2 = e^{-(0.76 - 0.01765 \text{ non-sugars})}$

Thus η can be expressed as

$\eta = e^{-(0.76 + 0.0839 \text{ non-sugars})}$

or $\eta = 10^{-(0.33 + 0.03643 \text{ non-sugars})}$.

Fig. 5 shows the relationship between calculated values of η, η_1 and η_2 and the solution purity in the form of a semi-log graph. The values are given in Table II for comparison of calculated with experimental values. The resultant differences lie within the limits of experimental error.

[8] *Proc. 12th Session I.C.U.M.S.A.*, 1958, 41.

[9] Handboek ten Dienste van de Suikerriet-Cultuur en de Rietsuiker-Fabricasie op Java, I, 1931.

* "Gums" as determined by this method is mainly polysaccharide material, but, strictly speaking, also includes protein, high molecular weight complexes and certain other water-insoluble substances.

[10] *Sugar J.* (La.), 1953, **15**, (8), 11–15.

Table II

Comparison of the rate constants of sucrose crystallization calculated from the empirical formula for η, η_1 and η_2 with constants found experimentally. The rate constant of sucrose crystallization in pure solution has been assumed as one.

	The rate constant of sucrose crystallization			
	non-decolorized solution		*decolorized solution*	
	calculated from η	*experiments*	*calculated from* η_1	*experiments*
Mother liquor from thick juice, 94 purity	0·2820	0·2945	0·5550	0·5725
Mother liquor of second product massecuite, 81 purity	0·0995	0·1010	0·1450	0·1525
Mother liquor of low product massecuite, 71 purity	0·0410	0·0404	0·0527	0·0518

The method for determining the values of η_1 and η_2 on the basis of solution purity permits determination of the purity at which the crystallization rate reduction is half caused by the non-sugars and half by the colouring matter. In this case $\eta_1 = \eta_2$ and $\ln \eta_1 = \ln \eta_2$.

Consequently

$$-0{\cdot}1015 \text{ non-sugars} = -0{\cdot}76 + 0{\cdot}01765 \text{ non-sugars}$$

$$0{\cdot}76 = 0{\cdot}11915 \text{ non-sugars}$$

$$\therefore \text{ non-sugars} = \frac{0{\cdot}76}{0{\cdot}11915} = 6{\cdot}38,$$

which corresponds to a thick juice of 93·6 purity.

carbon of solutions subjected to crystallization causes a significant increase in the crystallization rate and at the same time only a slight rise in purity, by about 0·3 units. Complete decolorization of solutions of purity exceeding 80 will cause a significant increase in crystallization rate and simultaneously a significant rise in purity. On the other hand, after decolorization of low purity solutions there is a considerably smaller increase in crystallization rate, but a sharp rise in purity. With molasses the purity rises by 3–4 units after active carbon decolorization.

No foaming occurred during thickening-up and crystallization of almost completely decolorized solutions, which is of considerable significance from a technological viewpoint. On the other hand, if colouring matter is added to pure sucrose model solutions (the colouring matter being isolated from active carbon using pyridine aqueous azeotrope), there is not only a sharp reduction in purity but the solutions have a slight tendency to foam.

Summary

The majority of previous papers on the rate of sucrose crystallization deal with the effect of added organic and inorganic compounds.

The authors investigated the dependence of the crystallization rate in sugar syrups and products at 80° C on the presence of colour matter and colloidal compounds adsorbed on active carbon. Crystallization was carried out in Dewar flasks applying the same supersaturation and circulation rate in every test.

Decolorization of sugar solutions in columns increases juice purity by 0·3 units and molasses purity by 3–4 units. In decolorized high purity solutions the crystallization rate is double that in the same solutions before decolorization, whereas decolorization of low purity solutions causes comparatively little increase in the crystallization rate.

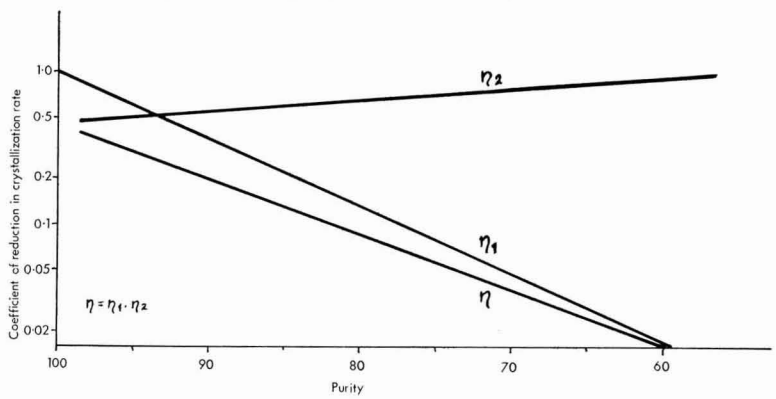
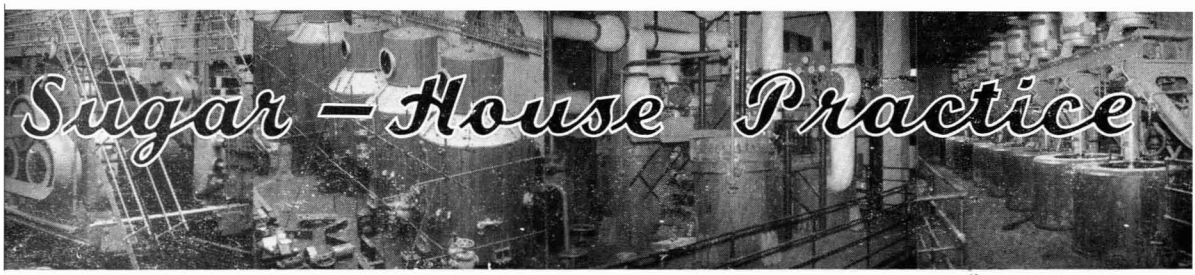


Fig. 5. Reduction of crystallization rate in impure solutions relative to pure sucrose solutions as a function of purity. η = coefficient of reduction for undecolorized solutions, η_2 = coefficient due to colouring matter and other compounds isolated by adsorption on active carbon, and η_1 = coefficient due to non-sugars not adsorbed on active carbon.

In Fig. 5 it can be seen that with solutions of 93·6 purity, the straight line corresponding to η_1 cuts the straight line corresponding to $\ln \eta_2$.

Hence it follows that complete elimination of colouring matter from a 93·6 purity solution of the type studied will increase the crystallization rate to a value intermediate between that of sucrose in the impure solution of 93·6 purity and a refined sugar solution.

In conclusion it must be added that complete decolorization by the column method using active



Boiler feed water treatment. R. A. EVANS. *Rpts. Hawaiian Sugar Tech.*, 1964, 34–39.—Techniques used for removal of oil contamination, dissolved solids and gases from boiler feed water, detection of sugar, and chemical treatment are described as, briefly, is chemical cleaning of the boilers.

* * *

The influence of low temperature corrosion in oil-fired boilers. F. M. FUGRAD. *Sugarland* (Philippines), 1965, **1**, (12), 24–27.—Sulphur in residual fuel oil, amounting to about 3%, is oxidized during combustion to SO_2 and SO_3. The SO_2 may be further oxidized by catalytic action in the boiler systems at about 1100°F. Water vapour present produces sulphuric acid which condenses on surfaces below the acid dewpoint (250–300°F), causing corrosion. Factors affecting SO_3 production are discussed, as are methods for preventing low-temperature corrosion, including operating procedures, materials of construction and the use of fuel additives. Specifications for fuel oils are tabulated and discussed.

* * *

Sugar mill research in Natal during 1964. ANON. *Ann. Rpt. Sugar Milling Research Institute*, 1964, 7–29.—It was found that sugar boiled from a juice subjected to acid pre-clarification (cold sulphitation to pH 3·2) was of higher purity and filtrability than usual. The juice was passed through a separator which gave an underflow (5% of the juice) which contained 90–95% of the floc, with which was associated about 65% of the starch. The underflow required an uneconomically high quantity of filter aid when filtered on a Stellar filter. Preliminary trials with the NICHOLSON & HORSLEY technique of auto-enzymic destruction of starch in mixed juice[1] showed that at a temperature of about 70°C up to 36% of the starch was destroyed in 20 min, further time giving no additional reduction. At the same time 0·2–0·3% of sucrose is lost and tests are to be made using added commercial enzymes to destroy more starch. The ratio of starch in sugar to starch in massecuite was found to vary widely between strikes and factories; it is considered desirable to investigate the causes. A steel sleeve was inserted in the downtake of a pan and raised with the massecuite level to prevent short-circuiting. Thermometers were also placed in rows of three, one below and two above the calandria. Boiling patterns were observed using these thermometers and were found to show considerable variation—sufficient to obscure any benefit from the sleeve. Deterioration of cane stored under the conditions obtaining in a mill yard were investigated by taking samples at intervals from a large bundle of cane, crushing and clarifying under standard conditions, and the juice processed to sugar. Sucrose was found to be inverted, the rate increasing with temperature, but the invert formed was decomposed only slowly. Starch in mixed juice decreased and gums tended to increase with storage. Turbidity of clarified juices first dropped and then increased. Sugar filtrability improved at first as the starch content fell but later tended to deteriorate because of the higher gum content of the juice. Crushing of cane left in the open for not more than 5 days had no adverse—and possibly a beneficial—effect on the raw sugar quality, but delay between cutting and crushing should be minimized because of the loss of sucrose involved. Storage of syrup before boiling was found to have no adverse effect on sugar quality. Samples taken from a massecuite during boiling gave crystals of different sizes; their filtrability was measured but differences were small and irregular so that they were not related to size. Methylation of oxidized gums from deteriorated cane was used as an initial step in examining the structure of the gums. Gums precipitation has been standardized by adoption of a mixture of 30 ml 1:1 HCl and 150 ml absolute ethanol as the precipitating solution; the most suitable filtering septum tried has been found to be kieselguhr supported on a No. 3 sintered glass filter. The LÓPEZ HERNÁNDEZ method of sugar determination[2] has been found to provide no benefit for Natal factories. Sampling and cold blending of shredded cane has been investigated, as has the stage efficiencies of individual mills in Natal tandems; the latter were 25–35%, and it is considered that replacement of a tandem by two diffusion stages (100% efficient) with an intermediate mill might be the most effective extraction process. Investigation of mill juice through various tandems revealed a high purity drop and greater production of reducing sugars in mills with apron carriers where bacteria accumulated between the slats; spraying with a quaternary ammonium bactericide brought the apron carrier mill analyses into line with other tandems. Spraying along the tandem at 4-hr intervals could suppress inversion and is more effective than adding the compound in imbibition water so that very little is used and is not detectable in syrup. An air-slide classifier was found to be more efficient than a screen for removing fines from bagacillo. Studies have continued on sucrose crystallization in *C*-massecuite in relation to final molasses viscosity, and tests have been carried out on pneumatic drying of low-pol sugar. The dryer performance was satisfactory as would be heat economy if air was recycled, and maintenance would be negligible. The

[1] *I.S.J.*, 1958, **60**, 260–263.
[2] *I.S.J.*, 1963, **65**, 46, 72, 107.

heat transfer rate between sugar and cooling air was measured and used to show that the S.M.R.I. air-slide classifier would provide enough cooling to prevent caking. Direct manufacture of low-pol sugar by retaining an *A*-molasses film on sugar crystals was shown to be practical if extra drying demand was met by supplying hot air to the dryer. Two samplers were designed for incoming and outgoing sugar at the Durban bulk terminal; both worked successfully but because of discrepancy between duplicate samples it is proposed that one sampler be adapted to continuous sampling. Boiler examination at two factories showed the causes of inefficient operation and need for supplementary fuel; at one the remedial measures were successful, but inadequate staff and steam shortage prevented improvement. Advice was given to factories as to superheater deposit and gearing problems. A survey was made on processing in South African sugar factories. Laboratory studies have been made on sucrose esterification in ethanolamine as solvent instead of the more expensive dimethylformamide.

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Calculation of the hermal loading of vacuum pans and crystallizers. V. D. POPOV, I. S. GULYI and N. A. SHEVANDIN. *Izv. Vysshikh Ucheb. Zaved., Pishch. Prom.*, 1964, (5), 123–126; through *S.I.A.*, 1965, **27**, Abs. 162.—A semi-graphic calculation of the total heat transfer, based on the method of finite differences, is described with worked examples in the cases of a continuous and a batch crystallizer with artificial cooling. The calculation is shown to be accurate, whereas a calculation based on the arithmetic mean of initial and final values of the heat transfer coefficient and temperature difference over-estimated the value by ~18%.

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Determination of the (air flow) velocity at which fluidization of dry granulated sugar commences. I. B. NOVITSKAYA. *Sakhar. Prom.*, 1965, **39**, 252–255. Fludization tests were carried out with an experimental unit which included a vertical cylinder containing a layer of dry sugar and of wet sugar (moisture contents of 0·06% and 1·95% respectively) of 20, 30 and 40 mm height. Subsequent tests were also conducted with dry sugar (0·03% moisture content) divided into five different fractions from 0·2 to 2 mm. The results were processed by the least squares method and an expression derived: $Re = 0{\cdot}087\ Fe^{1{\cdot}8}$, where Re = Reynolds number and Fe is Fedorov's number $[= \sqrt[3]{\frac{4}{3}\frac{g}{{\nu_B}^2}}\left(\frac{\gamma_m}{\gamma_B} - 1\right)$, where d_e = equivalent diameter of particle (m), g = acceleration due to gravity, ν_B = kinetic viscosity of air (sq.m./sec), γ_m = density of sugar (kg/cu.m.) and γ_B = density of air (kg/cu.m.).] The relation is valid for Fe = 5–55, permitting determination of the fluidization velocity for the final drying zone and cooling zone (i.e. where the sugar is practically dry). A graph of Fe *vs.* Re is given based on the experimental results measured at 27°C and 95°C. The pressure drop through the sugar layer was also determined.

$R = \frac{\text{actual pressure drop}}{\text{theoretical pressure drop}}$ varied within the range 1–0·84 for all cases, the lower values occurring with the small fractions. The fluidization velocity was practically independent of layer height.

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The adsorption of colouring bodies by magnesium oxide. M. FRIML and B. TICHÁ. *Listy Cukr.*, 1965, **81**, 70–77.—The decolorizing effect of MgO added in various forms ("Elguanite"*, coagulated MgO and aqueous suspension) to sugar solutions was studied. Under identical conditions, the MgO was less soluble than CaO. With addition of more than 0·25 g of MgO per 100 ml of juice, the alkalinity of the latter rose by a constant amount corresponding to approximately 0·01 g CaO/100 ml. At about 10 mg MgO/100 ml the soluble magnesium salts content also increased. The addition of 1·5 g MgO/100 ml permitted approx. 70% decolorization. The MgO precipitate was easily removed as a brown mud by filtration. Adding SO_2 together with MgO to remelt liquor enabled the pH to be maintained at a desired level, while a drop in pH by 1 unit (from about 9 to 8) raised the decolorization effect by a further 5%. MgO had little effect on the conductivity, but the latter rose sharply when the SO_2 was added. The use of MgO is recommended for remelt liquor treatment.

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Purification of cane raw sugar re-melt. A. K. KARTASHOV, R. G. ZHIZHINA and N. A. MAKSIMOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 148–197.—Literature on the processing of cane raws, either separately during the off-season or together with beet during the campaign, is reviewed (33 references). Laboratory tests were carried out and the results are discussed. Addition of raw sugar to limed juice caused an increase in 2nd carbonatation juice lime salts and colour, but the colour may be reduced by adding 0·5% CaO (on weight of beet) to the 2nd carbonatation juice. This does, however, have the additional effect of raising the lime salts content still further by destroying reducing matter. When added at up to 5% w/w to 1st carbonatation juice, raw sugar acts as a flocculant, increasing the settling rate and improving the quality of the supernatant. However, while 2–5% raw sugar reduces filtrability only slightly, with larger amounts filtration markedly deteriorates. With separate processing of cane raws, progressive preliming was found to have no real positive effect on the filtrability of the carbonatated melt liquor, although adding lime in three doses during carbonatation increased the filtration rate by almost 150%

* Containing 78·4% MgO (19·4% loss by heating), 0·23% CaO, 0·41% P_2O_5, 0·63% SO_3 and traces of B, Si, Mn, Ti, Cu and Ag.

compared with the rate obtained by pre- and main liming. Return of unfiltered carbonatated liquor to raw melt increased the filtration rate of the carbonatated liquor, but did not affect settling. Identical quantities of lime had different clarifying effects with raw sugar of varying quality, the effect diminishing as the colour of the original melt liquor increased. No clear recommendations on alkalinity at carbonatation could be given. It was found that double carbonatation had no essential advantages over single carbonatation for melt liquor, which after 2nd carbonatation filtered poorly and gave a turbid filtrate. Melt liquor from non-affined raws underwent a marked fall in pH when heated after simultaneous liming and saturation and had low thermal stability. If treated by prolonged liming (20–30 min) at 80°C it had high thermal stability. Where the raw sugar was first affined, there was no noticeable difference in the thermal stability as between prolonged liming and simultaneous liming and saturation. Recommended schemes for purification of affined and non-affined raw sugar are described. The affined sugar scheme incorporates liming, single carbonatation and sulphitation, while the non-affined sugar scheme involves simultaneous liming and saturation, followed by sulphitation.

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Mechanisms of the process of irregular filtration in the curing of sugar massecuites. B. N. TERESHIN. *Trudy Vysesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 212–221.—Separation of molasses from sugar crystals during curing is treated theoretically as filtration of a liquid through a porous medium. Formulae are derived for calculating the time taken to separate the molasses film and for determining the permeability of the layer of sugar crystals in the centrifugal basket. Sieve analysis data and microscope measurements are tabulated for massecuite, white and brown sugar. The greatest difference between experimental and theoretical data was found for refined granulated sugar. Reasons for the divergency are given.

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Use of granular active carbons with magnesite added for syrup clarification in refined sugar manufacture. I. L. ZDANOVICH and F. P. ALEKSEENKO. *Sakhar. Prom.*, 1965, **39**, 331–334.—To prevent a drop in pH of refinery syrups when treated with AGS-3 granular active carbon, magnesium oxide was added to the carbon which was then designated AGS-5 and preliminary tests carried out on this and a new carbon (AGS-4), also incorporating MgO. Both maintained syrup pH at a satisfactory level, the AGS-4 being better because of its higher MgO content. The magnesium content of the treated syrups increased only very slightly and did not exceed 0·002% MgO (on weight of dry solids) higher than the original syrup. The clarifying property of both carbons was approximately the same as that of the AGS-3 carbon. A reduction in buffering properties with syrup treatment is attributed to inadequate regeneration of the carbon.

The infection process in sour storage rot. B. T. EGAN. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 21–24.—Examination of platings made from various parts of cane billets and standing cane indicated that *Leuconostoc* infection of the stalks took place at the cutting point and at the time of cutting. Small numbers of bacteria enter the cut ends and develop rapidly, with spread throughout the billet within 24 hr. Subsequent growth is slower and after 5 days *Leuconostoc* populations will probably start to decline when the pH falls to 4·0–4·6. The mechanism of bacterial transport is described.

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Chemical control of sour storage rot. B. T. EGAN. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 25–30.—Preliminary trials were made whereby a number of bactericides (quaternary amino compounds, calcium hypochlorite and antibiotics) were tested for their effectiveness in controlling *Leuconostoc*. *In vitro* tests eliminated the $CaOCl_2$ and streptomycin, and the other materials proved ineffective in field trials where they were applied as a spray using a cane harvester-mounted rig. Fumigation with formalin showed some promise but entails great practical difficulties.

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The A.T.V. at Cattle Creek. W. H. ROSS and K. J. PEATEY. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 31–35.—In order to adapt to the Killer process (by producing heavy primary muds) and to provide rapid liquidation at week-ends, a Dorr A.T.V. clarifier was modified with extra juice withdrawal and run-off pipes, a greatly enlarged mud cone and internal conduits from one mud tray to the next provided with butterfly valves controlled from outside the clarifier. These internal mud pipes did not convert the A.T.V. unit into a single-point mud draw-off clarifier, but were found very useful since the valves permitted isolation of a compartment for up to 8 hr in the event of a pump failure. Mud boots could be emptied quickly and completely for liquidation and after holding juice during a week-end shut-down, while, during filling of the clarifier, clear juice could be withdrawn from the bottom and higher compartments as the juice level rose above them.

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Operational experiences with an Eimco belt filter. B. C. OLSON. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 41–44.—A 616-sq.ft. "EimcoBelt" filter replaced two 300-sq.ft. Oliver-Campbell screen filters at Pleystowe mill in 1964. Difficulties in operation in its first season are recorded; these included non-uniformity of cake at first, necessity to use "Separan" to flocculate the muds (0·5 lb/hr for 6 tons/hr of cake) which otherwise blinded the fine weave of the belt, unsatisfactory filtrate clarity, and higher pol losses than with the screen filters. The high retention obtained, however, is beneficial to the operation and capacity of both the clarification and filter stations.

Reconditioning stored subsider juice. C. S. HENDERSON. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 37–39.—Muddy juice which had to be stored during an 82-hr shut-down was treated with 830 p.p.m. of soda ash and cooled to 189°F so as to preserve it. The mud content was found not to settle, perhaps owing to extra pumping, but responded to treatment with 20 p.p.m. of P_2O_5 as superphosphate, liming, heating to 215°F and addition of 3–4 p.p.m. of 0·01% solution of "Separan AP-30".

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Factors influencing the filtration and washing of filter cakes. G. THOMAS. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 45–55.—The mechanism of filtration of a slurry such as cane mud is described and the Poiseuille and D'Arcy equations for flow rate are derived for a fixed cake. Cake porosity is discussed, as is the effect of pressure on specific resistance of a compressible cake. Cake formation and continuous operation are considered and an equation quoted for cake washing. The effects of air in the cake during washing are discussed as are other topics, including screens and filtrate clarity. Recommendations are made for obtaining the best performance from a continuous filter.

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Motor control centres. D. M. BAIRD and H. F. SCHERNICKAU. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 57–62.—Modern designs of control units for electric motors are briefly described.

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Sugar mill switchboards. F. M. LOHNING. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 63–74.—Switchboards built many years ago may be inadequate to cope with fault levels in present-day installations in sugar mills, where electric power has grown, perhaps with connexion to the local electricity network. Modern switchboard design and operation are described and a method outlined for rapid evaluation of fault levels in a mill.

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Industrial A.C. induction motors. E. G. BARNES. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 75–84.—Features of A.C. motors are described; these include insulating materials, type of winding, rewinding of existing motors, squirrel-cage motors, machine enclosures, ventilation, and belt drives.

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Gear lubricants of concern to the sugar industry. R. L. ASHLEY. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 85–90.—Requirements for lubricants for automotive transmission hypoid and worm gears, automatic gearboxes, tractor transmissions, diesel locomotives and mill gearing are discussed, with a note on pitting and wear of mill gears, oil contamination, etc.

Fabrication of steel pipework. J. H. BECKLEY. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 91–100.—The more important aspects of the codes which have been developed to cover pipework design and fabrication are reviewed, and the various methods used to fabricate steel tube are outlined.

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Design consideration in a boiler feed system. A. H. CHANCELLOR. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 141–147.—In a modern high-pressure, high evaporation rate boiler, there is only a short time delay, e.g. 7 min, between feed failure and exposure of the tubes to direct combustion heat, so that reliability of the feed system is essential. Aspects of such a system are discussed, including collection and purity control of condensate, feed storage with audible level alarms, feed pump mains and pump selection, capacity, drive protection and suitability.

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Tests of the Inkerman boiler. J. H. NICKLIN and A. D. DOOLAN. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 149–154.—Tests were carried out on a new large boiler at Inkerman mill to examine its efficiency and to see if it met its guaranteed capacity. Combustion efficiency proved to be excellent and the boiler delivered well over rated capacity with bagasse moisture as high as 53%. Because of high exit gas temperature, the boiler efficiency was only 53·2%, but with an air heater or economizer it would rise to 66·5%, comparable to boilers at Pioneer, Kalamia and Bingera. Flue gas calculations show the existing fan to be adequate for a steaming rate 30% above the guaranteed rate.

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Steam accumulator operation in a sugar factory. T. C. MULVENA. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 155–160.—The function, design and operation of a steam accumulator are described, and an account given of tests on a new unit at Pleystowe mill, where heat balances were taken at intervals and calculations made of the steam fluctuations which would have occurred had the accumulator not been installed. The unit proved quite effective in reducing peak demands on the boiler station, so helping to provide smoother operation. Steam flow fluctuations due to variations in factory heat requirements can be virtually eliminated.

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A thermo-compressor for conserving steam. R. J. BATSTONE. *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 161–162.—A floating ejector-type thermo-compressor has been installed at Pleystowe to convert flash vapour from condensate (at 1–3 p.s.i.g.) to 15 p.s.i.g. steam for the exhaust main by addition of live saturated steam at 190 p.s.i.g. Performance has compared favourably with the manufacturer's specifications, and no trouble has been experienced with its control or operation.

BEET FACTORY NOTES

Theoretical consideration of modern circulation carbonatation schemes. K. KOLLMANN. *Zucker*, 1965, **18**, 204–210.—An attempt is made to give a theoretical basis to the conventional method of directing air and CO_2 flow in a carbonatation vessel by means of guiding devices. The more important cross-section areas of the vessel and guide devices are incorporated in mathematical expressions and the physical concepts of throttling, thrust and power are discussed.

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A heat exchanger based on the principle of the DDS diffuser. H. BRÜNICHE-OLSEN. *Zeitsch. Zuckerind.*, 1965, **90**, 190–191.—Tests during the 1964 campaign have indicated the advantages of using a cossette scalder on the lines of a DDS diffuser. The only difference between the DDS trough and the heater lies in the much higher throughput achieved by increasing the screw speed and the slope of the trough. The steeper angle also enables the heated cossettes to fall from the upper end of the trough unaccompanied by juice. The test model was smaller than the conventional DDS trough (7 m, corresponding to a throughput of 1500 tons/day). The cossettes were heated to a temperature (65–67°C) only 3–5° below the temperature of the incoming juice. The Brix of the raw juice rose by about 2%.

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The sugar industry in Persia. M. MONAZAHIAN. *Zeitsch. Zuckerind.*, 1965, **90**, 192–197.—Information is given on the history and development of the Persian sugar industry, which consists of 12 beet factories, 3 refineries and 1 cane factory (all state-owned) and 7 private beet factories. A further 4 private beet factories are planned. Most of the state-owned factories are small, while the private ones are larger, though still with slicing capacities of only about 1000 tons of beet/day. The Persian government plans to increase output from the present 150,000 tons of sugar to 550,000 tons in 1968. Cane cultivation in the northern plain of Khuzestan has been beset with a number of problems and sugar production at the cane factory in 1964 was well below the planned output. The two major snags are damage to crops by wild animals and frost damage. Since there are few roads in Persia, road trucks carrying the beet must travel great distances over cart tracks. These become impassable in heavy rain and many tons of beet must be left in the fields. Large areas of Persia have many villages which become cut off from the outside world by rain and snowfalls for up to five months a year. An outline is given of future plans for the industry.

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Movement and rotation of beet roots in the field of force of (beet) knives during slicing into cossettes. V. N. SHCHEGOLEV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 14–49.—The effects of free movement of beets in slicers on the quality of the cossettes have been examined theoretically and experimentally. Formulae describing the various effects have been checked under factory conditions with various types of slicers. The formulae are analysed and a worked example is presented. The percentage of beets having curvilinear and straight-line cuts after removal of a knife frame from a centrifugal slicer was determined and with a second procedure the coloured areas of the cuts were transferred onto paper and diagrams of the actual forms presented. Among the recommendations for prevention of free movement based on the results are: the slicing rate in centrifugal slicers should be raised, the slicing force reduced, the pitch of the knife divisions increased to that of finger-shaped knives, cossette thickness increased and the number of working frames reduced, and the value of ψ (a coefficient taking knife shape into account) decreased. Since the free play of the roots increases with reduction in their height, U-shaped cossettes are recommended, or, where these are not feasible, laminar cossettes. Electro-polishing of knives has been shown by DRONOV[1] to improve cossette quality, but more information on knife condition before and after polishing is required. Woody beets have high resistance to slicing and a high elasticity modulus, which in turn increase free movement. Compression is caused by free play, and was found to be high with pressing wedges. However, proper use of wedges gives good quality cossettes.

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The capacity of beet slicers and optimal slicing rates. V. N. SHCHEGOLEV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 49–72.—The question of increasing slicer capacity and raising cossette quality is examined. From the premise that the roots in the feed hopper to the knives are momentarily halted as a root is sliced, thereby pressing the root onto the knives, it is shown that as the slicing speed increases, the output of the rotary section of the feed hopper decreases, while the slicer throughput is raised. With increase in the slicing rate, the distance travelled by a root in the rotating section of the hopper decreases, thus affecting the thickness of the resultant cossettes. The effect of an extremely high slicer throughput on cossette quality has been examined and found by other workers to lead to poor cossettes. This relationship is discussed in mathematical terms and the equations presented are analysed. In the case of disc slicers, with increase in cossette thickness it is necessary either to reduce the slicing rate or increase the size of the plate mounted on the disc opposite the knives. The advantages of this measure are demonstrated by the performance of slicers where the plate size has been increased by removing the knife frame. Also of importance for slicer capacity are the form and angle of slope of the feed hopper (the steeper the angle the greater is the pressure head of the beet column), the required

[1] Dissertation.

cossette thickness (with which is connected knife lift), the use of wedges, which tend to improve cossette quality, and the diameter of the throat of the helical feeder (where applicable).

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Compression of beets in slicers. V. N. SHCHEGOLEV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 72–84.—Using the theory of friction and angle of repose, the author explains how beets are compressed in beet slicers, where the slicing force pushes the beets against the wedges while other forces push the beets onto the knives. In disc slicers the dominating rôle is played by the pressure head of the beet column in the feed hopper, while in centrifugal slicers both the centrifugal force and the pressure head applying are significant. Tests were carried out with hoppers to determine the optimal design. It was found that a cylindrical hopper of as great a diameter as possible with an inverted conical bottom would increase the effective pressure head and reduce "sticking". The angle of internal friction, determining the movement of the beets in the hopper, varies throughout the height and depends not only on the pressure head, but also on the physical properties of the beets and their surface conditions. It increases if the beet remain in the hopper a long time, when the beets become deformed. Calculations of feed hopper diameters are to be used with caution, since the formulae assume a shorter dropping time than the true value.

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Conditions of movement on beets in beet slicers. V. N. SHCHEGOLEV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 85–107.—Movement of beets down the feed hopper of a centrifugal slicer theoretically occurs at up to twice the angle of slope from the verical in the initial zone, then at up to twice the angle of slope from the horizontal in the second zone. However, in practice, a bottleneck occurs at the point where the inner wall of the rotary section of the hopper changes from vertical to horizontal and the funnel-shaped column of beets nearest the wall cannot move. This is overcome by making the rotary section conical and thus widening the bottom. A method for calculating the proportions of a conical feeder is described. Comparative tests showed that the throughput of a slicer provided with a helical feeder of new design and with a wider hopper throat was increased by 18–20%, while the cossettes were of more uniform thickness, thin slivers being absent, and the cuts were smooth in most cases. The advantages of a slicer with inverted conical feeder, produced in 1963, are listed. The question of the various pressures applied to beets in a slicer and rotary movement of the roots around the knives is discussed, as is the amount of deformation permitted in order that the quality of the cossettes is not reduced. While rotary movement is not great as the root is being cut to its centre, once the knife has cut this far, rotary movement increases and thus tapering of the cossette is increased. To reduce fluctuations in the pressure of the beet around the knife edge, whereby the beet tends to rise above the knife which leads to tapering, the knife lift should be increase, or knives installed without any lift. The question of optimal knife angle, which can only be decided experimentally, is discussed. In this connexion reference is made to the use of Goller, Koenigsfeld and Chizhek knives in the three different types of slicers. The use of Chizhek V-ribbed knives in drum slicers in the U.S., giving high quality square-section cossettes and high slicer throughputs, is mentioned.

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Separation of impurities heavier than water from beet. N. M. DATSENKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 107–121.—Comparative tests were carried out on three different types of stone catchers: the conventional Raude batch type, the continuous Pavlyuk-Sokolov drum type[1] and an experimental continuous model, the KL-59. The last comprises an 8-paddle wheel rotating faster than the beet flow; this pushes the beet along the flume over a slightly upward sloping grid placed over a chute, but not completely covering it. Smaller impurities fall through the grid, while the larger ones fall into the chute after passing beyond the grid. For the test, stones were grouped into four categories, each containing 50–100 stones of one size, shape and density. The stones were thrown into the flume about 3–4 m from the catcher during a period of 20 min and the percentage of stones in each category caught was determined. The Pavlyuk-Sokolov drum type proved best, while the KL-59 showed no advantages over existing models and is not recommended. The drum type caught 98% of the large stones and 92% of the small stones compared with 94% and 78% respectively with the Raude. In tests on continuous removal of sand from the Raude model, to the bottom of which was added a conical screen and a nozzle, the screen became blocked and proved inadequate while the nozzle worked normally without blockage. Further tests with an enlarged screen surface are to be carried out. Investigations of the performance of the drum model are discussed and some modifications to the design are described.

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Influence of smoothness of operation of diffusers on the value of the coefficient of utilization of the diffusion stream. E. T. KOVAL' and A. YA. ZAGORUL'KO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.* 1964, **10**, 121–127.—The coefficient of utilization of the diffusion stream (ϕ) is given by $\frac{\text{Bi}}{3 + \text{Bi}}$, where Bi (Biot's number) $=$ $\frac{\text{mass transfer coefficient} \times \frac{1}{2} \text{ the equivalent cossette thickness.}}{\text{diffusion coefficient}}$

The effect of fluctuations in diffuser performance on the value of ϕ has been determined for Buckau-Wolf,

[1] *I.S.J.*, 1962, **64**, 340.

RT and BMA diffusers. The various factors significant for diffusion evaluation were measured over a period of 8 hr without press-water recirculation. The tabulated results show that as the frequency of deviations within a particular range from the mean rate of cossette processing increased in unit time, so the value of ϕ decreased to a minimum then increased again, and the sugar losses increased to a maximum corresponding to the minimum of ϕ, then fell again. Formulae incorporating ϕ are given for predicting diffusion losses with normal diffuser operation. The use of ϕ or any complex containing it, as calculated from actual diffusion losses and other diffusion parameters, for derivation of a computer algorithm is discussed.

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The "J" diffuser as reflected in the Soviet specialist literature. A. KORBONITS. *Cukoripar*, 1965, **18,** 70–73.—References in the Soviet literature to the performance of the Hungarian "J-VIII" diffuser are discussed and comparative data reproduced showing the performances of RT, Buckau-Wolf, DDS, BMA, Olier and "J-VIII" diffusers.

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Corrosion of brass tubes in sugar factory evaporators. M. SZABO and J. KOVÁCS. *Cukoripar*, 1965, **18,** 77–84. The corrosive effect of 1% HCl on evaporator Sr 63 brass tubes was studied gravimetrically and metallographically, whereby the brass was found to lose its zinc content. Of three Hungarian corrosion inhibitors tested, only one ("Mavebit CCC") was found to be effective, but since the protective layer formed adheres badly it is unsuitable for the food industry.

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Leaf filters in the sugar industry. I. OGLAZA. *Gaz. Cukr.*, 1965, **73,** 55–56.—Three leaf filters are described and some details given of their rated performances. The filters are: the "Herkules-R.A.", the "Filtromat 100" and the "Funda".

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Flume channel as ventilating duct. J. PAWLOWSKI. *Gaz. Cukr.*, 1965, **73,** 56–60.—Equations are presented for calculating the various factors involved in ventilating beet piles with electric fans using flume channels as air ducts.

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Improving the water circuit by heating flume water with condensate. W. LEKAWSKI. *Gaz. Cukr.*, 1965, **73,** 60–62.—At Werbkowice sugar factory the water from a settling tank is fed via a settling pond to a heat exchanger where its temperature is raised from 2°C to 17·3°C by condensate. It is then fed to the beet flume, after which it passes via the stone catcher and beet washer to a tank whence it is recycled to the settling tank. In the autumn, when there is no risk of freezing, the heat exchanger is excluded from the scheme and the water is pumped straight to the flume. Fresh river water passes through a preliminary condenser to one half of a bifurcated collector and from there to the diffuser, while surplus overflows into the other half of the collector. The condensate from the heat exchanger passes through a cooler to the main condenser, part also being used in the sugar factory. From the main condenser it flows to that half of the collector not filled by the condensate from the preliminary condenser and is then pumped to the heat exchanger.

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High oxidizability of water caused by steam boiler corrosion. L. LECHOWSKI. *Gaz. Cukr.*, 1965, **73,** 62–64.—At Chelmza sugar factory condensate from the 1st evaporator effect is fed to the 50 tons/hr 26 atm pressure boiler, while condensate from the 2nd evaporator effect is mixed with sodium triphosphate-treated water and is used as feed for the other smaller boilers used for power production. The steam from the large boiler is passed through a back-pressure turbine and is used to heat the juice in the 1st evaporator effect. The oxidizability of the condensates from the 1st and 2nd effects was found to be 150–200 and 700 mg $KMnO_4$/litre respectively, compared with the normal level of about 50–80 mg $KMnO_4$/litre. The main cause proved to be boiler tube corrosion. The condensates were analysed for alkalinity, oxidizability and pH after fractional distillation and the results are given in graph form.

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Results of tests on ceramic filters. V. A. ZAMBROVSKII. *Sakhar. Prom.*, 1965, **39,** 335–339.—In tests on a filter with 61 ceramic elements and 34·5 sq.m. filtering surface the performance was found to be largely dictated by the quality of the kieselguhr, which, it is stated, should be roasted and screened.[F] Comparison of West German ceramic elements with Soviet ones showed the latter to be more permeable and to be effective at a lower filtration pressure, while both gave a transparent 2nd carbonatation juice. While ceramic filters give a transparent filtrate at high filtration rates (provided high quality kieselguhr is used), "Stellar"-type candle filters are preferred. The major snags with ceramic filters lie in the difficulties of regeneration, brittleness of the elements, and clogging with mud particles.

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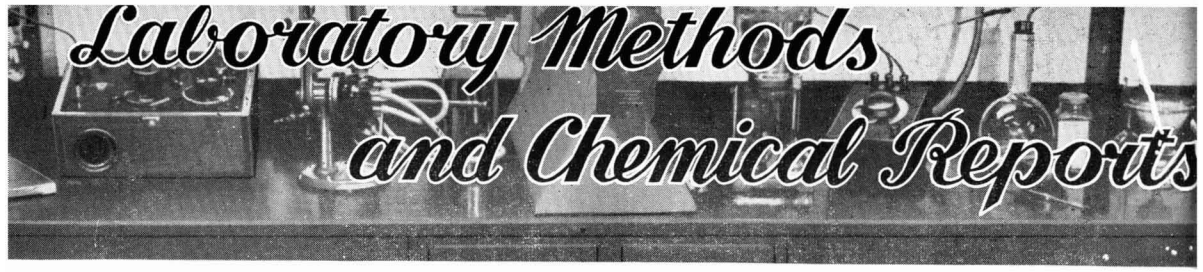
The performance of continuous diffusers in sugar factories of the RSFSR. V. A. SELYATITSKII. *Sakhar. Prom.*, 1965, **39,** 340–345.—Using information gathered from sugar factories in the Russian Federal Republic where 99 continuous diffusers have been installed, the author summarizes the mechanical and technological advantages and disadvantages of the four main types: rotary, tower, trough (twin-scroll) and J diffusers. While all the types discussed have high performance standards with low loss figures, preference is shown for the Hungarian J-type diffuser for various reasons which are stated. Performance data are tabulated for nine different sugar factories and mechanical details for nine different diffusers.



Complements to process control. E. GLIOZZI. *Ind. Sacc. Ital.*, 1965, **58,** 1–21.—Aspects of process control are discussed after reviewing the limits of precision obtaining. First carbonatation control by methods based on the precipitate structures are examined as well as the colour and ash contents of consumption sugars. The measurement and meaning of redox potential are described.

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The amino acids of sugar cane. I. The amino acids of cane juice and the effect of nitrogenous fertilization on the levels of these substances. D. H. PARISH. *J. Sci. Food Agric.*, 1965, **16,** 240–242.—Analyses of juices from cane fertilized with three levels of N were made using the method of THOMPSON & MORRIS[1]. Pipecolic acid, methionine, tryptophane and β-alanine have been detected for the first time and another new amino acid may be a hydroxypipecolic acid. The presence of arginine, previously reported only by MARTIN[2], is confirmed. Increasing the nitrogen supply markedly increases the content of asparagine and glutamine (amides) in cane juice, and lysine, histidine, arginine and tryptophane (basic amino acids) to a lesser extent. The neutral and acidic amino acids tend to increase and then decrease in level with increase in N fertilization.

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Coloration of sugar juices as a result of invert sugar decomposition. K. VUKOV. *Zucker*, 1965, **18,** 167–173, 200–204.—A survey of the literature (67 references) on coloration caused by invert degradation shows that coloration under the effect of atmospheric oxygen occurs where the oxygen partial pressure is insufficient to oxidize the enolate ions from the sugar to formic and arabonic acid, but is adequate to form desoxyozones which tend to resinify. By determining the degree of coloration of juices, expressed as the extinction coefficient of 1 g per ml of decomposed invert sugar(B_λ) it has been found possible to divide the coloration process into a kinetic component (rate of invert destruction) and a static component (B_λ) and thus permit the various factors affecting B_λ to be studied separately. The relative amount of the individual invert decomposition products in pure solutions and the intensity of coloration are linearly dependent on the pOH of the solution. With reduction in the pOH in the range 5–3 the extinction curve becomes progressively steeper and reaches a sharp maximum at 2·8–3·0, after which it falls away in a straight line to reach zero at approximately pOH 1. In the pOH range 1–3 the B_λ of beet factory juices follows almost the same pattern as with pure solutions. At higher pOH values (corresponding to thin and thick juices) the B_λ is practically independent of pOH and the invert and amino N contents increase accordingly. A rise in juice concentration causes a relatively small increase in B_λ, while the presence of air and/or the presence of even small quantities of iron salts increase the value of B_λ. This explains the relatively high B_λ values that occur during evaporation.

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Formation and composition of beet molasses. II. Average composition and the melassigenic coefficients. G. VAVRINECZ. *Zeitsch. Zuckerind.*, 1965, **90,** 184–190.—See *I.S.J.*, 1965, **67,** 315.

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Laboratory determination of the mechanical properties of sugar beet. M. Z. KHELEMSKII, N. T. POEDINOK and I. R. SAPOZHNIKOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10,** 3–11.—Details are given of the devices and techniques used to determine the specific resistance to slicing and the elasticity modulus of certain varieties of beets reference being made to the work of VUKOV *et al.* at the Hungarian Sugar Industry Research Institute.

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Methods of clarifying standard (press) juice, raw juice and pulp juice, with the aim of using them for automatic determination of the sugar content of beet, raw juice and pulp. E. T. KOVAL', A. YA. ZAGORUL'KO, V. G. YARMILKO and V. YA. VAILOV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10,** 128–148. Among the most important information for computers controlling diffusion are beet sugar content and diffusion losses. While the information should be fed continuously and not at intervals, continuous clarification by basic lead subacetate solution of press, raw and pulp juice for polarimetric measurement requires accurate dosing of very small volumes of reagent and water. With the aim of overcoming this difficulty, tests were carried out on the use of dry reagent. A 1:2 mixture (w/w) of dry basic lead acetate was compared with a dry 1·15:1:0·5 (w/w/w) mixture made up of manganese sulphate, potassium ferrocyanide and "Norit" active carbon (4% on weight of juice). While both mixtures completely removed colloids and colouring matter, basic lead acetate removed more optically-active compounds than did the $MnSO_4$ reagent. Both gave the same accuracy of sugar determination with an error of + 0·04%. The lead acetate deposited scale on the tube, but proved

[1] *Anal. Chem.*, 1959, **31,** 1031.
[2] *Sugar J.* (La.), 1960, **22,** (11), 11–20.

cheaper than the other reagent. However, in the USSR lead compounds are in short supply. Which of the two reagents to use is to be decided in future tests. Aluminium, iron, zinc, magnesium compounds and anion exchange resins (AN-2, AV-16, AV-17, N-O, MMT-1 in OH^- form) were also tested as clarifying agents but proved unsuitable.

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Thermal conductivity of beet standard (press) juice. M. Z. KHELEMSKII and V. Z. ZHADAN. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 11–13. The thermal conductivity was determined using a bicalorimeter (a sphere within a sphere where the space is filled with the test solution and this heated to a given temperature, cooled in water and the thermal conductivity calculated from the cooling rate). The thermal conductivity of a beet juice of purity greater than 80 was approximately the same as that of a refined sugar solution of corresponding purity, while the value for the press juice was some 22% higher than that for the beet itself. While the density and specific heat of beet and beet juice and thermal conductivity of the beet juice approximately conform to the rule of additivity, this is not true in the case of the thermal conductivity of beet. The differences between determined and calculated values of thermal conductivity were within experimental error.

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Simplified complexometric method of analysis of fluid filter-press mud. V. A. TSIRUL'. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 222–231. After thorough mixing of a fluid carbonatation mud sample, 100 or 200 ml is transferred to a measuring flask for polarization. A further 10 ml is poured into a 250-ml conical flask and 4·5–5·1 ml of dilute HCl (1:1) added dropwise with vigorous mixing to eliminate gas bubbles. After 1–2 min when the acidification is complete the flask contents are transferred to a 500-ml measuring flask and made up to volume with distilled water. 10 ml of this solution (I) is transferred to a 250-ml flask to which is added 90 ml of distilled water, and the solution neutralized with 2–3 drops of 25% ammonia. 5 ml of ammonia buffer solution (100 ml of 20% NH_4Cl solution mixed with 100 ml of 20% NH_4OH and made up to 1 litre) is added and the Ca and Mg then titrated with N/28 "Complexon III" (EDTA) solution using a pinch of dry mixture of acidic chrome dark blue indicator (1 part indicator to 200 parts sugar or 100 parts NaCl ground to a fine powder) added on a penknife. 0·5 ml of "Complexon III" is added until the first colour change, and the last drops added slowly with vigorous mixing. The end-point is marked by colour change to pure blue. Back-titration may be carried out with N/28 $CaCl_2$ solution. The total time of determination is 8–10 min. Advantages of the method over previous ones[1,2] are listed. The sugar content % on thick mud is given by $AP \times 20{\cdot}86$, where P = polarization and A is a coefficient dependent on the amount of "Complexon III" x used to titrate 10 ml of solution I. Tables of the sugar losses are given for a pol of 1–10, with values of x in the range 5·0–25·0. Sugar loss on 100 kg of beet is given by APC, where C = the amount of lime added to juice per 100 kg of beet. Results are compared with those given by SHAPIRO's method[1].

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Investigation of the effect of massecuite fractional composition on the crystallization of low-grade massecuite. A. L. SOKOLOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **10**, 198–212.—Comparative tests were carried out to determine the distribution of the various crystal fractions in massecuite from three different crystallizers (VATs-800, Buckau-Wolf and Grenzdorfer). Photomicrographs show that the distribution differs even with the same crystallizer, indicating that the use of the supersaturation coefficient alone to obtain homogeneous crystals is inadequate. Measurement of mean aperture and coefficient of variation (C.V.) of massecuite samples were made at two factories; the greater the latter, the greater is the variation in the crystal lengths. While at Novokubanskii factory the mean crystal length was 0·431 mm, giving no difficulties in curing, at Zhashkovskii factory the mean crystal length was 0·226 mm, whereby curing was difficult and "bottlenecks" occurred in the sugar house. The C.V. for both factories was about 50%, a very high value indicating extreme heterogeneity. Crystallization was carried out without regular additions of water. The beneficial effect of water additions on the massecuite fractional composition was demonstrated in further comparative tests.

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Thermal stability of sugar factory juices. I. Concept of thermal stability. II. Sucrose decomposition. K. VUKOV. *Cukoripar*, 1965, **18**, 65–69.—The extent of sucrose destruction and of coloration during heating is accurately given by the following factors: the rate of sucrose hydrolysis, the rate of invert sugar destruction, colour intensity of the invert degradation products and the invert content at the start of the reaction. Sucrose hydrolysis marks the initial stage of decomposition and at high temperatures (about 80–120°C) the rate is the sum of the rates under the effect of catalysis (i) by hydrogen, (ii) by hydroxyl ions and (iii) by salts. Under normal pH conditions, the hydrolysis rate under the effect of the salts is greatest, i.e. sucrose decomposition is related to the total salt content of the juice (anions + amino acids + acid products of invert destruction + titratable alkalinity). Graphs are presented showing the relationship between the sucrose hydrolysis rate and the pH and pOH values of juice (i) with no salt, (ii) with low salt content, and (iii) with a high salt content, at 80, 100 and 120°C.

[1] DOBRZYCKI: *Gaz. Cukr.*, 1957, **59**, 285–289.
[2] *I.S.J.*, 1959, **61**, 117.

Continuous measurement of the viscosity of sugar factory products. A. I. GROMKOVSKII. *Sakhar. Prom.*, 1965, **39**, 360–365.—Tests with a co-axial rotating cylinder viscometer, which is described with the aid of a diagram, are reported. Comparison of molasses viscosity measurements at 20, 30 and 40°C and calibrating oil viscosity at 20·4°C with results given by a Höppler viscometer showed a deviation ranging from —1·8 to +2% for viscosities in the approximate range 9–122 poises. Both molasses and massecuite (of up to 45% crystal content) behaved as Newtonian liquids, i.e. the viscosity was not affected by the change from axial to rotary flow, and the viscometer design proved suitable for continuous measurement.

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Chromatographic and polarimetric method of analysing sugar mixtures. N. A. ARKHIPOVICH and L. M. ZELENINA. *Sakhar. Prom.*, 1965, **39**, 366–369.—The method described earlier[1] was found to be suitable for a study of changes in the carbohydrate complex in beet and sugar factory products, and the changes occurring in growing beet as determined by the method are given as an illustration. The raffinose content in molasses was found to be considerably higher than that determined by direct and inversion polarization, while fructose and glucose in molasses were not in equimolecular amounts in contrast to their relative quantities in the growing beet. At the start of the growth period the sugars pass into the root relatively quickly and sucrose is not found in the leaves, while in August, when sucrose accumulates rapidly in the root, the sugars do not manage to pass into the root and there is a small amount of sucrose in the leaves. After a sufficiently large quantity of sucrose has accumulated in the root (greater than 15%) raffinose synthesis commences in the cells. For sucrose determination in the presence of other sugars, after polarization 50 ml of the filtered solution is poured into a 100-ml flask and 5 ml HCl (s.g. 1·19) added together with 15 ml of water or 10 ml of 25% HCl and 10 ml of water. The solution is heated to 67–70°C in a hot-water bath for 2½ min, held at this temperature for 5 min, then cooled under the tap for 2½ min. The amount of alkali needed to neutralize the acid needed for hydrolysis is determined by titrating [presumably an aliquot or duplicate—Ed.] with 20% NaOH solution using methyl orange indicator. After cooling, this amount of alkali is added and the solution made up to volume at 20°C. The contents of the flask are shaken, filtered and the filtrate polarized in a 200-mm tube at 20°C. From the filtrate two 0·01-ml samples are spotted onto paper and the previously described method applied[1]. (For raffinose and kestose determination only, a shortened method of SILINA[2] is used and the sugars determined after 3–4 hr in the eluates by the present method.) The direct and inversion polarizations and the kestose and raffinose contents are substituted in formulae which are presented and the sucrose content determined. The method takes less time (5–6 hr) and is more accurate than the double-enzyme method, since it takes account of kestose, while for raffinose and kestose determination the method is more accurate than the polarimetric method.

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Thermal stability of sugar factory juices. III. Invert decomposition rate. K. VUKOV. *Cukoripar*, 1965, **18**, 112–115.—Invert destruction is a 1st order reaction and in alkaline medium its rate is not dependent on the initial glucose:fructose ratio. The rate coefficient (k_c) in pure solution is given by $k_c = 10^{\frac{(16.88-5620)}{T}} a_{OH}$ where T = absolute temperature and a_{OH} is the hydroxyl ion activity. Salts of alkali metals do not affect the decomposition rate, while Ca and Mg cations, amino acids and invert degradation anions cause considerable increase in the destruction rate. In beet factory juices the rate coefficient is greater than in pure solution by a factor which is approximately proportional to the amino N content of the juice. Graphs are presented showing the relationship between invert sugar degradation rate and the pH and pOH values in juice with varying amino N contents at 80, 100 and 120°C.

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The rate of invert sugar decomposition. K. VUKOV. *Zeitsch. Zuckerind.*, 1965, **90**, 253–259.—See previous abstract.

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The first decomposition products when dry sucrose is heated. D. BOLLMANN and S. SCHMIDT-BERG. *Zeitsch. Zuckerind.*, 1965, **90**, 179–184, 259–265.—Using the method described earlier[3] 13 substances were isolated, one of which (6-kestose) has already been discussed[3]. Using various specific spray reagents, micro-determinations were made of the fermentability, reducing power and the presence of keto- and free aldo-groups. Paper chromatography of the products of partial hydrolysis of the substances revealed five trisaccharides containing two fructose molecules and one glucose molecule (including 6-kestose), two disaccharides (fructoside-glucoses) one of which is probably β-D-fructofuranosido(2→6) glucose, a disaccharide reacting as glucosidofructose, and two monosaccharides having fructose anhydride characteristics. One of these has been identified as α (2,5) β (2,6)-D-fructose anhydride. It was found that the action of heat on crystal sucrose caused the glucoside linkage to split. Glucose and fructose residues are formed which can be transferred to the hydroxyl groups of sucrose and glucose to form α and β fructoside linkages. Intramolecular reaction of the fructoside groups causes formation of fructose anhydrides through closure of the ring. Ninety-three references are given to the literature.

[1] *I.S.J.*, 1965, **67**, 315.
[2] SILIN and SILINA: "Khimicheskii kontrol' sveklosakharnogo proizvodstva (Chemical control in beet sugar production)" (Pishchepromizdat) 1960.
[3] *I.S.J.*, 1965, **67**, 143–146.

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.

Electric actuator for small rotary valves. Rotork Engineering Co. Ltd., Bath, Somerset.

A new type of small, electrically powered actuator for ball, butterfly and plug valves and boiler flue dampers, has been introduced. Because of its low cost, the remote electrical operation of 1-in to 6-in bore 90° rotary valves and similar mechanism becomes, for the first time, an economical proposition. Known as the "B" type, the new actuator is available in three sizes: 3B, 5B and 7B with rated torque outputs of 20, 60 and 200 lb/ft respectively, suitable for operating butterfly valves—for example—up to about 10 in bore. The actuators are remarkably compact, the largest measuring only about 12 in by 16 in overall. They are of simple construction and can be operated through an ordinary tumbler switch, obviating normal motor control gear.

The "B" type actuator is powered by a single-phase, shaded-pole motor. Drive is through a spur gear train to a final shaft, which is connected to the valve spindle by a reciprocating crank linkage. This form of linkage means that with the motor driving constantly in one direction, the operating arm will alternately open and close the valve through a quarter-turn without any need to reverse the rotation of the motor. The method of drive also means that the resultant torque output curve is matched to the needs of rotary valve operation. Peak torque occurs where it is most needed—at the opening and closing ends of the cycle. Conventional motor control gear is unnecessary. Two push-buttons, a change-over switch or change-over relay contacts are all the control gear needed for manual or automatic remote operation.

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"Vibraline" vibrating conveyors. Stephens-Adamson Mfg. Co., Aurora, Illinois, U.S.A.

A new line of standard, balanced medium-duty vibrating conveyors capable of handling up to 100 tons of material per hour is announced. The rate of conveying of these balanced units can be controlled manually or remotely over an infinite range of speeds from zero to maximum. Transmitted vibrations to surrounding structures are virtually eliminated. Unique dynamic balancing of the unit is said to be more economical than other methods employing static balancing of such units.

"Vibraline" natural frequency conveyors offer advantages that make them uniquely suitable to many applications: they are self-cleaning; they handle a wide range of material temperatures; they have no dead spots, deep crevices or creases to harbour bacteria or vermin; and they can be equipped with all-stainless steel conveying troughs to meet all needs of sanitary handling of food and for corrosive chemicals. The conveyors are available with straight-sided troughs 12, 18 or 24 inches wide, in standard lengths which are assembled on site to accomplish the desired overall length.

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"Slac". Fabcon Inc., P.O. Box 187, Chagrin Falls, Ohio, 44022 U.S.A.

"Slac" is a granular chemical powder intended for addition to bagasse in order to form a friable, easily removed ash in the boiler. To eliminate the problem of slag sticking to the fire box floor, a $\frac{1}{4}$-inch layer of "Slac" may be spread over the fire box floor after cleaning. For serious problems of slag consolidation into glass masses in the boiler, it is necessary to add "Slac" to the bagasse as it is fed to the boiler.

The primary chemical in "Slac" has demonstrated the capacity to modify completely the slag in boilers from a jelly-like corrosive ash to a friable ash easily removed by soot blowers. This result is obtained because "Slac" combines with the slag, raising the melting point of the new ash to a level well above fire box temperature.

Performance varies as a function of the amount of "Slac" used. Information to date suggests evaluation from 300 to 1000 p.p.m. "Slac" on the basis of dry fibre in the bagasse.

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Remote control multi-station temperature indicator. Wright Rain Ltd., Ringwood, Hants.

Wright Rain Glasshouse Automation have produced a compact wall-mounted unit which can be fitted at any convenient point to give temperature readings from up to twelve stations to an accuracy of $\pm 1\frac{1}{2}$°F at distances of up to 500 yards. Although developed originally to enable commercial growers to check on temperatures in a number of glasshouses without moving from a central point, the indicator may be used in any circumstances where accurate remote readings in the temperature range 20–100°F are required, and is already being used successfully in grain storage silos and in a wide variety of industrial applications.

The unit operates on long-life mercury batteries and is fitted with a clearly calibrated dial. A built-in fixed resistance ensures accurate settings. Temperature sensing devices, one for each station, are connected to the indicator, and the elements of these devices are surrounded either by a small aspirated screen for atmospheric use or in a brass protective sleeve for use in liquids or bulk solids.

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Cane mill juice splash guard. Fletcher & Stewart Ltd., Masson Works, Derby.

Splash guards have been introduced for attachment to the feed side of Fletcher & Stewart cane mills. Fitted to the mill side caps by four bolts, they are easily detachable for cleaning and washing down and

in most cases can be fitted to existing mills of the individual juice tray type.

The fitting of the splash guards has involved a change to the mill cross girders, which in future will be steel fabrications of an even stronger design than the previous cast-iron girders and will be far less susceptible to damage or breakage during transport or erection. The cross girders on the delivery side of the mills, to which no splash guards will be fitted, will have those surfaces which are exposed to juice sheathed in stainless steel.

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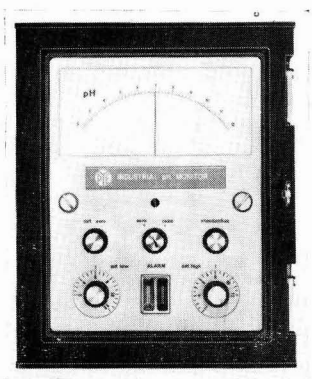
New industrial pH monitor from Pye. W. G. Pye & Co. Ltd., P.O. Box 60, Cambridge.

Pye has developed a new pH indicator/transmitter/controller, Cat. No. 11534, to meet the stringent requirements of industrial users. Employing a new and exceptionally stable amplifier circuit, the instrument has a pivotless indicating meter which is sensitive, virtually indestructible and free from any errors caused by hysteresis, friction or deterioration. A special feature is the incorporation of two independent transistorized alarm/control systems which have no moving parts and consequently are very reliable.



These will operate alarms or simple on-off control devices and are rated at 5 amp, 250 volts. A separate proportional electrical output is provided for slave indicators, recorders, electro-pneumatic converters and other external devices.

The standard range of measurement is 2–12 pH and discrimination on the panel meter is to within $\pm$0·1 pH (circuit accuracy is better than $\pm$0·02 pH). The zero stability in continuous working conditions is better than $\pm$0·02 pH per day and mains voltage variations of $\pm$25 volts affect readings by less than $\pm$0·05 pH. Full automatic temperature compensation for slope and shift is provided throughout the range of 0 to 100°C. The instrument is compactly housed in a metal panel-mounting case which is impervious to dust, moisture and fumes, and all controls are visible through an armoured-glass door panel. The terminal compartment is also fully sealed.

PUBLICATIONS RECEIVED

DOW AND THE SUGAR INDUSTRY. Dow Chemical Company, Midland, Mich., U.S.A.

This leaflet reprints a talk given by Dr. K. C. BARRONS to some delegates at the 1965 I.S.S.C.T. Conference. It provides information on the newer Dow chemicals for use in sugar cane agriculture, including the herbicides "Tordon" and "Daxtron", the insecticides "Korlan" (or "Nankor") and "Dursban", a flowering inhibitor APO, and the soil fumigant "Telone", as well as more established products including "Dowpon" and 2,4,5-T ("Silvex") weed-killers, etc.

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BMA INFORMATION. Braunschweigische Maschinenbauanstalt, Braunschweig, Postfach 295, Germany.

The latest edition (No. 4) of this house magazine includes a description of the 5000-ton beet sugar factory at Timashevskii in the Kuban' region of the U.S.S.R., with plentiful illustrations, a flow-sheet, and full details of the process and equipment employed. A second article describes results obtained at Rain-am-Lech sugar factory in experimental boiling of masse-cuites in a pan fitted with supersaturation (b.p.e.) measurement and an agitator. They have led to the design of a BMA pan especially for use with an agitator. A 19th-century cartoon by Honoré Daumier, depicting the "battle" between the sugar cane and sugar beet is reproduced, and brief notes are provided (with the offer of further information on request) on a process for the extraction of monosodium glutamate from molasses, a molasses fractionating process not involving ion exchange and a starch conversion process to glucose.

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GEBO WOVEN WIRE. G. Bopp & Co. Ltd., Cambridge Works, 2 Bedford Rd., London N.2.

A full range of high-grade wire cloths to English, Continental and American standards is available from this Company which is associated with G. Bopp & Co., of Zürich, Switzerland. The range includes Liebermann screens and is manufactured in mild steel, spring steel, stainless steel, phosphor bronze, brass, copper, nickel, Monel metal, a number of alloys of nickel, and aluminium and aluminium alloys, as well as synthetic fibres, etc. The wide variety of cloths is illustrated and described in a new leaflet.

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SWEET SATELLITES. Swiss Precision Machinery Corporation, Star Route No. 2, Box No. 17, Bayamon, Puerto Rico.

The leaflet with this title is a survey by Dr. J. G. SANDZA, President of Caribbean Technical Associates and consultant to the Economic Development Administration of Puerto Rico, on the by-products from cane sugar production which do or may have application in Puerto Rico. These include citric acid, food yeast, baker's yeast and rum from molasses and an animal feed supplement containing molasses, yeast, and fish solubles, paper and board from bagasse, a bagasse-reinforced plastic, and furfural, levulinic acid and an animal feed from bagasse. The leaflet includes illustrations of the bagasse drying and briquetting equipment supplied by Swiss Precision Machinery Corporation which is used to reduce the large volume of bagasse so making it easier to store and handle.

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INDICATING PNEUMATIC TRANSMITTERS. Brooks Instrument N.V., Veenendaal, Groeneveldslaan 6, Holland.

Bulletin DSE-5500 provides detailed information on the method of operation, design features, materials of construction and performance of Brooks indicating pneumatic transmitters delivering standard pneumatic signals linearly related to flow rate as measured by Brooks variable area flowmeters.

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NEW DESIGN RENOLD SUGAR CANE CARRIER CHAINS. Renold Chains Ltd., Renold House, Wythenshawe, Manchester.

A short article on the new chains appears in the Renold "News Letter". The two new chains have breaking loads of 70,000 and 100,000 lb, respectively, with internationally accepted gearing dimensions and attachment hole sizes. The platform height is now reduced to 1·625 inches in line with current requirements in the sugar industry. Each bearing pin is retractable from one side, thus permitting individual links to be replaced quickly. Grease gun lubrication can be provided if desired.

ICUMSA

The 14th Session of the International Commission for Uniform Methods of Sugar Analysis (ICUMSA) will be held from the 22nd to 27th May 1966 in Copenhagen, Denmark. Further information may be obtained from the Secretary, Mr. R. Saunier, Syndicat National des Fabricants de Sucre de France, 23 Avenue d'Iéna, Paris 16e, France.

BREVITIES

Fletcher & Stewart Ltd.—In our October issue an advertisement appeared which seemed to indicate that cane shoots breaking through the earth were ready for harvesting. This resulted from the use of a printing plate bearing a text corresponding to a different illustration, and we therefore offer our sincere apologies to Fletcher & Stewart Ltd., the advertisers concerned, for our mistake.

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U.K. sugar surcharge reduction.—The Sugar Board surcharge of 3¾d per lb (35s 0d per cwt) was reduced to 3½d per lb (32s 8d per cwt) from 13th October 1965. The higher rate had been in effect since the 27th August when it was raised from the level of 3½ per lb (32s 8d) which had been maintained since the 14th May.

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Commonwealth Sugar Conference postponed[1].—The Commonwealth Sugar Conference, originally scheduled to open in London on the 18th October, has been postponed to "about October 26", according to the Jamaican Cane Farmers' Association. No official reason had been given for the delay but it was attributed to "the fact that negotiating countries at the International Sugar Conference in Geneva had failed, up to the date of the announcement, to reach agreement on the quotas to be awarded to exporting countries and the range of sugar prices on the world free market."

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Sugar mill for South Africa[2].—Volkskas Beperk and General Mining and Finance Corp. Ltd. have announced that support given to a project for establishing a sugar industry in the Malelane area of Eastern Transvaal has been found to justify the erection of a sugar mill. Accordingly arrangements are being made for the erection of a mill with an initial capacity of 125,000 tons of sugar per annum, to commence production in May 1967. It is to be erected near Impala siding, about half-way between Malelane and Hectorspruit, and a new company Transvaalse Suikerkorporassie Beperk will shortly be registered and will erect the mill and establish about 5500 acres of cane under spray irrigation. It has been decided to use the diffusion process in the mill.

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Sugar for U.K. animal fodder[3].—At a London reception sponsored by W. R. Grace & Co. early in October, Dr. I. W. LANE of Grace's Latin America group argued that the price of sugar was now low enough to justify its extended use in the feedstuffs industry. Without the Sugar Board's surcharge the cost per 1000 calories is 1·63d as compared with 2·08d for wheat, 2·19d for maize, 2·62d for barley and 2·81d for oats. The surcharge, however, raised the cost to 3·63d. It would thus appear that the surcharge would prevent economical application of sugar for feedstuff purposes, but previous amendments to the 1957 Sugar Act have allowed drawback of surcharge on sugar used other than human consumption, and it would not seem impossible for the passage of legislation entailed in allowing drawback in the circumstances concerned.

BREVITIES

Peru bulk sugar port completed[1].—Work on the modernization of the port of Salaverry, one of the principal points for the handling of shipments of sugar, has recently been completed. The works were carried out in three stages over nine years at a cost of 350 million soles (about £4,700,000) by the British firm of George Wimpey & Co. Ltd., which has also received a contract for the construction of new port works at Paita in northern Peru. The port of Salaverry has been completely mechanized ; the loading of 10,000 tons of sugar, which had previously required 25 days, is now being done in 16 hours.

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Yeast plants for Brazil[5].—A yeast protein plant is to be built at the Central do Cabo distillery in Pernambuco. The plant will have a capacity of 12 tons per day. A protein plant at the Central Distillery of Alagoas started operations recently; its goal is 2300 tons of protein per year.

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Bagasse paper production in Costa Rica[6].—The Comisión Consultiva de Industrias has decided in favour of the establishment of a second paper mill in Costa Rica. The new mill, which will be situated at Turrialba, represents an investment of some 22 million colones (£1,200,000). The plant can produce 18,000 tons of paper products a year, using bagasse as raw material.

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Sugar factory for Brazil[7].—A modern highly-automated sugar factory is to be built in the capital of Pernambuco with a capacity of 10,000 bags (600 metric tons) per day.

* * *

Cameroon sugar factory[8].—The Government of Cameroon and the Société Sucrière du Cameroun have come to an agreement concerning the construction of a sugar factory near Mbandjock. It is expected that this factory will produce about 15,000 tons of refined sugar annually.

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New sugar factory for Mali[9].—A new sugar factory is to be erected this year in Dougadongon by the Chinese. The daily working capacity will be 400 tons of cane and it is hoped to produce 4000 tons of sugar per year.

* * *

New Uganda sugar factory[10].—The new 6000-acre sugar estate at Sango Bay near Masaka in Uganda started production in August.

* * *

Sugar expansion in Egypt[11].—Sugar production in the five Egyptian factories amounted to 370,000 metric tons in 1964. The output of the factories is to be increased: Nag-Hamadi from 110,000 to 150,000 tons per year, Kom-Ombo from 75,000 to 150,000 tons, Armant from 75,000 to 120,000 tons, Abou Kourgas from 60,000 to 110,000 tons, and Edfu from 50,000 to 180,000 tons. The Nasr Company which owns Edfu factory is to put its new Kous factory into operation in 1966, while the Deshna and Baliana factories of the Société des Sucreries et de Distillerie d'Egypte (which owns the other existing plants) are to go into operation in 1968 and 1970, respectively, with outputs of 150,000 tons, 100,000 tons and 40,000 tons, respectively, for the three new factories. This will raise production capacity to 1,000,000 tons by 1972, and it is further proposed to raise the output of the Baliana factory from 40,000 tons to 150,000 tons per year.

[1] *The Times*, 14th October 1965.
[2] *S. African Sugar J.*, 1965, **49**, 787.
[3] *Public Ledger*, 9th October 1965.
[4] *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 746.
[5] *Sugar y Azúcar*, 1965, **60**, (9), 72.
[6] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (23), 12.
[7] *Sugar y Azúcar*, 1965, **60**, (9), 72.
[8] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (23), 14.
[9] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (23), 16.
[10] *Overseas Review* (Barclays D.C.O.), September 1965, p. 44.
[11] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (28), 18.

BREVITIES

Floods in South America[1].—Sugar cane plantations in Bella Union in Northern Uruguay have had part of their land inundated following a rise in the level of the river Uruguaya which recently caused flooding in Argentina and Brazil.

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New sugar factory for Chile[2].—Braunschweigische Maschinenbauanstalt, who have supplied three sugar factories to Industria Azucarera Nacional S.A., have received an order for a fourth factory to be erected in Cocharcos near Chillán in the Province of Nuble. The factory is scheduled to be put into operation early in 1967 and will have a slicing capacity of 3000 tons.

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Sugar beet in Libya[3].—A successful crop is expected from the experimental sugar beet growing scheme in the Jefara near Tripoli. It is now proposed to build a sugar factory to handle this crop which is expected to reach some 20,000 tons of beet a year.

* * *

Bagasse board factory in India[4].—The first factory for the manufacture of chip board from bagasse is being installed at Golagokarnath in Uttar Pradesh, at a cost of about £600,000. The factory will have an initial capacity of 30 tons/day and will gradually be expanded to double this. The boards will be suitable for use in making high-quality furniture, flush doors, partitions, ceilings and flooring.

Stock Exchange Quotations

London Stocks (*at 18th October*, 1965)	CLOSING MIDDLE s d
Anglo-Ceylon (5s)	6/3
Antigua Sugar Factory (£1)	11/–
Booker Bros. (10s)	20/6
British Sugar Corp. Ltd. (£1)	21/4½
Caroni Ord. (2s)	2/2¼
Caroni 6% Cum. Pref. (£1)	16/6
Demerara Co. (Holdings) Ltd.	3/4½
Distillers Co. Ltd. (10s units)	25/10½
Gledhow Chaka's Kraal (R1)	14/6
Hulett & Sons (R1)	17/3
Jamaica Sugar Estates Ltd. (5s units)	3/4½
Leach's Argentine (10s units)	13/9
Manbré & Garton Ltd. (10s)	29/3
Reynolds Bros. (R1)	17/6
St. Kitts (London) Ltd. (£1)	12/6
Sena Sugar Estates Ltd. (5s)	7/10½
Tate & Lyle Ltd. (£1)	31/4½
Trinidad Sugar (5s stock units)	2/11¼
West Indies Sugar Co. Ltd. (£1)	9/3

New York Stocks (*at 15th October*, 1965)	CLOSING MIDDLE $
American Crystal ($5)	18¼
Amer. Sugar Ref. Co. ($12.50)	27
Central Aguirre ($5)	25¼
Great Western Sugar Co.	12⅞
North American Ind. ($10)	14
South P.R. Sugar Co.	19¾
United Fruit Co.	24⅝

European Sugar Production Estimates, 1965/66[5]

	(*metric tons, raw value*) 1965/66	1964/65	1963/64
Western Germany	1,575,000	2,182,836*	2,108,071*
Austria	233,000	329,590	329,661
Belgium/Luxembourg	365,000	556,638	354,607
Denmark	278,000	437,000	368,000
Finland	42,700	60,989*	57,731*
France	2,200,000	2,438,690	2,085,331
Greece	95,000	68,867	38,544
Holland	545,000	659,769	427,382
Ireland	118,900	141,080	145,408
Italy	1,067,000	1,039,322	948,893
Spain	400,000	492,182	384,442
Sweden*	223,000	296,167	245,396
Switzerland	52,000	56,965	46,403
Turkey	592,000	794,922	423,638
U.K.	960,000	1,045,876	834,248
Yugoslavia	300,000	357,090	347,777
TOTAL WESTERN EUROPE	9,046,600	10,957,983	9,145,538
Albania	12,000	12,000	11,000
Bulgaria	185,000	180,000	158,556
Czechoslovakia	750,000	1,115,000	1,103,889
East Germany	675,000	818,333	789,317
Hungary	425,000	495,221	434,260
Poland	1,700,000	1,837,678	1,454,400
Rumania	380,000	466,600	318,127
U.S.S.R.	8,400,000	8,600,000	6,150,000
TOTAL EASTERN EUROPE	12,527,000	13,524,832	10,419,549
TOTAL EUROPE	21,573,600	24,482,815	19,565,087

* Including sugar from foreign beets.

Turkish sugar crop reduction[6].—Sugar output in Turkey from the 1965/66 crop is now forecast at 550,000 metric tons, compared with the July forecast of 750,000 tons. The beet crop is estimated at only 3,500,000 tons against an estimate of 4,775,000 tons in July. A crop of 4,700,000 tons in the 1964/65 campaign yielded 731,000 tons of sugar. Consumption in Turkey is put at 400,000 tons which will leave a surplus of 150,000 tons from the current crop. However, export outlets are proving hard to find owing to the high local producer prices.

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Brazil sugar production, 1964/65[7].—Sugar production during the season June 1964/May 1965 is now finally put at 3,527,613 metric tons, which compares with 3,055,884 tons and 3,033,528 tons produced during 1963/64 and 1962/63 respectively.

* * *

Frost damage in Brazil[8].—Frost which hit regions of São Paulo in August will lower sugar production by one million bags (60,000 tons) according to the *Boletim Cambial*. The newspaper said that the greatest damage was to the plantations reserved for the 1966/67 crop but gave no estimate of the damage.

[1] *Public Ledger*, 4th September 1965.
[2] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (21), 10.
[3] *Overseas Review* (Barclays D.C.O.), September 1965, p. 49.
[4] *Sugar y Azúcar*, 1965, **60**, (9), 74.
[5] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (27), 1–2.
[6] *Public Ledger*, 18th September 1965.
[7] C. Czarnikow Ltd., *Sugar Review*, 1965, (734), 181.
[8] *Public Ledger*, 18th September 1965.