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NOTES AND COMMENTS

Prospects for 1964.

In their *Sugar Review*[1] for the 2nd January, C. Czarnikow Ltd. provide a summary of the main factors and their effects on the sugar markets during 1963. They conclude with an account of their views on the future:

"During the second half of the 1950's it was sometime possible to look ahead and, secure in the knowledge that supplies from many countries would be limited by the provisions of the International Sugar Agreement, draw up a statistical balance sheet for the ensuing year. Quota provisions of the Agreement are now in abeyance, however, and there appears little likelihood of their being resuscitated during 1964. In any case the question for the next twelve months is not how can supplies be limited to conform to the availability of outlets, but how can sufficient sugar be produced to meet the world's needs.

"In the immediate future, one might expect to see a continuation of current high prices. The supply and demand picture for the first three quarters of the year plainly indicates a deficit and with pipe lines in many parts of the world now considerably depleted there seems little that can be done to improve the situation by a further reduction in stocks.

"At this time of the year East European producers are normally active sellers whilst Western Hemisphere sugar, particularly Cuban, can usually be reckoned to be featuring largely in world market transactions. Surprisingly little beet sugar from the current crop has so far made its appearance but it would be wrong to conclude from this that none will emerge during the early months of 1964. It is unlikely that quantities similar to those which have been marketed in recent years will be available, but supplies from this source cannot be dismissed altogether.

"The crop in the Soviet Union is known to be poor and no doubt East European producers will be called upon to ease the situation. In recent years the U.S.S.R. has not only imported very substantial tonnages but has figured largely as a re-exporter of white sugar. The latter trade can hardly be expected to disappear; indeed, much of the business forms part of long-term agreements, whilst political considerations may also be involved. Nevertheless, it would not be surprising if re-exports were to be curtailed to some extent, thereby reducing the tonnage which would have to be imported into the U.S.S.R.

"Cuba has withdrawn from the market until May 1964, when the size of the crop will be known, but in any case it is thought unlikely that she will reappear with any important tonnages. Difficulties of various types have been encountered in Cuba during the past two or three years and production has fallen each season. It had been thought probable, however, that the crop in 1964 would be at least no worse than its predecessor and some had been forecasting a modest increase. These ideas have had to be reviewed since the hurricane which struck the island in October and it is now considered unlikely that exports will much exceed three million tons. About one-third of this quantity has already been sold to world market destinations and presumably the balance will be pre-empted to fulfil Cuba's existing trade agreements. Of this the major share may be expected to go to Russia in view of the situation in that country but no doubt China will also continue to figure as an important market for Cuban sugar.

"Amongst the Western Hemisphere producers, Argentina is reported to be expecting an export availability of some 250,000 tons this year, and if so large a tonnage should eventually materialize it is probable that a proportion will find its way onto the world market. The Dominican Republic has also shown a recent interest in selling for delivery to free market destinations during 1964 and further supplies may be forthcoming from that origin, whilst Peruvian sugar, after having at one time been reserved exclusively for the United States, has also re-appeared in other consuming areas. Finally, a few cargoes of Brazils may be offered for tender in the course of the year. These exceptions apart, however, it may be assumed that Latin American sugar will be reserved for the United States and that the lukewarm interest apparent in that outlet at the moment will evaporate as the U.S. and world parities come closer into line.

[1] 1964, (642), 1–12.

"Outside South America the main exporters south of the Equator, Australia, South Africa, Mauritius and Fiji are all expecting to increase their export availabilities next year. Much of this sugar is already committed, however, and with the possible exception of Mauritius, which country has traditionally to await the passage of the cyclone season, it is unlikely that these producers will find themselves in possession of much in the way of supplies of sugar for destinations not already earmarked. An interesting development of the breakdown of the restrictive provisions of the International Sugar Agreement has been that those countries whose exports were formerly limited under Article 16, which dealt with deliveries within the Commonwealth Sugar Agreement, have now been able to expand their industries. Far from this sugar becoming a burden on the market, however, it has satisfied a vital need and it would seem that if international quotas are eventually renegotiated these countries will have a very strong case for substantial increases from the tonnages they were formerly permitted to export.

"In addition to South Africa there is a considerable expansion in production taking place all over the African continent, although of course, this sugar is not mainly for export. New industries are getting into their stride in many African states whose rate of consumption growth may now be assisted by domestically produced supplies.

"Despite Indian plans to increase production to 3·3 million tons in 1963/64 the world market cannot rely with any degree of certainty on exports in excess of the 300,000 tons already contracted. Indonesian efforts towards production expansion have met with little success and it seems she is as far off regaining her pre-war position as ever. The volume of exports did expand in 1963, however, and a continuation of this tendency may be expected in 1964.

"There has recently been pressure in Taiwan to use cane lands for rice growing and it may be that this will adversely affect sugar production in that country. Nevertheless it does seem that Taiwan's importance in the world market will be maintained in 1964, particularly in view of the fact that the quantity of sugar to be delivered under the trade agreement with Japan is to be reduced from 450,000 to 350,000 tons.

"Many of the importing countries have already made long term arrangements to safeguard their supplies and the efforts of Japan in particular to ensure regular deliveries until mid-1965 will be recalled. Nevertheless there are a great many outlets yet to be filled and it may be expected that there will be a series of tenders during the early months of the year for sugar in a very prompt position.

"The U.S. Secretary of Agriculture has put the import requirements of the United States at a figure lower than most market observers had anticipated. It remains to be seen whether adequate sugar in the right delivery periods will be obtained on the basis of the current arrangements but in any case it may be assumed that the United States will eventually secure all the sugar she needs. It may be, however, that to do this she will need to increase the Supply Quota or call for the delivery of more supplies within global quota arrangements. No doubt some producers have been reluctant at this time of the year to commit too large a proportion of their estimated supplies, but will be more willing as their crops proceed; nevertheless, any further substantial calls for sugar by the United States cannot fail seriously to affect the already tight world statistical position.

"In Europe as a whole the annual growth in the area to be devoted to beet is likely to be stepped up somewhat this year and, given reasonable growing weather, a marked increase in output is to be expected. The importance of climatic conditions has been clearly emphasized during the past two seasons and great attention will be paid to those prevailing this year. The availability of substantial quantities of exportable sugar from Europe in the autumn will do much to restore a balance between supply and demand but it would be unwise to expect it to do more than that. To some extent consumption was held in check in 1963 by high prices and this situation can be expected to continue so long as very high values are maintained. Any reduction in price levels, however, may well bring with it a resurgence in offtake, and the reappearance of surplus conditions at any time during 1964 appears unlikely."

* * *

U.S. supply quota 1964[1].

In mid-December the U.S. Secretary of Agriculture formally confirmed that the Supply Quota had been set at 9·8 million short tons, as announced earlier[2]. The Government of the Dominican Republic has now been recognised by the United States and so may deliver her entire quota to the U.S.A. whilst the quota of the Virgin Islands has been raised from 15,000 short tons to 15,832 tons. Under the terms of the Sugar Act the Virgin Islands' quota is established at 15,000 short tons. Nevertheless, if that territory's production should be such as to permit the quantity available for export to exceed that figure, the quota for the following year may be increased by the extent of the excess, subject to a predetermined limit, and it is presumable under this provision that the quota has been raised. This is the reason for small reductions in quotas of foreign countries; revised entitlements for 1964 appear below.

By the 24th December, the Dept. of Agriculture announced, approximately 745,000 tons of the 1,000,000 tons global quota had been subscribed, 53% of this being scheduled for delivery during the first seven months of 1964 and the remainder on or before the 31st October. On the 9th January, the Department announced further acceptances of global quota applications totalling some 130,000 tons. The quotas, basic and global, as allocated, are listed elsewhere in this issue.

[1] C. Czarnikow Ltd., *Sugar Review*, 1963, (641), 219.
[2] *I.S.J.*, 1964, **66**, 2.

SUGAR BEET AND CANE CULTIVATION IN THE MIDDLE EAST

AN interesting survey[1] has been made of the present-day production of sugar, from cane or beet, by countries in the Middle East. These countries are not traditional sugar producers on account of generally unsuitable climatic conditions. Most parts of the Middle East are too hot and dry for sugar beet and too dry for sugar cane. However there are limited areas where this does not apply or where conditions may be altered, e.g. by irrigation, and sugar production from cane or beet carried on.

Great strides have been made in recent years by some Middle Eastern countries in increasing their own sugar output, thereby reducing imports. It is also interesting to observe, from figures quoted, the phenomenal increase in centrifugal sugar consumption by some of the countries concerned. During the decade 1949–1959 most of these countries increased their consumption fourfold, some considerably more, especially those countries whose economy has been favoured by the development of mineral oil resources.

Turkey

The progress made in sugar production, from sugar beet, has been remarkable. In 1926 there were two sugar factories producing some 500 tons of sugar annually. By 1958 there were fifteen factories producing 350,000 tons of refined sugar. Four other sugar beet factories are under construction. Not only is the country now self-supporting in sugar but there is a small export trade. Beet cultivation is under the direct supervision of the sugar factories and some 15,000 workers are employed by the sugar industry.

Egypt

Sugar cane has been cultivated in Egypt, for local use, from very early times. The area under cane cultivation increased from 14,000 acres in 1939 to 120,000 acres in 1954 and is mainly in Upper Egypt, especially between Luxor and Aswan, where the high winter temperature allows full ripening. Average yields are not high, being about 80 tons of cane per hectare, compared with 120 in Java and 400 in Hawaii.

There are five factories in Central and Upper Egypt and a refinery at Hawamdieh. In 1956 the sugar factories were nationalized. The Sugar Cane Cultivation Department at the Egyptian Ministry of Agriculture is breeding new sugar cane varieties, better suited to Egyptian conditions, in order to increase yields. The possibility of sugar beet cultivation in Lower Egypt is under consideration.

Iran

Sugar cane was extensively grown in Iran during the Mohammedan era and the country was well known in ancient times as a sugar producer. Sugar cane cultivation is today restricted to the Caspian provinces (Gilan and Mazanderan) and Khuzestan. Extensive developments with sugar cane are planned i.e. the Khuzestan Project. The work on the irrigation system, drawing water from the Dez River, began in 1958. An initial plantation of 5000 acres, a mill and a refinery were ready for operation in October 1961.

The cultivation of sugar beet takes place in the Provinces of Khurassan, Esfahan, Fars and Khuzestan. Sugar beet production increased from an annual average of 350,000 tons in 1948–52 to 560,000 tons in 1956. As Iran has a heavy consumption of refined sugar, about 450,000 tons annually, and local production only covers a fraction of requirements, the welfare of the beet and cane industries are important to the country.

Iraq

Until 1956 centrifugal sugar had not been produced in Iraq. With an expanding economy the consumption of sugar has been rapidly increasing, from 52,000 tons in 1949 to 141,000 tons in 1956. In 1956 the Development Board of Iraq arranged for the construction of a sugar beet factory near Mosul, in the north of Iraq, capable of processing 800 tons of beet a day and yielding 10,000 tons of beet sugar annually. It is estimated that 25% of the irrigated land in Mosul Province devoted to beet would sustain the factory's operation. A second larger factory is planned for erection at Sulaimaniya. Together the two factories should provide about 45% of the country's sugar consumption.

A sugar cane factory in the south, near Basra, is also envisaged.

Iraq being the premier date-producing country of the world, it is not surprising that a liquid sugar factory, producing syrup and alcohol from dates, should now have been started at Kerbala, south of Baghdad. It has an annual capacity of 8000 tons of liquid sugar and 3,000,000 litres of alcohol.

Syria

Sugar beet cultivation is becoming increasingly important in Syria and is carried on in both irrigated and rain-fed areas, mainly around Homs and Damascus. Three additional factories are envisaged to supplement the two already at Homs and Damascus. It is considered the selection and development of an early maturing type of sugar beet suited to Syria is desirable, also that mixed farming should be promoted in sugar beet areas.

Lebanon

A sugar beet factory has been established by a German firm in the Bekea region, about 60 kilometres east of Beirut, which processes sugar beet grown in the fertile area between Lebanon and the Anti-Lebanon mountains, It also refines imported raw sugar producing about 10,000 tons of sugar a year.

[1] K. H. SHIH: *Taiwan Sugar*, 1962, **9**, (4), 36–41.

Israel

The cultivation of sugar beet, although on a small scale, is reputed to be expanding, good yields and sugar content having been obtained. Two refining plants, at Afula and Ramat Gan in the north, are in operation producing 15,000–17,000 tons of refined sugar per year, against a domestic consumption of 80,000 tons. Trials with sugar cane cultivation in the district of Hula and in the Jordan valley have proved successful.

Afghanistan

A sugar beet factory operated at Baghlan, processing 35,359 tons of sugar beet in 1958/59. It operated at only half its capacity because of lack of sugar beet. A cane sugar factory at Jallalabad, put into operation in 1958, was later closed down because it was unremunerative. Domestic requirements of sugar are mainly met by imports, almost exclusively from the Soviet Union.

Sudan

In the Sudan the sugar cane industry is quite young having developed as a result of a survey prepared for the Government in 1959. The first mill, at Guneid on the Blue Nile, and built by two German firms, commenced operations in January 1962. An initial area of cane, of 5000 feddans* in 1961, is to be increased to 15,000 feddans in 1963, irrigation being afforded by the Blue Nile. Another undertaking is planned for Khashm El Girba where cultivation experiments have proved successful. The output of the two factories should meet the country's sugar requirements.

F.N.H.

SUGAR CANE DISEASES IN MADAGASCAR

LIKE other sugar cane growing countries, Madagascar (or La République de la Malagache as it is now called) is not without some troublesome sugar cane diseases. An outline of the sugar industry of the country and its cane diseases has recently been given by C. G. HUGHES[1] who visited the country from Australia. This large island, 1000 miles in length and 360 miles wide at its widest part, has a central plateau splitting the island lengthwise and separating the wet steamy coastal strip of the east from the more extensive drier plains on the west. The Malagache people are of Malayo-Polynesian and Melanesian stock and number over 4,000,000. The main foreign element is the French, numbering about 50,000.

There are only four commercial sugar factories on the island, but numerous small "betsa-betsa" mills exist and small plantings of sugar cane used for chewing more or less everywhere on the island. The interesting betsa-betsa mills are small mills crushing about 15 tons of cane a day to provide juice for what is almost the national beverage, called betsa-betsa, or fermented cane juice, the murkier the better. Each betsa-betsa mill has a plot of cane nearby and stalks are cut or pulled as required from the tangled perennial stand of cane of all ages. A plot may stand for many years and the effect on the disease and pest situation may well be imagined. If a block becomes diseased it may remain a source of infection for a long time.

The following diseases are recorded by the writer as being present in Madagascar: brown spot, chlorotic streak, eye spot, Fiji disease, gumming disease, leaf galls, leaf scald, mosaic, mottled stripe, pineapple disease, Pokkah Boeng, ratoon stunting, red spot, rust, smut and yellow spot. Notes are given about each of these diseases and their prevalance or degree of virulence in the island. The most serious or threatening disease in recent years appears to have been Fiji disease, first found in the island in 1954. It spread rapidly in the susceptible varieties then grown in the commercial and betsa-betsa areas. Control measures involving the roguing of many thousands of stools and gradual replacement with resistant varieties has greatly reduced the incidence of the disease. The menace of ratoon stunting disease is realized by the authorities and heat treatment of planting material carried out. With regard to leaf scald the widespread planting of the resistant variety Pindar on the east coast has reduced the disease to a minimum. Mosaic occurs only on the east coast but as Pindar has a satisfactory level of resistance the disease is not a problem. Chlorotic streak occurs in all the commercial cane areas of Madagascar. The discovery of leaf galls on the underside of cane leaves on the east coast two or three years ago created a stir at first as it was thought they might be those of Fiji disease, but microscopical examination established the fact that they were not.

F.N.H.

* * *

Sugar cane mosaic disease. R. J. STEIB. *Sugar J.* (La.), 1963, **25**, (11), 34–39.—The history of this troublesome disease in the United States is given, together with recommendations to growers for lessening of the incidence of the disease. The production of mosaic-resistant varieties may offer the only means of complete control of this disease which is well known in the sugar cane growing world. Varieties in Louisiana are classified as follows with respect to their reaction to mosaic—immune: very resistant; resistant; moderately resistant; moderately susceptible; susceptible and very susceptible.

* One feddan = 1·038 acres

[1] *Proc. 30th Conf. Queensland Soc. Sugar Cane Tech.*, 1963, 85–89.

CANE GROWING IN TAIWAN

Report of the Taiwan Sugar Experiment Station, 1963, (31).

THIS report consists of a dozen different papers covering a range of subjects. It is in Chinese with English summaries and English captions as well as Chinese for the photographs and figures.

Frosted Shoots

Reference is made to the unusual cold experienced in Taiwan in late January of 1962, which killed the young shoots of cane in many areas. The opportunity was taken of studying the effects of shaving or cutting back young shoots to ground level on the final yield. This is described in a paper by H. C. FU, T. P. SOO and Y. H. HSIEH, the results showing conclusively that there was no advantage in cutting back all the shoots in a frosted field since this led to reduced final yields of millable cane. If left, most of the frosted shoots resume normal growth and production of green leaves. During the final earthing up it is recommended that any dead stalks be removed.

Interplanting

Work on interplanting sweet potato with sugar cane, in which the date of interplanting, variety of sweet potato and row width of interplanted cane were studies, is described in a paper by C. K. TANG, which covers trials or experiments carried out during 1958-61, in the loamy clay soil of Hsinying experiment station. Different planting times with five different varieties of sweet potato were used. Results and yields showed that there was obvious competition between cane and sweet potato, the varieties of sweet potato with small deeply cut leaves, short vines and early maturity having the least effect on cane yield. There was competition for soil moisture and for sunlight.

Nitrogen Requirements

Field experiments on the nitrogen requirements of the new sugar cane varieties F 146, F 147, F 148 and F 149 are described in a paper by Y. C. PAN *et al.* Fertilizers in Taiwan are expensive and considered to represent about 60% of the total production costs of sugar cane. Fertilizer field experiments, especially with nitrogen, are usually carried out with a new commercial variety of sugar cane before it is released. The optimum nitrogen requirement of all four of these new varieties was found to be 200–300 kg/ha in the Pintung sugar mill district where the trials were carried out. This is higher than that for N:Co 310, which is the most widely planted variety at present.

Diseases

The nature of the causal agent of white leaf disease of sugar cane in Taiwan is the subject of a paper by H. P. LIU, S. M. LEE and W. TENG, who studied the transmission of the disease from the evidence of special hot water treatment experiments. The disease is a comparatively new one in Taiwan, having been first found in 1958. According to a survey made in 1962 it affected 500 ha in the areas of twelve mills of the Taiwan Sugar Corporation. Unfortunately the much planted variety N:Co 310 is very susceptible to the disease. Hot water treatment of diseased planting material (54°C for 40 minutes) resulted in disease-free young plants. Where diseased setts were partly immersed in the hot water, plants arising from treated buds were disease free, while those from the untreated part of the sett were diseased. The actual cause of the disease has not yet been clearly established.

Pests

Two papers by H. P. LIU *et al.* deal with field studies on the behaviour of the large ladybird, *Synonycha grandis*, which is important in controlling woolly aphis (*Ceratovacuna lanigera*) on cane. Radioisotope techniques were used. In the first paper the efficiency of three different methods of tagging was tested—a feeding technique, a sticking technique and a soaking technique. The soaking technique, in which the ladybirds were submerged in a radioactive phosphorus (^{32}P) solution with 1% wetting agent, was found to be the most economical and efficient method of tagging large numbers of live adult ladybirds. In the second paper the dispersal of tagged ladybirds released in a cane field was studied, the cane plants being 2–3 feet high. Of the ladybirds released in the open air 26·7% were recovered: of those released on aphis-infected plants 74% were recovered. The effective dispersal distance did not exceed 100 feet, the longest flight being 230 feet. In the control of woolly aphis it was considered that the release of ladybirds directly on to the aphis-infected plants was more effective than releasing them in the open.

An account is given by C. B. CHEN and T. H. HUNG of the introduction of the Ichneumon wasp *Isotima javensis* from India to Taiwan for the control of the top-borer *Scirpophaga nivella*. It was bred and successfully increased under laboratory conditions and subsequently released in seventeen plantations in 1961 and 1962, at a rate of 10–48 individuals for each plantation. From June to September 1962 recoveries of *Isotima* were made in nine plantations. The average extent of parasitization of top-borers was found to be 5·1%, the highest rate being 18·8%.

Root-knot nematodes (*Meloidogyne* spp.) are destructive with sugar cane and many other crops in Taiwan. The two species reported in Taiwan so far (*M. arenaria* and *M. javanica*) have also been reported from Queensland. C. H. HU gives an account of his studies of these nematodes on sugar cane roots with photomicrographs of the different stages of development in the root. Field studies were carried out with seven varieties of sugar cane. These showed no significant differences in susceptibility.

F.N.H.

The quality situation in sugar beet in Okayama prefecture. H. YUNOMURA and S. KANO. *Bull. Okayama Agric. Exp. Sta.*, 1960, (57), 1–24; through *Plant Breeding Abstracts*, 1963, **33**, (3), 441.—This is a chemical investigation of the principal varieties of sugar beet grown in Okayama and elsewhere in Japan.

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Redistribution of surface flow from high-application-rate sprinklers. R. B. CAMPBELL. *Hawaiian Planters' Record*, 1963, **56**, (4), 277–287.—Results are given of elaborate tests carried out on six plots of approximately 2–3 acres each (belonging to the Oahu Sugar Company), in which the sprinkler or overhead irrigation rate was studied in relation to infiltration rate of the soil or soil-crop complex. The plots were separated from one another by roads. It was demonstrated that with furrowed or irregular soil surfaces the no-run-off application rate could be nearly doubled without producing run-off sufficient to cause erosional hazards.

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Sugar cane quality and nitrogen fertilization. G. STANFORD. *Hawaiian Planters' Record*, 1963, **56**, (4), 289–333.—This investigation, conducted at three Oahu plantations, was undertaken to determine the effects of various rates and times of fertilizer application on quality of cane and on yields of cane and sugar. A feature of the study was the periodic measurement of N uptake by the crop as a direct means of evaluating the recovery of N in relation to applied treatments. Approximately 95% of the maximum yield of sugar was obtained with 200 lb N/acre. Applications of 400 and 600 lb N/acre tended to increase yields of cane but greatly reduced juice quality. Late applications of N persistently reduced sucrose content of the juice.

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Significance of leaf surface in dry matter production of sugar beets. C. SCHULTZ. *Zucker*, 1963, **16**, 288–292.—Attention is drawn to the extent to which the leaves of a normal healthy beet shade one another. The production of dry matter is considered to be at an optimum when the "leaf surface index" is in the range of 3 to 4, the "leaf surface index" being the proportion of total leaf surface to soil surface area.

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Mechanical harvester evolved. J. DAWES. *Sugar J.* (La.), 1963, **25**, (12), 16.—The magnitude of Australia's sugar cane industry (Australia being the world's fourth largest producing country) and of the harvesting problem is outlined. A successful harvester, first designed and produced in Australia in 1958, is described. Its great virtue is its ability to deal with lodged cane. It can deal with 8 tons of lodged cane in an hour or 15 tons of erect cane. By comparison a good manual worker may deal with 8–9 tons a day. The price of the harvester with 50 h.p. tractor and two trailers is £A6000.

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Experiences with insecticides in the control of sugar cane pests in Trinidad. ANON. *Sugar J.* (La.), 1963 **25**, (12), 18–20.—The writer was engaged on insect control work on a sugar estate in Trinidad for six years. He points out that well planned use of insecticides can be of great benefit to the cane grower but that improper use can result in disastrous financial loss. The insects discussed are froghopper (*Aeneolamia*), borers (*Diatraea canella* and *D. saccharalis*), giant moth borer (*Castnia licus*), jumping borer (*Elasmopalpus lignosillus*), parasol ants, fall army worms, mealy bugs and aphids.

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Yield constancy of sugar beet varieties examined in variety trials. H. LÜDECKE and A. VON MÜLLER. *Zucker*, 1963, **16**, 317–322.—In this biometrical study the writer analyses the yield figures obtained from 21 different varieties of sugar beet grown in 10 different areas between 1958 and 1962. The varieties originated from both northern and southern Germany. The writer considers a wider range of experimentation is called for.

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"Rotospreader" for spreading filter-press cake. ANON. *S. African Sugar J.*, 1963, **47**, 310–311.—Successful trials with the Howard "Rotospreader" in spreading filter-press cake are here described with photographs. The same machine, which originated in the U.S.A. has been profitably used in other countries for spreading all sorts of materials, from farmyard manure to slaughter-house waste. Unfortunately the cost is high.

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The S.A.S.A. Experiment Station. ANON. *S. African Sugar J.*, 1963, **47**, 320–321.—This pictorial feature on the South African Sugar Association's experiment station at Mount Edgecombe, some 14 miles from the centre of Durban, includes six photographs showing the new wing added to the laboratories, laboratory accommodation being provided for Chemistry, Soils, Agronomy, Plant Breeding, Plant Pathology, Entomology and Biometry.

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Steps taken against Numicia at Pongola. ANON. *S. African Sugar J.*, 1963, **47**, 325.—An outbreak of *Numicia*, or green leaf sucker, similar to one in Swaziland in 1962, is described. Serious infestation was present on three farms while four other farms were sufficiently badly infected to justify some form of control. "Malathion", applied as a fog by helicopter, gave satisfactory results. Wild grasses along roadsides and canal banks were found to harbour the insects. It is thought that the advent of the dry season and the drying-off of the grasses caused the insects to attack sugar cane.

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The I.I.S.R. "Polythene" nursery system of sugar cane planting. R. R. PANJE and P. S. GILL. *Indian Sugar*, 1963, **12,** 737–742.—The uses of polyethylene in horticulture and agriculture are many and this is yet another effective use for it. In North India poor germination of cane setts is a problem and leads to heavy expense in planting. In the method here described the setts are nursery sown, i.e. placed side by side on a prepared nursery bed (resembling a rough reed mat) covered lightly with soil, watered and then covered with polyethylene sheet 2 metres wide (250 or 300 gauge), the edges of the sheet being held down with a ridge of soil. Germination is rapid and highly satisfactory, nearly all the buds germinating. The sheet is removed 3–5 weeks later, depending on the season, and the germinating setts or young plants planted in the field. In very hot weather shading of the polyethylene sheet may be necessary, cane trash being used.

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The sugar industry in Uttar Pradesh. L. H. R. SWARAP. *Indian Sugar*, 1963, **12,** 759–764.—The unsatisfactory economic condition of the sugar industry is stressed and reasons for it are given. Average yields are very low—only 12–14 tons of cane per acre—and sugar recovery 9–10%. Some factories are very old and finance difficult. Agriculturally, improvement is considered to be needed in regard to fertilizers, irrigation, waterlogging, flooding, incidence of pests and diseases, lack of training facilities and slowness in applying research results.

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Cane field mechanization. R. J. LEFFINGWELL. *Sugar y Azúcar*, 1963, **58,** (6), 8–10.—An account is given of the strides that have been made in mechanization in the island of Taiwan since a commencement was made in 1949 with tractors, one tractor doing the work of 20 buffaloes. Tractors plus other equipment, e.g. trailers, now perform numerous field operations. Several field mechanization problems have yet to be solved, including planting and harvesting and in-field transport of cane.

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Two new beet harvesters. ANON. *Sugar y Azúcar*, 1963, **58,** (6), 59.— Afew details are given of two new sugar beet harvesters: the McCormick International No. 23 and No. 24. A photograph of the No. 24 two-row machine in operation is shown; it is alleged to be capable of harvesting "a ton of beets per minute."

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Puerto Rico's changing sugar production pattern. D. SMITH. *Sugar J* (La.), 1963, **26,** (1), 32.—The writer discusses what are, in his view, the various factors responsible for the sharp decline in sugar production in the past 12 to 15 years. Some of these are agronomic, others climatic, social or economic. One of the factors not mentioned in past discussions on the subject is the increase in dairying in the country and the production of fresh milk. For this some former cane lands have been put down to pasture.

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Poorly drained soils of Puerto Rico have contributed to sugar yield decline. J. A. BONNET. *Sugar J.* (La.), 1963, **26,** (1), 38–44.—A high percentage of the area planted with cane is considered to be affected by drainage problems, being poorly drained clay soils and sub-soils. The advent of mechanization and heavy machinery combined with the Louisiana planting system has accentuated this poor drainage. One of the results is poor root development with the cane, delayed ripening, harvesting of immature cane and consequent low sugar percentage returns. A classification of the bad drainage areas of the island according to districts and soil types is given and recommendations based on lowering the water table below the plant root zone are added.

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Cane handling. C. SANTISTEBAN. *Sugar J.* (La.), 1963, **26,** (1), 50.—The writer discusses the rapid changes that are taking place in Caribbean cane fields in moving the harvest from the field to the factory. Often the nature of the terrain must govern the type of equipment used.

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The decrease in sucrose content of cane in Puerto Rico. G. SAMUELS. *Sugar J.* (La.), 1963, **26,** (1), 62–67. The writer discusses, one by one, and at some length, the various factors that have been put forward as being a cause of reduced sucrose content and lower sugar output in recent years.

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Cane fires. ANON. *S. African Sugar J.*, 1963, **47,** 375.—Attention is drawn, with the approach of the holiday season and the dry season in Natal, to the risk of fire in the cane fields along the coast when trash has become bone dry and inflammable. The latter part of the dry season, when strong winds commence, is especially dangerous. The S. African Cane Growers' Association appeals to growers to ensure that adequate fire breaks are established on their farms before July/October. A fire disrupts the even flow of cane to the mills.

* * *

Coping with demands of increased cane production. G. S. BARTLETT. *S. African Sugar J.*, 1963, **47,** 383–387.—Ways and means of making the best use of available labour on the Natal cane fields are discussed under such headings as cane cutting, tasking, loading, trans-shipping, cane planting, and weeding. It is pointed out why the high degree of mechanization achieved in some other cane growing countries may be more difficult or take longer to attain, the quality of skilled or semi-skilled labour being often poor. Many of the Natal and Zululand cane fields are hilly.

Cane cutters' outputs increased by new system of tasking. ANON. *S. African Sugar J.*, 1963, **47**, 407–409. A Zululand farmer claims greatly increased yields per cane cutter through the application of a system of tasking differing from those normally practised. Details are given.

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Mechanical thinning of sugar beet in Belgium in 1962. M. MARTENS. *Pub. Tech. Inst. Belge pour Amél. Betterave*, 1963, **31**, 1–20.—A detailed account of the trials carried out on mechanical thinning during 1962 is given.

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Problems posed by the harvesting of mechanically thinned sugar beets. M. MARTENS. *Pub. Tech. Inst. Belge pour Amél. Betterave*, 1963, **31**, 21–31.—Problems arising from mechanical thinning are discussed, also the performance of different kinds of mechanical harvester in the field. Modifications to some of the harvesters are suggested.

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Sugar cane stalk borer in India. A. N. KALRA. *Indian Sugar*, 1963, **13**, 209–213.—It is pointed out that the stalk borer, *Chilotraea auricilia*, is one of the most destructive cane pests in North India. Until recently it has been restricted to Bihar and U.P. but has recently spread to the Punjab-Jagadhri area. The difficulties of control are outlined as are the proposed future lines of study with the pest.

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Influence of main plant food nutrients on cane yield on different soils of the Phagwara zone. S. S. SAINI. *Indian Sugar*, 1963, **13**, 219–223.—NPK trials were carried out on three major soil types, the cane in cultivation being variety CoL9. Nitrogen, at 200 lb per acre, gave significant yield increases on all soils. P application did not give consistent results and K was found not to influence cane yield in the soils in question.

* * *

New record for a Bracanoid parasite of the sugar cane internode borer in India. S. A. RAJA RAO. *Indian Sugar*, 1963, **13**, 225.—This parasite, *Rhaconotus sp. nr. signipennis* appears to have been previously recorded only from Java. Its habits are different from those of other species of *Rhaconotus*. Its use in the control of the internode borer is considered to be promising.

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Chemical weed control trials in sugar beet in 1962. L. DETROUX and M. MARTENS. *Pub. Tech. Inst. Belge pour Amél. Betterave*, 1963, **31**, 67–85.—Trials were carried out in small plots. The mixtures OMU+BIPC and "Endothal" + "Propham" confirmed the good results obtained previously. A series of new products was examined. As pre-emergence weed killers the mixtures OMU + PCA and "Diuron" + IPC gave good results as did PCA and "Product 634" of E. I. DuPont de Nemours & Co. Inc. in post-emergence application, the latter being specially interesting with mechanical thinning. Some products studied gave poor results.

B4362—a new cane variety in the Philippines. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1963, **10**, (6 & 7), 1.—Characteristics of this new variety (with photograph), preferred for planting in the intermediate rainy zone, are given. It gives high tonnage, good sucrose content and has medium to large sized stalks, greenish in colour, maturing in 11–13 months. It is self-trashing and fast-growing but tends to lodge. Other disadvantages are susceptibility to leaf scorch and yellow spot disease.

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Three year performance of sugar cane varieties from field experiments. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1963, **10**, (6 & 7), 4.—Yield tables of 55 varieties over the last three crop years (to 1961/62) are given, Co 440 being the most extensively cultivated commercial variety at present. New varieties recommended for commercial planting are: Phil. 54–60; B 43–62; B 37–172; F 140; H 49–5; N:Co 310; H 38–2915; Q 57.

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Silage from sugar beet tops. M. E. MAWBY. *British Sugar Beet Rev.*, 1963, **32**, (1), 27–29.—An account is given of the mechanical handling of sugar beet tops in bulk for silaging in large clamps covered with polyethylene. The silage (350 tons) fed to yarded bullocks after Christmas was very successful.

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The struggle against weeds in sugar cane plantations. E. ROCHECOUSTE. *Rev. Agric. Sucr.* (Mauritius), 1963, **42**, 119–133.—Modern chemical methods of weed control are discussed, including pre-emergence and post-emergence treatments, with special reference to weed control in cane fields. The usual rates of application in Mauritius are given.

* * *

Value of cane filter press cake in tomato growing in Puerto Rico. H. AZZAM. *Caribbean Agriculture*, 1963, **1**, (3), 223–230.—Tomato growers in Puerto Rico often use soils of low fertility, low organic matter, and poor tilth. Newly transplanted tomato seedlings in such soils suffer from lack of nutrients and lack of moisture until they develop root systems capable of utilizing applied fertilizer. The value of starter solutions, as used in tomato growing in the United States, and of filter press cake (well decomposed) for improving the texture and moisture-retaining property of the soil is outlined. Yield figures for different plot treatments are given. These vary from 1·61 tons (untreated) to 10·77 tons per acre.

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Results obtained from fertilizing sugar beet with different kinds of magnesium fertilizer. N. ROUSSEL and R. VAN STALLEN. *Pub. Tech. Inst. Belge pour Amél. Betterave*, 1963, **31**, 33–65.—The account is given of trials carried out in 1962 with magnesium in different forms in soils showing signs of magnesium deficiency. Magnesium was applied in different dosages in three forms—oxide, sulphate and carbonate. The immediate effect was better with the sulphate and oxide than with the carbonate.

THE INFLUENCE OF LOAD ON SLUDGE FILTRABILITY, JUICE COLOUR AND GAS ABSORPTION

in a carbonation tank with internal circulation well

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(Swedish Sugar Corporation)

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

IT has been known for a long time that in ordinary carbonatation tanks without internal circulation wells the colour of the first carbonatation juice is influenced by the specific load[1]. When the specific load is low, i.e. when small quantities of beet are being processed per day per square metre horizontal cross-section of the tank, the colour is dark but when the load is increased the colour improves and finally reaches a limiting level. The probable explanation is that at low specific loads only comparatively small quantities of gas pass through the tank. The agitation then being very poor, part of the juice in the tank is overcarbonatated, and other parts undercarbonatated. The outflowing juice may well have the correct optimal alkalinity but is a mixture of overcarbonatated and undercarbonatated juice, both of which are of worse quality than a juice that has been carbonatated straight away to the correct alkalinity. When the gas flow is sufficiently high the contents of the tank are well mixed and every particle of juice is at once carbonatated to the correct alkalinity.

To judge from earlier experience in Sweden, a circular tank of 2 metres diameter should be about right for a factory processing 2000 metric tons of beet a day, i.e. the area of the horizontal cross-section should be approximately 1·5 square metres per 1000 tons of beet per day[1]. It is probable that this specific cross section could be diminished to 1·3 sq.m. This general rule is admittedly rather vague and, moreover, it is based only on experience in factories with processing capacities of approximately 2000 tons. We do not know for certain if it also holds for factories with higher or lower capacity. So far as the other dimensions of a carbonatation tank are concerned our experience indicates that a juice level of 4·5 to 5 metres above the gas distributor should give satisfactory gas absorption and that a total height of 9 to 10 metres should provide a satisfactory space for foam. Our newer carbonatation tanks have been designed with these data in mind and with reasonably good results.

The carbonatation tank being one of the most important pieces of apparatus in a beet sugar factory it has long been felt highly desirable to settle the question of design data not by haphazard observations in various factories but by systematic experimentation. It has not been possible to achieve this, however, for carbonatation tanks of the ordinary type. It is of course, for economic reasons out of the question to instal several full scale tanks of different sizes in one and the same factory. On the other hand, to build a pilot tank with all dimensions a fraction of those of a normal tank would be of no value at all; for one thing, the gas absorption would not be normal. Probably, the best solution would be to build a pilot tank with all vertical dimensions the same as in a full scale tank but with the cross section a fraction of that of the big tank[2]. In this way the gas absorption would be normal but on the other hand the circulation pattern would be totally different from that in a big tank. There would be no place for the juice to whirl around. The carbonatation would be more similar say to that in a Blanke tube carbonatation. It is thus seen that the working operation in an ordinary carbonatation tank is so complicated that the scale-up from small to large capacities is very difficult indeed.

The design of a carbonatation tank with internal circulation well at the Puttershoek factory in the Netherlands has solved the greater part of these difficulties and made systematic experimentation possible. The juice streaming up with the gas in the central well and flowing back through the annular space outside the well, it can be expected that the circulation pattern will be approximately the same in tanks with small and with large cross sections, provided the vertical dimensions and the specific load are the same in both cases. The results obtained in a small tank should then be truly representative of those in a full scale factory tank.

In 1961, a carbonatation tank of the Puttershoek type was installed at the Karpalund beet sugar factory. The results were favourable, the sludge being quite easily filterable and the juice of light colour. It was decided to build a pilot tank of the same type in Karpalund and to test it under various loads. The pilot tank was to have approximately the same verical dimensions as the factory tank but its cross section was to be only a fraction of the area of the large tank.

A drawing of the pilot tank is shown in Fig. 1. All the dimensions are in millimetres. The juice level in the tank could be varied by fitting overflow weirs of different heights. (1000—b) is the height of the weir over the upper rim of the circulation well. The cross-section area of the circulation well was 0·5 sq.m. and that of the annular space also 0·5 sq.m. For

[1] WIKLUND: *Zucker*, 1953, **6**, 264.

[2] JOHNSTONE & THRING: "Pilot Plants, Models, and Scale-up Methods in Chemical Engineering" (McGraw-Hill Book Co. Inc., New York.) 1957.

comparison it may be mentioned that the cross section of the circulation well in the factory tank is 2·7 sq.m. and that the factory normally works about 2050 tons of beet in 24 hours.

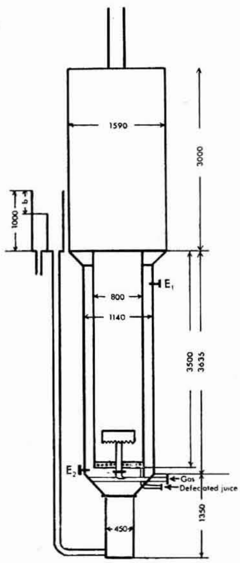


Fig. 1. Pilot carbonatation tank

The juice was fed in through a series of holes in a square tube welded to the internal lower rim of the circulation well. As a gas distributor we at first used a Segner turbine wheel, driven by the reaction force of the streaming gas. The Segner wheel is reportedly a good distributor[3,4] but we found it to be blocked very quickly by calcium carbonate. In the experiments reported here we therefore used a circular distributor of the Dorr type with indentations.

Originally the outlet pipe for carbonatated juice was connected to the bottom cone but since it was found that appreciable quantities of gas accompanied the juice out of the tank, a circular well was fitted to the bottom cone for degassing.

The general arrangement of the experimental installation and the instrumentation are shown in Fig. 2. Defecated juice was taken from a buffer tank after the main defecator. The juice was kept in constant movement in this tank by a slowly revolving agitator. The flow of juice to the carbonatation tank could be regulated by a valve and measured by a recording orifice meter. A thermometer was fitted in the juice pipe. The juice level in the carbonatation tank was indicated by a manometer in the bottom of the tank. Gas was taken from the factory pipe line. The pressure of the gas just before the gas distributor was indicated by a manometer. The gas flow was recorded by an orifice meter and regulated so that the pH of the carbonatated juice was constant. To this end a glass electrode—saturated calomel electrode combination was placed in a by-pass from the pipe for carbonatated juice just below the overflow weir. Signals from this electrode combination were fed into a pH regulator of the ordinary "Micro-Max" type of Leeds & Northrup. The pH of the out-flowing juice was continuously recorded. It should perhaps be noted that the pH meter was so adjusted that the alkalinity of the filtered carbonatated juice was kept at a predetermined value. The temperature of the juice in the carbonatation tank itself was measured.

In a preliminary series of experiments before the 1962 campaign, we tried to measure the circulation intensity in the tank, i.e. how fast the juice streams up through the circulation well and down through the annular space. To this end two electrodes for conductivity measurements were fitted in the tank wall, E_1 below the overflow from the well and E_2 close to the bottom cone, as shown in Fig. 1. The electrodes were connected to a conductivity recorder with very rapid action. The air tank was filled with water to a suitable height and air pumped in by the factory gas compressor. When the circulation of the water was well started and the conditions deemed

[3] PITROF, HAVELKA & MEESS: *Stammers Jahresberichte*, 1882, 122.

[4] ZSCHEYE: *Zeitsch. Ver. deut. Zuckerindustrie*, 1907, **57**, 758.

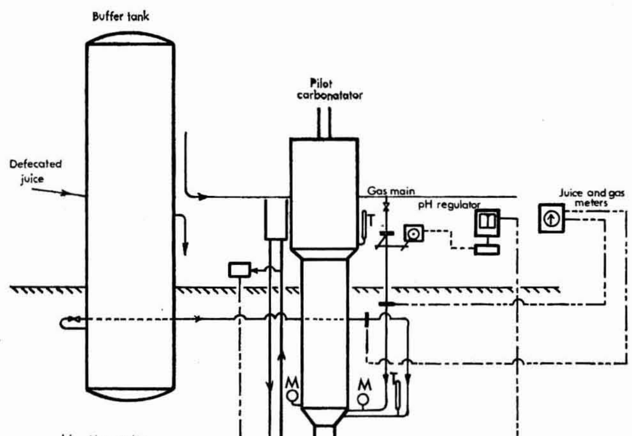


Fig. 2

steady a quantity of concentrated common salt solution was suddenly run in through a funnel in the centre of the tank roof. The salt was rapidly mixed with the water in the upper part of the tank and then on its way down through the annular space first passed electrode E_1 and then electrode E_2, causing peaks to be registered in the conductivity curves. The time interval between these peaks was taken as the time for the passage from E_1 to E_2 and the travelling speed of the salt calculated.

In a series of five experiments, the water level (1000–b) was varied but the gas flow kept constant at 9·6 cubic metres of air per minute, the volume of gas in this paper always being referred to a pressure of 760 millimetres of mercury and a temperature of 0°C. We guessed that this flow would correspond to the normal capacity of the tank but it was later found that it is rather a high value. The result of the experiments is shown in Fig. 3, where the total flow through the annular space is noted on the ordinate in cubic metres per second and the water level above the upper rim of the circulation well is noted on the abscissa. The points show a rather wide spread but there is a slight tendency for the circulation to increase when the water level is higher. The correlation coefficient is 0·45 and the probability that the points have been grouped by chance is 1/3. These statistical data should, of course, not be taken very seriously, the points being very few. However, a later series of experiments at the gas flow of 14·3 cubic meters per minute shows a similar tendency, and it is therefore reasonably certain that the circulation increases somewhat with increasing height of liquid above the circulation well.

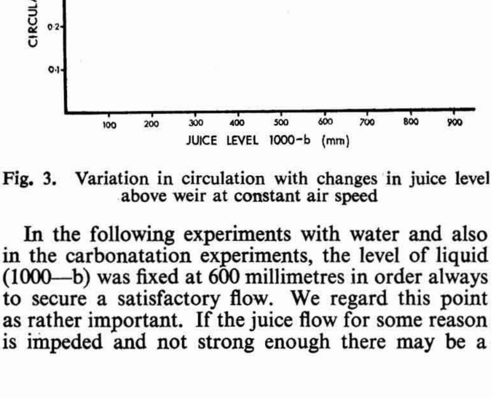


Fig. 3. Variation in circulation with changes in juice level above weir at constant air speed

In the following experiments with water and also in the carbonatation experiments, the level of liquid (1000—b) was fixed at 600 millimetres in order always to secure a satisfactory flow. We regard this point as rather important. If the juice flow for some reason is impeded and not strong enough there may be a tendency for the defecated juice not to be caught completely by the circulating juice but partly to pass straight from the inflow to the outlet, thus lowering the quality of the carbonatated juice.

In the following series of experiments with water and air the flow of air was varied from 3 to 17 cu.m. per minute and the speed of circulation measured. The result is shown in Fig. 4. The circulation speed increases with the air flow and reaches an upper limit at about 13 cu.m. of air per minute. This may be compared with the flows in the carbonatation experiments of about 5 cu.m. of gas at 300 litres of juice per minute and about 9 cu.m. of gas at 500 litres of juice. At the temperature in the tank during the carbonatation the actual volume of gas is a little higher than the recorded figure, say 10 cu.m. of gas at 500 litres of juice. The temperature of the juice being higher than that of the water it is probable that maximum circulation of juice is reached at a somewhat lower gas flow than the one recorded here. Probably the highest possible circulation will be reached at a juice flow of approximately 500 litres per minute. Unfortunately, the juice pipe did not permit a higher flow than 500 litres.

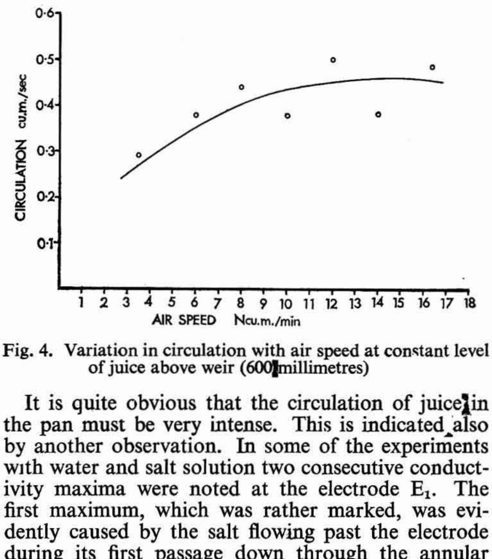


Fig. 4. Variation in circulation with air speed at constant level of juice above weir (600 millimetres)

It is quite obvious that the circulation of juice in the pan must be very intense. This is indicated also by another observation. In some of the experiments with water and salt solution two consecutive conductivity maxima were noted at the electrode E_1. The first maximum, which was rather marked, was evidently caused by the salt flowing past the electrode during its first passage down through the annular space in the tank. The second maximum was not remotely so obvious. We think it highly probable that it was caused by salt which had made its first complete turn down through the outer ring and up again through the circulation well. The time interval between the two peaks, which was 15 seconds for an air flow of 5 cu.m./min, should then be a measure of the time taken for one complete turn. The total volume of juice in the tank being 4·6 cu.m. and the corresponding flow of juice to the tank 300 litres per minute, the average time of sojourn in the tank is about 15 minutes. This means that one particle of juice on the average may have the chance to pass the circulation well 60 times before it leaves the tank. This figure gives, of course, only a very rough idea of the number of passes, the time of sojourn and number of passes being statistically distributed.

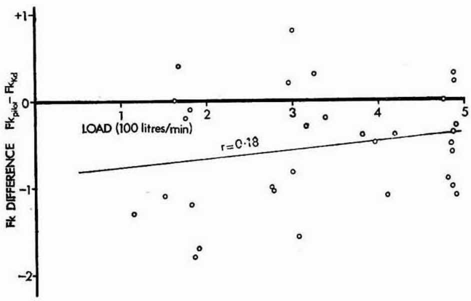


Fig. 5. Difference in *Fk* for pilot and factory tank at varied load

During 14 series of carbonatation experiments from 17th October to 9th November 1962, the flow of defecated juice to the tank was varied from 150 to 500 litres per minute. The alkalinity of the defecated juice was on the average 1·25 grams of CaO per 100 ml, of the filtered carbonatated juice from the pilot tank 0·082 and of that from the factory tank 0·084. The alkalinity, filtration coefficient *Fk* according to BRIEGHEL-MULLER and the colour of the carbonatated juice were measured both for samples drawn from the pilot tank and for corresponding samples from the factory tank. The sludges were photomicrographed. For the colour determination, the filtered

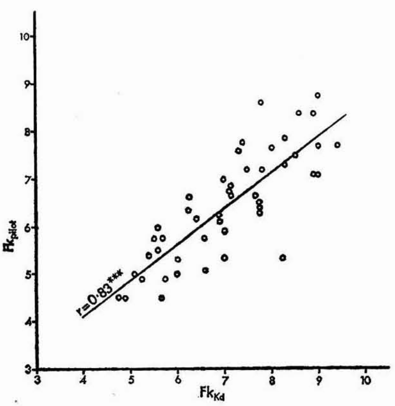


Fig. 6. Correlation between *Fk* values for pilot and factory tanks.

juice was first neutralized to pH 7 and then filtered through a dense glass filter. The light absorption was measured in a Zeiss "Elko II" photoelectric photometer in blue light using an S47 filter, and expressed as decadic extinction coefficient a_1 for a layer of 1 cm and a concentration of 1 gram refractometrically determined dry substance per cubic centimetre.

In Fig. 5, the differences between the *Fk* values for the pilot tank, Fk_{pilot}, and the corresponding values for the factory tank, Fk_{Kd}, have been noted against the feed of juice to the pilot tank. There is no correlation between the two set of data which means that the filtration coefficient is independent of the load and governed by the quality of the defecated juice. In Fig. 6, the filtration coefficient for the pilot tank has been plotted against the coefficient for the factory tank. The correlation is very good, the probability that the two set of data really are interdependent being greater than 1000 to 1. On the average, the pilot tank gives a somewhat better sludge than the factory tank.

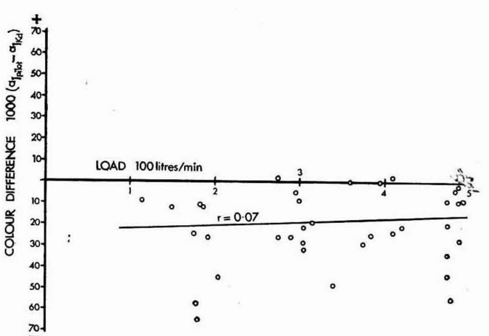


Fig. 7. Colour difference for pilot and factory tanks at varied load.

As to the colour, the conclusions are much the same as for the filtration coefficient, as is shown by Figs. 7 and 8.

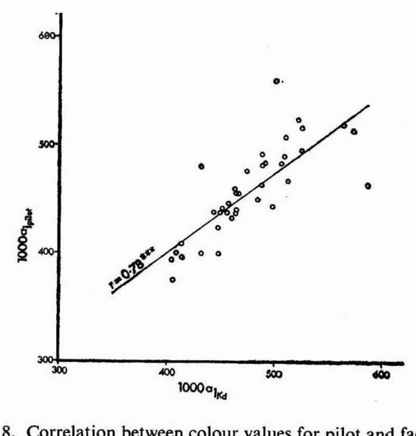
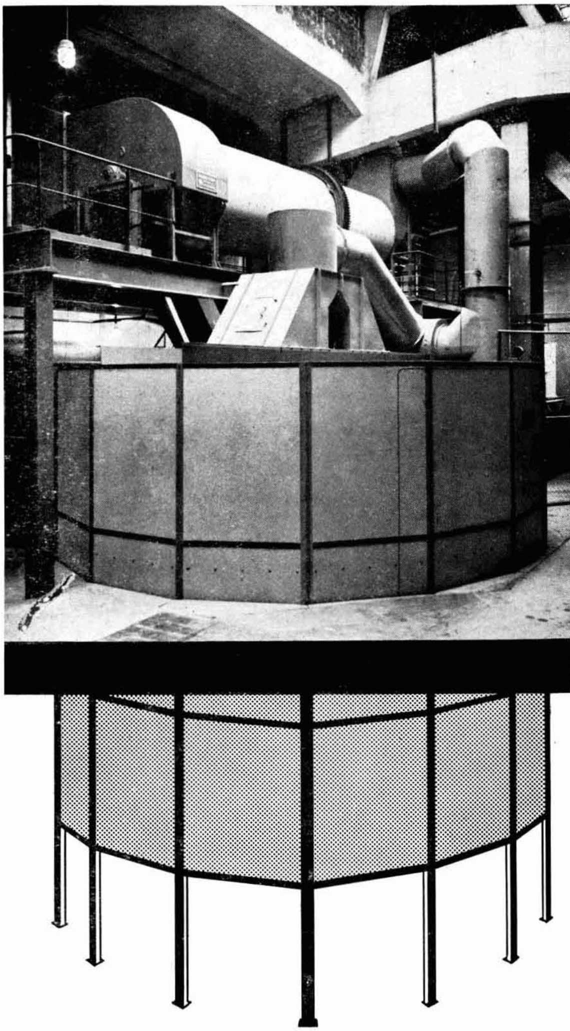
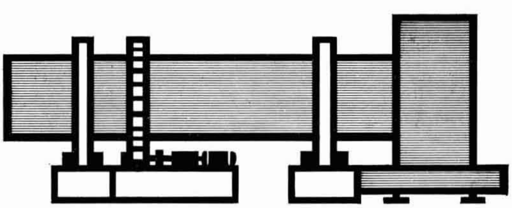
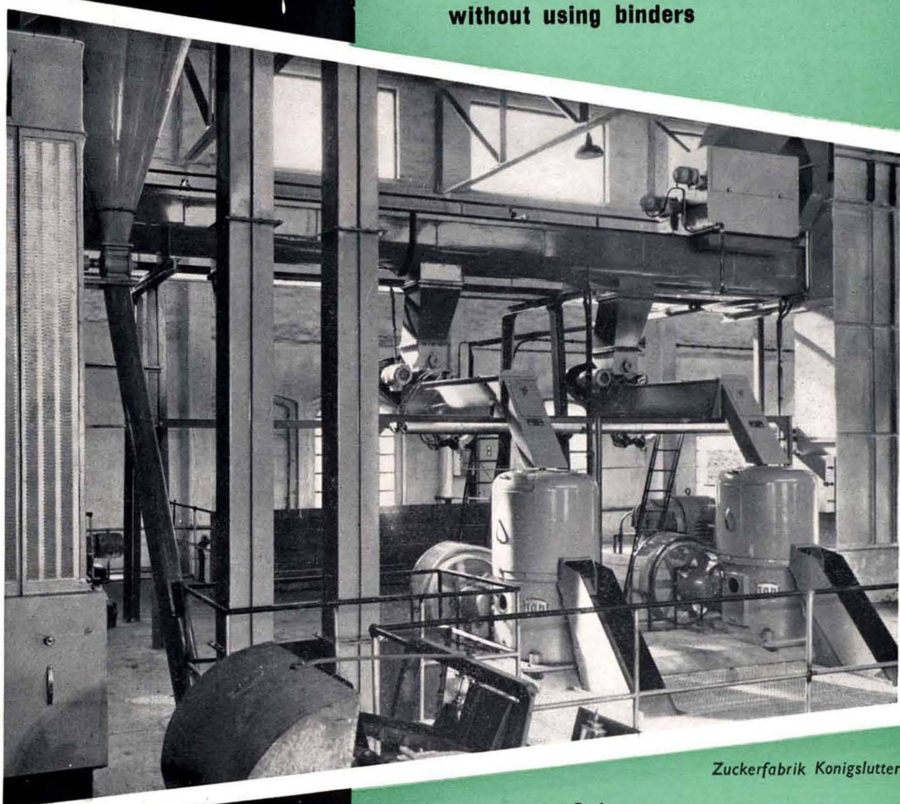


Fig. 8. Correlation between colour values for pilot and factory tanks







Zuckerfabrik Konigslutter

It can therefore be concluded that for a carbonatation tank of this type the quality of the juice within the limits examined will be independent of the load and governed mainly by the quality of the defecated juice. The tank is thus highly flexible which, of course, is very advantageous in factory operations. Moreover, it is obvious that the information obtained in pilot operations will hold also for factory conditions. The scale-up is very easy.

It should be noted that in these respects the experiences with the carbonatation tank of the Puttershoek type differ favourably from those of ordinary tanks, and we are of the opinion that the Puttershoek design is to be preferred.

The quality of the sludge was quite good, considering that no sludge was being fed back to the preliming tank. To judge from photomicrographs, the structure of all the sludges was much the same. Hasslarp uses batch carbonatation and obtains sludge of a very fine grain and with very few aggregates which, however, filters surprisingly well. Roma uses continuous carbonatation without any recirculations of sludge. The sludge consists of large glomerules of carbonate with interspersed smaller particles. The filtration is poor. Staffanstorp uses continuous carbonatation and overcarbonatated unfiltered juice is returned to the inlet compartment of the preliming tank. The sludge consists mainly of typical aggregates and filters quite easily. Finally, Jordberga carbonatates continuously in a Puttershoek tank and returns concentrated sludge from a Dorr thickener to the preliming. The sludge contains mainly aggregates and filters very well.

It seems to us that the sludge from Karpalund occupies a position between the sludge from Roma on the one hand and those from Staffanstorp and Jordberga on the other. Some aggregation seems to have taken place in the tank. The reason for this must remain a subject of speculation but it is probable that, owing to the repeated passes through the carbonatation zone, small particles will have repeated opportunities to adhere to other small particles and that some sort of aggregates will eventually result.

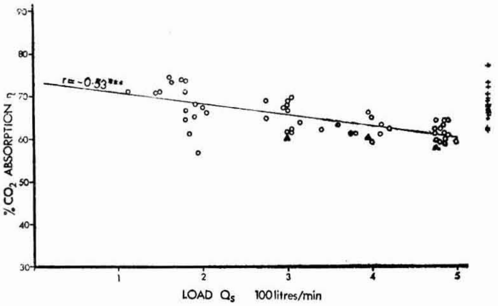


Fig. 9. Absorption efficiency at varied load; ▲ no distributor, + factory carbonatating tank. The line follows the equation η (% gas absorption) = 73·2—2·65 Q_s (load in 100 litres/min).

In all the experiments, the CO_2 content of the gas was measured before and after the tank and the percentage of absorption of CO_2 η % calculated. In Fig. 9, η has been plotted against the flow of juice to the tank. The absorption efficiency steadily drops when the load is increased.

For comparison, absorption data from the factory tank have been plotted in the right hand margin of the diagram. Their average was 68·2%. At the same specific load of 550 litres of juice per square meter cross section and minute the efficiencies were for the pilot tank 66% and for the factory tank 67%. The slightly better efficiency in the factory tank may be due to the juice level of 3·9 m above the gas distributor against 3·7 m for the pilot tank.

In three experiments, the Dorr distributor was removed from the pilot tank and the gas permitted to stream freely from the gas tube of 80 mm internal diameter. The efficiencies obtained are plotted as filled triangles in Fig. 9. They are only about 5 units lower than when the distributor was being used. It seems fairly obvious that the gas is divided in small bubbles by the turbulent motion of the juice or, in other terms, the gas "tears itself apart." To judge from this experiment, it should not matter very much whether a gas distributor is being used or not, but such a conclusion would be premature and probably misleading. In a tank of Puttershoek type at Jordberga, the absorption efficiency varied from 76 to 91% and on the average was 81%. This figure is admittedly extremely high, and it is not clear whether the good efficiency in Jordberga was due to a somewhat higher juice level than in Karpalund or if the praise is due to the gas distributor which is of the Richter type[5] and has been adopted on the advice of the designers in Puttershoek.

At the absorption efficiencies attained at Karpalund, the maximum permissible load on the carbonatation tank will be limited by the surplus of carbon dioxide available, i.e. by the percentage of coke used in the lime kiln. It is rather difficult to tell where the limit is but probably it would be unwise to exceed about 650 litres of juice per square metre cross-section of the circulation well per minute.

ACKNOWLEDGEMENTS

Our thanks are due to Mr. K. G. ANDERSSON, who planned the instrument installation, to Mr. G. ANDERSSON, who took the photomicrographs, and to Mr. V. ASK who, with his assistants, carried out the experiments.

Bagasse paper in Venezuela[6].—A Venezuelan company, Venepal, was to begin production in December 1963 of white writing paper entirely from bagasse; chlorine from the Morón petrochemical plant is to be used for bleaching purposes.

[5] *Zeitsch. Ver. deut. Zuckerindustrie*, 1903, **53**, 223.
[6] *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 991.

ISOLATION BY CHROMATOGRAPHY OF 1-KESTOSE AND 6-KESTOSE FROM CANE FINAL MOLASSES

By W. W. BINKLEY

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OUR generation has witnessed a revival of chromatography. Researchers working with sugars have been keenly aware of its potentialities. In 1939, the column chromatography of the coloured *p*-phenylazobenzoate sugar esters was introduced[1] and extended successfully[2]. A year later a carbon column flowing chromatogram was used to separate mixtures of simple sugars[3] and subsequently to group oligosaccharides according to their degree of polymerization[4]. Mixtures of methylated sugars were resolved on alumina by this technique[5] soon thereafter. The brush technique[6] for zone location was utilized then in the column chromatography of sugar acetates[7] and uncombined sugars[8]. The extension in 1947 of paper chromatography to sugars[9] was one of the milestones in this renaissance. More recently gas-liquid partition chromatography was applied successfully to mixtures of methylated and acetylated simple sugars[10]. Chromatography in thin adsorbent layers of these derivatives[11] as well as simple[12] sugars and mixtures of malto-oligosaccharides[13] is being achieved and the utilization of thicker adsorbent layers permits the isolation of these resolved substances[14]. The herein reported isolation of 1-kestose and 6-kestose in crystalline form from cane final molasses was effected with the combination of certain of these chromatographic techniques.

EXPERIMENTAL

Crude Fractionation on Clay of Cane Final Molasses. The Cuban molasses used in this work was produced at Central Cunagua in 1947. The analysis of this molasses has been published[15]. One hundred grams of molasses were diluted with 50 ml of distilled water. The addition of 50 g of a 5/1 mixture[16] of clay[17] and filter-aid[18a] produced a smooth paste. This paste was added in small amounts to 2000 ml of absolute ethanol during agitation. The resulting suspension was poured onto a 12 cm high × 8 cm dia. bed of 250 g of 5/1 clay/filter-aid, prewet with 1 litre of 95% aqueous ethanol[19]. Five litres each of 95%, 80% and 50% aqueous ethanol and water were allowed to percolate successively through this adsorbent bed. Examination of the bed effluent from the passage of 95% ethanol (Fraction A) has been published[20]. The effluents from 50% ethanol and water were set aside for future study. The average yield of residual syrup (Fraction B) from the 80% ethanol effluent after solvent removal[21] was 10·29 g. Fraction B was brown in colour; it possessed a bitter taste and the odour of cane juice. Ten lots of Fraction B representing a total of 1000 g of the original molasses were prepared.

Fractionation on Clay of Fraction B.—An amount of 9·81 g of Fraction B in 30 ml of distilled water was diluted with 270 ml of methanol. The resulting solution was added at the top of a 11 cm high × 14·6 cm dia. column of 900 g of 5/1 clay/filter-aid[18a] prewet with 2 litres of 95% ethanol followed by 150 ml of 90% aqueous methanol. Twelve litres of 95% ethanol and 15 litres each of 90% and 70% ethanol, respectively, were then allowed to pass successively through the adsorbent column. The yields of non-volatile solids from the 95%, 90% and 70% ethanol effluents after solvent removal[21] was 2·50 g (Fraction B-95), 1·44 g (Fraction B-90) and 4·34 g (Fraction B-70), respectively. Fractions B-95 and B-70 were set aside for future study.

Ten combined Fractions B-90 (14·18g) were re-fractionated by the same process utilized in the fractionation on clay of Fraction B. The 95% and 90% ethanol effluents were combined, yielding 11·60 g (Fraction B-90R) after solvent removal[21].

Column Chromatography on Clay of Fraction B-90R. A 410 cm high × 10·3 cm dia. adsorbent column was prepared from 17·10 kg of 5/1 clay/filter-aid[18a]. The adsorbent was purged with 95% ethanol until the solids content of the column effluent became constant, 0·9 mg solids per 100 g effluent, 30 days being required. The column was operated under the reduced pressure of 10 cm Hg. Molasses Fraction B-90R in 300 ml of absolute methanol was added at the top of the adsorbent column. The chromatogram was developed with 130 kg of 90% ethanol followed by 36 kg of 70% ethanol. The column was operated continuously for 223 days. A plot of this flowing chromatogram is shown in Fig. 1.

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[1] REICH: *Compt. rend.*, 1939, **208**, 589, 748; *Biochem. J.*, 1939, **33**, 1000.
[2] COLEMAN *et al.*: *J. Amer. Chem. Soc.*, 1942, **64**, 1501; COLEMAN & MCCLOSKEY: *ibid.*, 1943, **65**, 1588.
[3] TISELIUS: *Arkiv Kemi, Mineral. Geol.*, 1940, **14B**, (22), 4.
[4] WHISTLER & DURSO: *J. Amer. Chem. Soc.*, 1950, **72**, 677.
[5] JONES: *J. Chem. Soc.*, 1944, 333.
[6] ZECHMEISTER *et al.*: *Bull. Soc. Chim. Biol.*, 1936, **18**, 1885.
[7] MCNEELY *et al.*: *J. Amer. Chem, Soc.*, 1945, **67**, 527.
[8] LEW *et al.*: *ibid.*, 1946, **68**, 1449.
[9] PARTRIDGE: *Nature*, 1947, **158**, 270.
[10] MCINNES *et al.*: *J. Chromatog.*, 1958, **1**, 566; BISHOP & COOPER: *Canad. J. Chem.*, 1960, **38**, 388; KIRCHER: *Anal. Chem.*, 1960, **32**, 1103.
[11] TATE & BISHOP: *Canad. J. Chem.*, 1962, **40**, 1043; GEE: *Anal. Chem.*, 1963, **35**, 350.
[12] STAHL & KALTENBACH: *J. Chromatog.*, 1961, **5**, 351.
[13] WEILL & HANKE: *Anal. Chem.*, 1962, **34**, 1736.
[14] Private Communication from Dr. D. HORTON, Ohio State University, Columbus 10, Ohio, U.S.A.
[15] BINKLEY & WOLFROM: *J. Amer. Chem. Soc.*, 1960, **72**, 4778.
[16] Ratios of adsorbent mixtures are by weight.
[17] "Florex XXX", a fuller's earth clay produced by the Floridin Co., Tallahassee, Fla., U.S.A.
[18] "Celite 545" (a) and "Celite 535" (b), products of Johns-Manville Co., New York, N.Y., U.S.A.
[19] All solvent proportions are by volume before mixing.
[20] BINKLEY & WOLFROM: *J. Amer. Chem. Soc.*, 1947, **69**, 664; 1948, **70**, 290.
[21] Achieved at 50°C under reduced pressure.

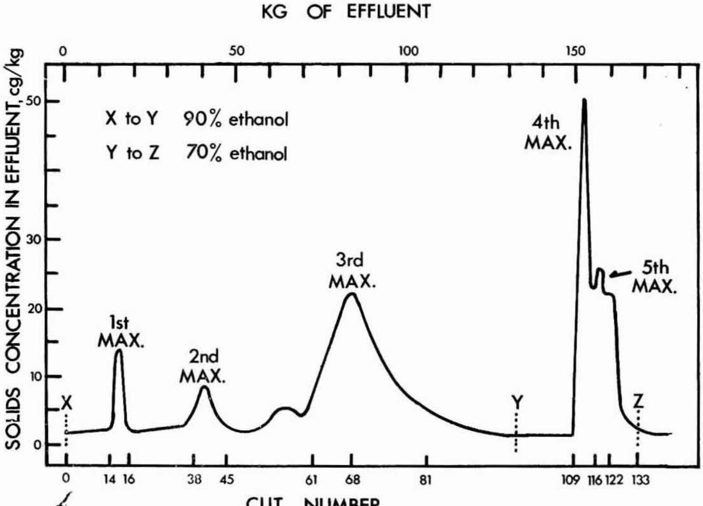


Fig. 1

The non-volatile residues from the first maximum (Cuts 14, 15, 16) of Fig. 1 were reddish-brown, viscous liquids with pleasant odour, elemental analysis C, 72·97; H, 8·86; N, 0·0; they were soluble in methanol, ethanol and chloroform, insoluble in water, Molisch test—negative. Crystalline sodium chloride was isolated from Cuts 17 to 25, yield 18 mg.

The second maximum of (Cuts 38 to 45) of Fig. 1 yielded 85 mg of crude crystals. Treatment of an aqueous solution of these crystals with decolorizing carbon followed by ethanol addition yielded well-formed, nearly colourless crystals, yield 72 mg. These crystals melted at 184–185°C (decomp.), $[\alpha]^{20}_{D}$ + 65·6° (c 3, water). They reacted as follows: Molisch—positive; Benedict, before acid hydrolysis—negative, after acid hydrolysis—positive. The crystals from the second maximum of Fig. 1 were thus adequately identified as sucrose.

A yield of 3·65 g of amorphous solid was obtained from the third maximum (Cuts 61 to 81) of Fig. 1. This solid reacted as follows: Molisch—positive, Benedict, before acid hydrolysis—negative, after acid hydrolysis—positive; paper chromatography of its acid hydrolysate revealed the probable presence of glucose and fructose.

The fourth maximum (Cuts 109 to 113) of Fig. 1 resulted from the change in developer from 90% to 70% ethanol. Cut 110 reacted as follows: Molisch—positive; Benedict, before acid hydrolysis—negative, after acid hydrolysis—positive. Investigation of this maximum is being continued.

The fifth maximum (Cuts 114 to 117) and the following plateau (Cuts 118 to 121) of Fig. 1 yielded 113 mg of crude crystals which on recrystallization from aqueous ethanol melted at 223–224°C; mixed melting point with an authentic specimen of *myo*-inositol was unchanged. These crystals reacted as follows: Molisch—negative, Benedict—negative, Scherer inositol test—positive[22]. The presence of *myo*-inositol in the fifth maximum and the following plateau of Fig. 1 is thus established. A study of the residual syrups from these crystallizations is under way.

The residues from effluent Cuts 122 to 133 will be the subject of a future article.

Chromatography of the Combined Cuts 61–81 *from the Chromatography on Clay of Fraction B-90R*

(*A*) *Acetate Chromatography.*—An amount of 1·63 g of the residual syrup from the combined Cuts 61–81 of Fig. 1 was allowed to react with 1 g of fused sodium acetate and 15 ml of acetic anhydride for 90 minutes at 90°C. The reaction mixture was cooled to 25°C and poured on 30 g of finely crushed ice. The resulting solution was adjusted to pH 5·5 with sodium bicarbonate and extracted with five 20 ml portions of chloroform, yield 2·93 g after solvent removal.[21]

The 2·93 g of acetylated combined Cuts 61–81 in 60 ml of benezene were added at the top of a 250 mm high × 76 mm dia. column of 400 g of 5/1 "Magnesol"[23]/"Celite"[18b] prewet with 100 ml of benzene. The chromatogram was developed with 3·70 litres of 100/1 benzene/ethanol. A large zone (T) was detected in the trisaccharide region[7] of the column and a small zone (D) was located in the disaccharide section (Fig. 2A); zone yields were 2·22 and 0·08 g, respectively.

A 0·43 g portion of the acetates from the trisaccharide region (Zone T) of the previous chromatogram was rechromatographed on a 122 mm high × 65 mm dia. column of 200 g of "Magnesol"/"Celite"[18b] using 5 litres of 100/1 benzene/ethanol. Three zones were detected (Fig. 2B). The recovered adsorbates from the zones were brittle, amorphous solids, light yellow in colour. Cuts 61–81 from the clay chromatography of Fraction B-90R appeared to contain a minimum of three trisaccharides.

(*B*) *Paper Chromatography.*—The residual syrup from Cuts 61–81 was deposited at a designated place on a 23 × 52 cm sheet of Whatman No. 1 filter paper. The descending paper chromatogram was developed at 20°C for 139 hr with 7:1:2 1-propanol:ethyl acetate: water[24]. Three spots were detected with α-naphthol-

[22] *Annalen*, 1852, **81**, 375.
[23] A synthetic hydrated magnesium acid silicate, 2 MgO,5SiO$_2$.
[24] Albon & Gross: *Analyst*, 1952, **77**, 410.

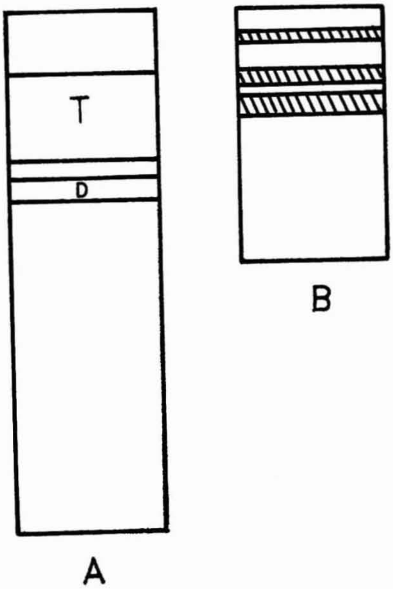


Fig. 2

phosphoric acid spray reagent[24] as depicted in Fig. 3. A : $R_{sucrose}$ 0·62–0·63, 0·48–0·49, 0·43–0·44 and spot intensities 10, 2, 1, respectively. The $R_{sucrose}$ values for 1-kestose, neo-kestose and 6-kestose using this developer are 0·61, 0·61 and 0·48, respectively[25].

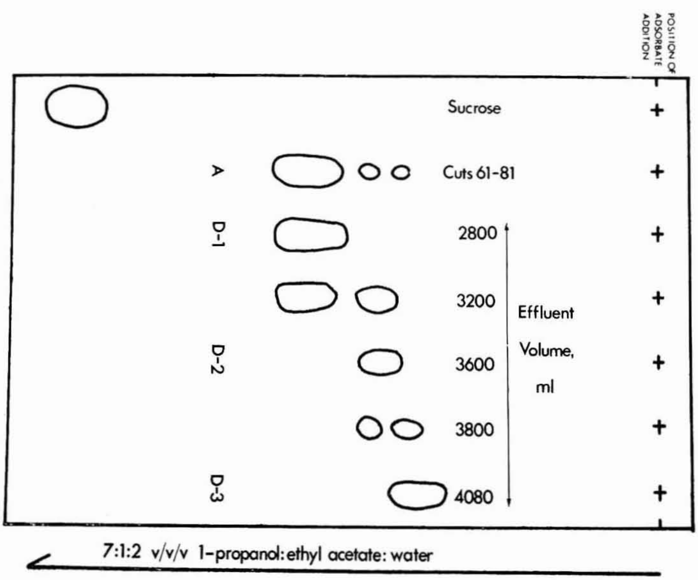


Fig. 3

(*C*) *Paper Electrophoresis.*—The residual syrup from Cuts 61–81 was deposited also at a designated starting position on a sheet of 23 × 56 cm of Whatman No. 3 filter paper. Tetramethyl-D-glucose was added also at the starting position to establish the distances of the migrations. These substances were subjected to electrophoresis at 12°C for 4 hr at 2000 V in a 0·05*M* borate buffer at pH 9·2. Spray reagents *p*-anisidine phosphate and α-naphthol-phosphoric acid were used to determine spot locations (Fig.4, A).

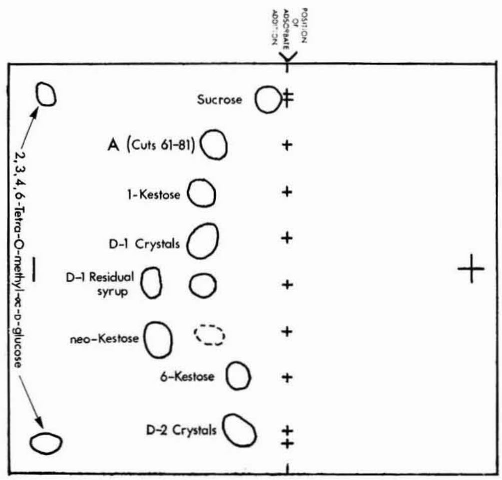
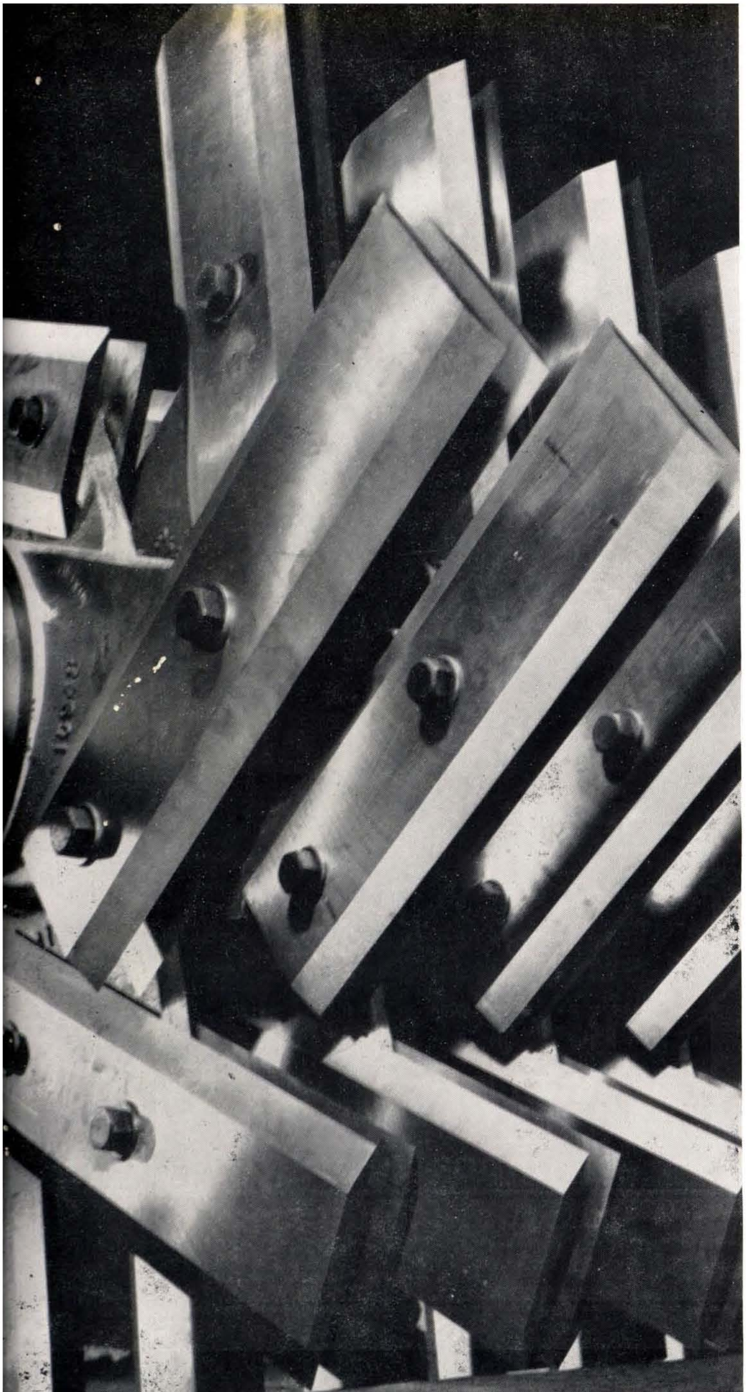


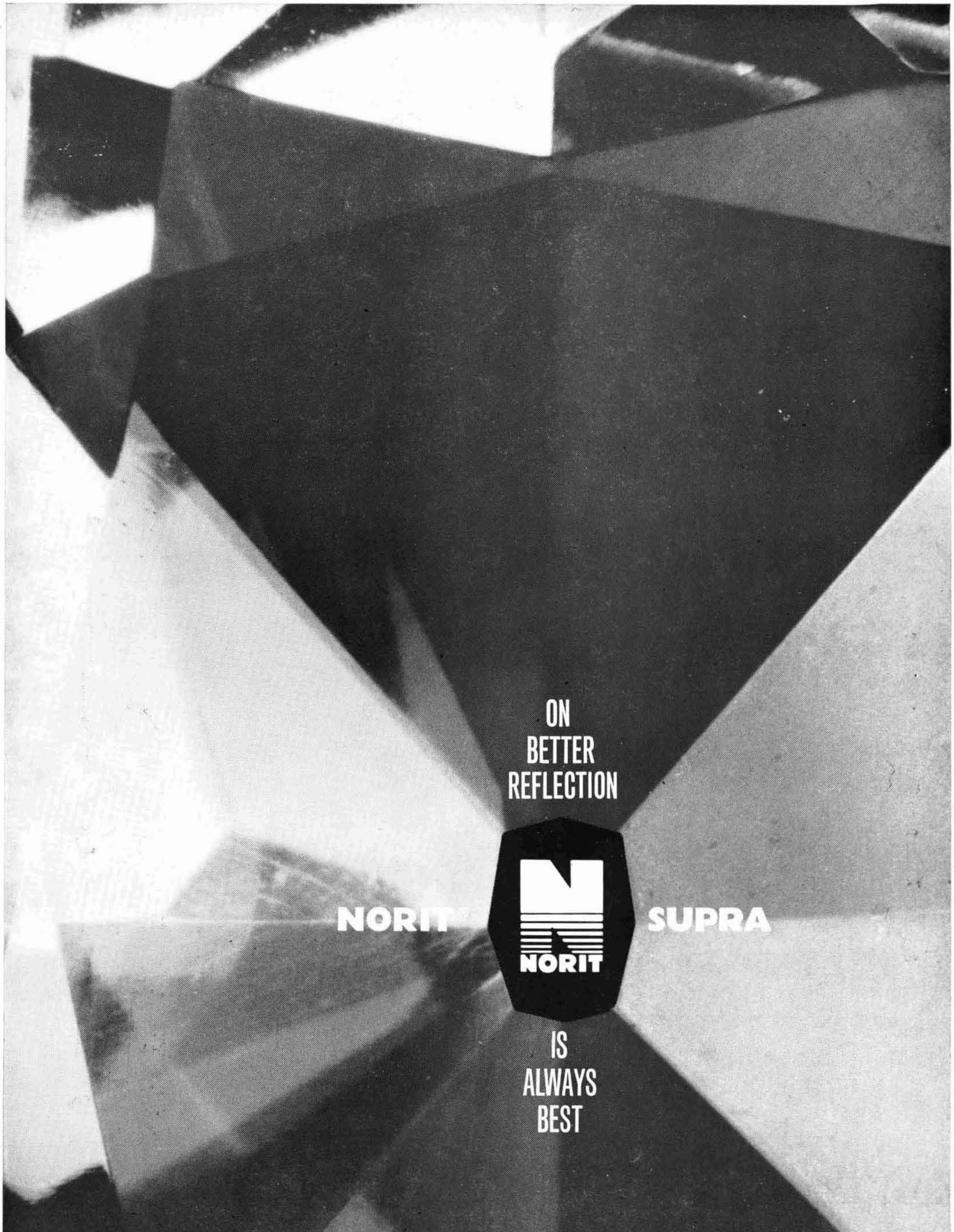
Fig. 4

The $M_{sucrose}$ value for Cuts 61–81 extended from 0·69 to 0·78. The $M_{sucrose}$ values for 1-kestose and 6-kestose are 0·66 and 0·78, respectively[25].

(*D*) *Column Chromatography on Powdered Cellulose.* A 1·56 g lot of the Cuts 61–81 residual syrups in 60 ml of the developer (7:1:2 2-propanol:1-butanol: water[25]) was added at the top of a 57 cm high × 5·5 cm dia. column of 465 g of Whatman Standard powdered cellulose, purged with 4 litres of distilled water followed by 2 litres of the developer. The chromatogram was then developed at 25–27°C with 4·4 litres of the designated solvent mixture. A total of 108 effluent fractions ranging from 20 to 60 ml in volume were collected with the aid of a suitable

[25] GROSS: *Methods in Carbohydrate Chem.*, 1962, **1**, 360.

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fraction collector[26]. These effluent fractions were examined by paper chromatography as described above (Section B). The results are presented in Fig. 3. The effluent fractions were grouped as follows: 2600–3100 ml (D-1), 3380–3700 ml (D-2), and 3960–4400 ml (D-3), $R_{sucrose}$ values being 0·62, 0·48 and 0·43, respectively.

(D-1) *Isolation of* 1-*Kestose*.—A yield of 0·889 g of residual syrup was obtained after solvent removal[21] from the grouped fractions comprising the 2600–3100 ml of column effluent from the powdered cellulose chromatogram. A 0·740 g portion of this syrup was dissolved in 10 ml of methanol and the resulting solution was diluted with 5 ml of ethanol and seeded with 1-kestose[27]. Crystal growth at 25–27°C was allowed to proceed with the infrequent additions of 5 ml portions of ethanol, yield 0·68 g. Recrystallization yielded well-formed prisms which melted at 200–201°C (decomp.), mixed melting point with an authentic specimen of 1-kestose being unaltered, $[\alpha]^{20}_D$ + 28·9° (c 4·0, water); $R_{sucrose}$ 0·62 and $M_{sucrose}$ 0·68 were in good agreement with those of 1-kestose. The elemental analysis of these crystals was as follows: C, 42·1; H, 6·1; calculated for $C_{18}H_{32}O_{16}$, C, 42·86; H, 6·39. These crystals reacted as follows: Molisch —positive; Benedict, before acid hydrolysis—negative, after acid hydrolysis—positive. Paper chromatography of the acid hydrolysate indicated the probable presence of glucose and fructose. These crystals were thus identified as 1-kestose. X-Ray powder diffraction data[28] were as follows: 9·26w, 7·79w, 6·76s, 6·01w, 5·61s, 5·04m, 4·64m, 4·21m, 3·87s, 3·72s, 3·39w, 3·06m, 2·80m, 2·66m, 2·40w, 2·01w, 1·93w.

(*D*-1 *RS*) *Probable Presence of neo-Kestose*.—The residual syrup from the mother liquor from the first crop of 1-kestose crystals (D-1) reacted with the Molisch and Benedict reagents in the same way as 1-kestose. The probable presence of glucose and fructose in its acid hydrolysate was established by paper chromatography. The $R_{sucrose}$ value of this residual syrup was 0·62; it possessed a substance with an electrophoretic mobility on paper the same as neo-kestose[29] (Fig. 4, D-1 RS). The corresponding $R_{sucrose}$ and $M_{sucrose}$ values for neo-kestose are 0·61 and 0·18.

(*D*-2) *Isolation of* 6-*Kestose*.—The grouped fractions making up the 3,380–3,700 ml column effluent from the powdered cellulose chromatogram yielded 0·147 g of residual syrup after solvent removal[21]. An amount of 0·11 g of this syrup in 2 ml methanol was nucleated with 6–kestose[30]. Rapid crystal growth occurred at 25–27°C, yield 0·07 g. Recrystallization produced very fine needles which melted at 143–144°C (decomp.), mixed melting point with an authentic specimen of 6-kestose being unchanged, $[\alpha]^{20}_D$ + 27° (c 2·2, water); $R_{sucrose}$ 0·48 and $M_{sucrose}$ 0·78 were the same as those for 6-kestose. The carbon and hydrogen contents of these crystals were found to be C, 42·0; H, 6·6%, respectively; calculated values for $C_{18}H_{32}O_{16}$ would be C, 42·86% and H, 6·39%. These crystals underwent the same reactions as those in Section D-1 of the EXPERIMENTAL. The crystals from the 3380–3700 ml column effluent from the powdered cellulose chromatogram were thus adequately identified as 6-kestose. X-ray powder diffraction data[28] for crystals formed by slow growth in methanol were as follows: 11·86w, 8·19s, 6·66s, 6·02s, 5·75s, 5·18m, 4·78m, 4·38m, 4·08m, 3·87m, 3·59s, 3·30m, 3·17w, 3·00w, 2·82m, 2·60w, 2·53w, 2·28m, 2·22w, 2·148w, 1·937w.

DISCUSSION

The application of clay chromatography to cane final molasses resulted in the recovery of 74% of the sucrose present[20]. In the work herein reported this adsorbent was used in a modification of this process to isolate from cane molasses a fraction low in sucrose and rich in non-reducing carbohydrate substances. Elution chromatography on a column of fuller's earth clay four metres in length indicated in the form of five maxima the presence of a minimum of five molasses constituents in this molasses fraction (Fig. 1). The first maximum contained an amber viscous non-carbohydrate liquid. The residual sucrose was found in the second maximum. The composition of the fourth maximum will be the subject of a subsequent paper. *myo*-Inositol crystallized from the fifth maximum and the plateau following. The isolation of this cyclic hexitol from cane final molasses has been documented[31]. Our investigation of the third and principal maximum of this chromatogram is reported in this paper.

Qualitative tests showed that the third maximum of Fig. 1 contained sugars which were made up of glucose and fructose. Acetylation and acetate chromatography (Fig. 2) indicated the probable presence of a minimum of three trisaccharides in the third maximum of Fig. 1. Paper chromatography and paper electrophoresis (Figs. 3 and 4) suggested strongly that two of these trisaccharides were 1-kestose and 6-kestose. Subsequently, elution chromatography with a column of powdered cellulose led to the isolation of these sugars in crystalline form from this maximum. This is the first record of the direct isolation of crystalline 1-kestose and 6-kestose from cane final molasses. The minimum concentrations of these sugars in this molasses were 0·16 and 0·016%, respectively, based on these isolations. Their X-ray powder diffraction patterns are described. Paper chromatography and paper electrophoresis (Figs. 3 and 4) indicated the probable presence in trace

[26] HICKSON & WHISTLER: *Anal. Chem.*, 1953, **25**, 1425.

[27] We are indebted to Dr. J. S. D. BACON, Aberdeen, Scotland, for these seed crystals and for the crystallization procedure used.

[28] Interplanar spacings expressed in Angstroms; relative intensities estimated visually (s = strong, m = medium, w = weak). CuKα radiation was used for the diffractograms.

[29] Authentic specimen kindly supplied by Dr. D. GROSS.

[30] These seed crystals were kindly supplied by Dr. D. Gross.

[31] BINKLEY *et al.*: *J. Amer. Chem. Soc.*, 1945, **67**, 1789.

amounts of neo-kestose in this molasses. These techniques have been useful in detection and quantitative estimation of these sugars in raw and refined cane sugars and in sucrose prepared from cane sugar[32].

As the harvest season approaches, sugar cane possesses the combination of maximum sucrose concentration, available transfructosylase(s) and almost ideal incubation temperatures for kestose formation. Paper chromatography has indicated the probable presence of these kestoses in cane juice[33]. Since the ranges of temperature and pH utilized in the production of raw sugar from cane juice are not conducive to the formation of these kestoses[34] their presence in the final molasses is attributed to the sugar cane.

SUMMARY

The presence of 1-kestose and 6-kestose in cane final molasses was established utilizing column chromatography on clay and powdered cellulose which led to the isolation of these sugars in crystalline form.

ACKNOWLEDGMENT

A portion of this work was performed under a contract between the Sugar Research Foundation and the Ohio State University Research Foundation (Professor M. L. WOLFROM, supervisor). Certain research samples from this contract were kindly made available by Professor WOLFROM. The counsel and encouragement of Dr. D. GROSS of Tate & Lyle Refineries Ltd. is gratefully acknowledged. Thanks are due to Dr. L. F. MARTIN and Mr. E. J. ROBERTS, Sugar Investigations, United States Department of Agriculture, for their assistance and counsel with the paper electophoresis and Mr. H. CHANZY, State University College of Forestry at Syracuse University for his assistance with the X-ray diffractograms.

[32] GROSS *et al.*: *I.S.J.*, 1962, **64**, 69.
[33] Private Communication from Dr. L. F. MARTIN, United States Department of Agriculture, New Orleans, La., U.S.A.
[34] PAZUR: *Methods in Carbohydrate Chem.*, 1962, **1**, 365.

REFRACTOMETER SOLIDS IN SUGAR PRODUCTS

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IT is a well established fact that the refractometer Brix of molasses determined from a half-diluted solution exceeds that measured directly by more than one unit. This difference cannot be explained by the error in the International Scale (1936) of Refractive Indices, found by SNYDER[1] and CHARLES[2]. It was therefore decided to study more closely the effect of dilution on the refractometrically determined Brix of boiling house products.

EXPERIMENTAL

Samples of final beet molasses from the 1962 campaign from six Danish sugar factories were used for the experiments. Each sample was centrifuged in order to remove suspended solids. Samples representing higher purities were made by mixing final molasses, granulated sugar and deionized water.

Known weights of the sugar product were mixed with known weights of deionized water, the weighings being performed on a K7 Mettler balance with a minimum accuracy of 0·05%. Samples of greater than 20°Bx were read on a Zeiss Abbé refractometer (0–95% sugar), while a Zeiss Abbé precision refractometer was used for samples of less than 20°Bx. In the former case the accuracy of a reading is about 0·1°Brix, and in the latter case a reading within about 0·02°Brix units is obtained. Both refractometers were controlled thermostatically to 20°C $\pm$0·03°C.

The refractometers were checked at various points of the scale with sugar solutions made by dissolving known weights of the purest available refined sugar with known weights of deionized water. The sugar concentration of the solutions was determined polarimetrically, the value agreeing with that calculated from the known weights within 0·03%.

Prior to and after each set of experiments the zero points of both refractometers were checked with deionized water taken from the same batch used for diluting the samples. The refractometer Brix of each sample was calculated as the mean of five independent readings. For Brix values greater than 57% the corrections adopted by ICUMSA[3] were applied.

RESULTS AND DISCUSSION

Fig. 1 shows the results obtained from dilution experiments on three different molasses samples. The Brix of the original sample is calculated from the dilution factor and the refractometer reading of the diluted sample, and it is seen from the figure that the more the sample is diluted the higher is the calculated Brix of the original sample. Fig. 1 also shows that the calculated Brix of the original sample may be taken as varying linearly with the Brix reading of the diluted sample.

The question is, then, *which* refractometer Brix should be assigned to a given molasses sample, and it would be logical to choose the Brix value which is identical with the true solids. Unfortunately "true solids" is not well defined, and if an attempt is made to dry molasses, it is found that the loss in weight depends on drying time and temperature as well as on the pressure at which drying takes place. In fact

[1] *Proc.* 12*th Session ICUMSA*, 1958, 23.
[2] *I.S.J.*, 1959, **61**, 236.
[3] *I.S.J.*, 1961, **63**, 42; 1962, **64**, 324.

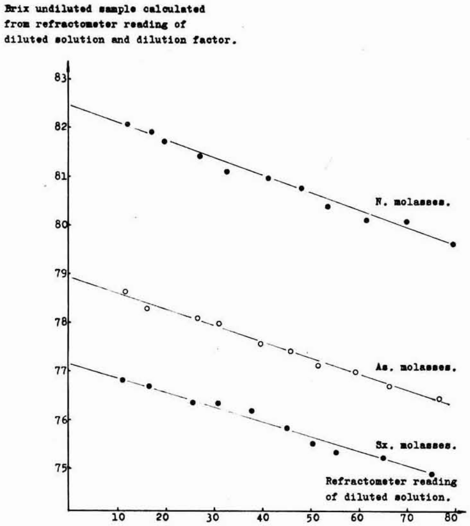

Fig. 1. Influence of dilution on the determination of Brix.

there is no generally adopted analytical method by which true solids in molasses can be determined. As will be shown later, there are certain advantages in defining the solids as the refractometer Brix value at infinite dilution, i.e. the intercept on the ordinate axis of the straight lines shown in Fig. 1.

The fact that a straight line relationship exists between the refractometer Brix of an x times diluted mixture, BX_x, and the calculated Brix of the original sample, $x \times Bx_x$, leads to the following conclusions: In Fig. 2 the straight line I represents this relationship for a substance having the direct refractometer reading Bx_o. Two points on this line are shown for two different dilutions, k and p, where

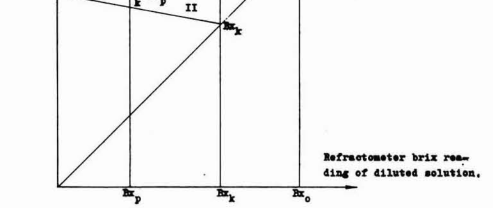

Fig. 2. Relationship between the calculated Brix of undiluted sample and the refractometer Brix reading of diluted solution.

$$k = \frac{M + V_k}{M} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$p = \frac{M + V_p}{M} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

M is the weight of the original sample, which is mixed with an amount of water, V_k and V_p respectively.

If the original sample is diluted k times, and the mixture so obtained (with the refractometer Brix reading Bx_k) is diluted to read Bx_p, the dilution factor is:

$$\frac{(M + V_k) + (V_p - V_k)}{M + V_k} = \frac{M + V_p}{M + V_k} = \frac{p}{k} \ldots\ldots (3)$$

and the straight line going through the points (Bx_k, Bx_k) and ($Bx_p, \frac{p}{k} \times Bx_p$) is obtained, shown as line II in Fig. 2.

Calling the slope of line I $-\alpha$, it is seen from the Fig. that the slope of line II, $-\alpha_k$, is

$$-\alpha_k = \frac{\frac{p}{k} Bx_p - Bx_k}{Bx_p - Bx_k} = \frac{1}{k}\left[\frac{p\ Bx_p - k\ Bx_k}{Bx_p - Bx_k}\right] = \frac{-\alpha}{k}$$

i.e. $-\alpha = k \times (-\alpha_k) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$

Calling the intercepts of line I and line II with the ordinate axis T_o and T_k respectively, it is seen that

$$\frac{T_o}{T_k} = \frac{k\ Bx_k}{Bx_k} = k$$

$$T_o = k \times T_k \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Equation (5) shows that T_o and T_k have the property of true solids from a mathematical point of view of the molasses samples with the direct refractometer readings Bx_o and Bx_k respectively.

Dividing equation (4) by equation (5) it is seen that the ratio between the slope and the intercept on the ordinate axis is constant and independent of the solids concentration of the molasses used in the dilution experiment. The ratio $\frac{-\alpha}{T_o}$ therefore characterizes the particular molasses used in the dilution experiment, and it depends on the nature of the non-sugars and on the ratio between sugar and non-sugar.

The results of dilution experiments at different purities using molasses samples from Danish sugar factories are shown in Fig. 3 where $\frac{-\alpha}{T_o}$ is plotted against (100 – purity). Considering that the accuracy in determining $\frac{-\alpha}{T_o}$ is about 15%, $\frac{-\alpha}{T_o}$ may be taken as varying linearly with (100 – purity), so that

$$\frac{-\alpha}{T_o} = K \times (100 - P) \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Table I

Corrections to refractometer Brix and purity

Sample	*Refractometer read in dilution*	*Sample °Brix*	*Sample Purity*	*Corrections in units of Brix*	*Corrections in units of Purity*	*Corrections in %*
Thin juice	undiluted	15	92	0·02	−0·1	0·1
Thick juice	undiluted	70	92	0·41	−0·5	0·6
A-massecuite	1:1	92	94	0·26	−0·3	0·3
A-molasses	1:1	76	89	0·33	−0·4	0·4
B-massecuite	1:1	93	89	0·50	−0·5	0·5
B-molasses	1:1	78	79	0·66	−0·7	0·8
C-massecuite	1:1	94	79	0·96	−0·8	1·0
Final molasses	1:1	78	60	1·26	−1·0	1·6
Final molasses	undiluted	78	60	2·54	−2·0	3·3

where P is the purity defined as $\frac{\text{Pol }\%}{T_o} \times 100$.

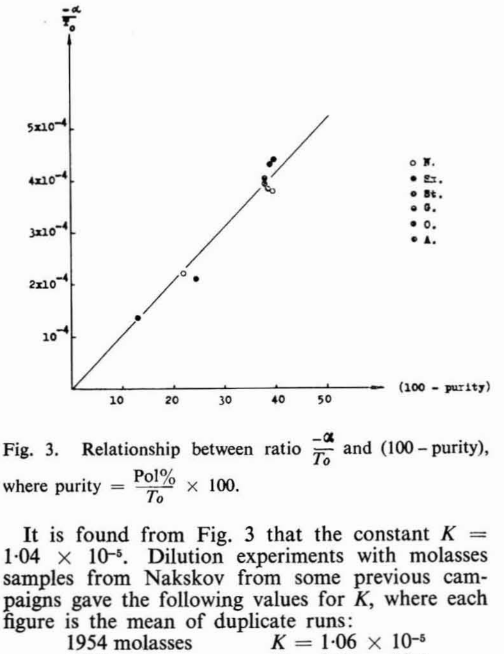

Fig. 3. Relationship between ratio $\frac{-\alpha}{T_o}$ and (100 − purity), where purity $= \frac{\text{Pol}\%}{T_o} \times 100$.

It is found from Fig. 3 that the constant $K = 1{\cdot}04 \times 10^{-5}$. Dilution experiments with molasses samples from Nakskov from some previous campaigns gave the following values for K, where each figure is the mean of duplicate runs:

1954 molasses	$K = 1{\cdot}06 \times 10^{-5}$
1957 molasses	$K = 1{\cdot}03 \times 10^{-5}$
1959 molasses	$K = 1{\cdot}07 \times 10^{-5}$

For Danish conditions therefore, the value of K remains fairly constant from year to year and between localities.

From Fig. 2 it is seen that

$$T_o = \text{Bx}_o - \alpha\text{Bx}_o \quad \ldots\ldots (7)$$

Introducting equation (6) and solving for T_o

$$T_o = \frac{Bx_o}{1 - K(100 - P) \times \text{Bx}_o} \quad \ldots\ldots (8)$$

Since $K(100 - P)\text{Bx}_o$ is a small figure compared with 1, equation (8) approximates to:

$$T_o = \text{Bx}_o[1 + K(100 - P)\text{Bx}_o] \quad \ldots\ldots (9)$$

Equation (9) shows how T_o may be calculated from a knowledge of the directly determined refractometer reading, Bx_o. The correction applied to Bx_o is seen to be proportional to the amount of impurities present in the sample because $(100 - P)\text{Bx}_o = 100 \times$ non-sugar %.

The magnitude of the corrections to be applied to the refractometer Brix determinations and to the purities is shown in Table I.

Conclusion

Nöel Deerr[4] concluded from his investigations with Brix hydrometers that all Brix determinations, in order to be comparable, should be made at equal concentrations of non-sugar. In the case of final molasses, for instance, in order to make the Brix reading at the same non-sugar concentration as that in thin juice, it would require 20–30 times dilution of the molasses so that the multiplied experimental error—even with the most accurate refractometer—would be of the same magnitude as the error which the method is trying to correct.

The present investigation has shown that it is possible to correct all refractometer readings normally carried out in the sugar factory for the varying non-sugar concentrations by the equation (9). The values so obtained may be termed corrected refractometer solids, and they should be useful for the purpose of solids balances and for the comparison of purities.

Mexican sugar expansion[6].—Production of sugar in Mexico in 1963 totalled 1,618,139 metric tons, *tel quel*, compared with 1,427,457 tons in 1962. The cane crop reached 17,719,597 tons, as against 15,765,050 tons in 1962, while sugar yield was 5·067 tons/ha compared with 4·720. Consumption in the first nine months of the year rose by 5·7%, and this increasing demand plus requirements for export have resulted in the formulation of a plan for expansion of the sugar industry which includes the expansion of 24 existing factories at a total cost of about $20,500,000, together with the erection of eight new mills at a cost of $32,800,000.

* * *

Sugar factories for Malaysia[5].—The first sugar factory in Malaysia is to be built near Butterworth in Penang, while a second is to be erected in Batu Tiga near Kuala Lumpur. The United Malay States Sugar Industries Ltd. has been formed with this object.

[4] *I.S.J.*, 1933, **35**, 476.
[5] *Sugar y Azúcar*, 1963, **58**, (11), 88.
[6] *Zeitsch. Zuckerind.*, 1963, **88**, 643.

SUGAR HOUSE PRACTICE

Sugar research in Natal. (**Ann. Rpt., 1962**) *Comm. Sugar Milling Res. Inst.*, 1962, (57), 32 + 5 pp. Separation of starch from mixed juice using a De Laval Type QX 412-315 separator was inefficient, only 25% removal being achieved at the designed throughput of 11,000 gal/hr. Only by reducing throughput to 6600 gal/hr could a removal of 60–70% be attained, whereas two small separators (Type 122 and Type QX 210-30 B) have achieved removals of about 80% The larger separator, used to treat Oliver filtrate, however, reduced the solids content of 1·3–1·7% to 0·2–0·4%, raising the combined retention to 95%. The overflow could not, however, be safely fed to the evaporator. Sugar losses in clarification were determined over a 72-hr period at a sulphitation factory, but difficulty in drawing conclusions from the data was caused by four factors which are listed. A higher inversion rate than that predicted from Stadler's table is possibly a result of the effect of ions other than hydrogen, while it is also suggested that another cause is the presence of enzymes still active at 100°C. Tests with cane samplers at Darnall showed that the mean sucrose content of the samples taken from the cane carrier was comparable to that in the hand-picked samples of shredded cane, but that the sucrose contents of individual samples often differed considerably. In studies to determine whether an accurate analysis of residual Brix in 1st mill bagasse could be obtained from an accurate analysis of the Brix in the extract from water and bagasse, it was found that the sampling error was small enough to justify high precision Brix analysis only with shredded cane taken from a tandem preceded by a shredder or crusher. A continuous pilot-scale disintegrator is considered necessary for direct sampling and analysis of Brix in bagasse. Laboratory studies confirmed that within certain limits, liming to higher pH values gives a lower soluble phosphate content in the clarified juice. Considerable variations in the phosphate content were found in mixed juices of different origin which were limed to the same pH and settled after boiling. No correlation was found between the phosphate content of clarified juice and the original raw juice. Hot liming with saccharate solution gave approximately the same phosphate contents as did cold liming. Liming cold raw juice to pH 6–7·5, heating to 75°C, and liming to pH 8 gave lower phosphate contents than did other liming methods, while the actual content appeared to be independent of the pH to which the cold juice was limed. Cold liming with milk-of-lime gave slightly lower phosphate contents than when using saccharate solution. However, the former resulted in flocculation of small-sized mud particles which on settling gave a fairly compact mud, whereas the saccharate gave a larger floc which settled more quickly and showed a clearer demarcation line between juice and mud. Where juice would not clarify easily with milk-of-lime, the saccharate method gave better results. The rate of feed of saccharate to cold juice subsequently boiled and settled did not appear to affect the clarified juice phosphate content materially, although the appearance of the clarified juice and mud was affected. The slower the feed, the greater was the mud volume and the more "feathery" the mud. while the faster the liming rate, the faster was the settling rate and the clearer the juice. Adding soluble sodium phosphate and milk-of-lime to clarified juice to effect a second clarification reduced turbidity and the phosphate content, the best effect being given by adding about 300 mg/litre of phosphate after the initial floc formation. Parallel factory investigations of clarification showed similar trends to the laboratory experiments, which however gave somewhat better results because of the ideal test conditions. It was found that only a small fraction of the gums present in mixed juice is removed by defecation. The gum content of cane was found to increase with the number of days after cutting. Gum isolated from stale cane, apparently a low molecular dextran, yielded only glucose on hydrolysis in 1N sulphuric acid. It had a mol.wt. of 9000, while a sample from molasses had a mol.wt. of 140,000. Organic acids in fresh and stale cane juice were collected by ion exchange, separated by silica gel column chromatography, and identified as: acetic, fumaric, succinic, aconitic, glycollic, oxalic, malic, and citric acids. Only succinic and aconitic acids were present in sufficient purities and quantities to be identified by their melting points. Glycollic, malic and citric acids showed positive spot tests and oxalic acid was identified by its Ca precipitate and subsequent titration with permanganate. A small amount of an unknown acid emerged from the column between fumaric and succinic acids. In stale cane, the quantity of succinic acid appeared to increase during the first 10–15 days, then decreased. Fumaric acid also slightly increased on occasions in stale cane. Full details are given of the method and apparatus now used to determine raw sugar filtrability. Buffering to pH 9·0 ± 0·1 for filtrability tests was found to result in a smaller pH drop from sugar solution to filtrate but filtrability values were approximately the same. The effect of filter-aid quantity on the filtrability was studied and an optimum dose found after which filtrability tends to decrease. The composition of the suspended matter (starch, wax, gums, silica and phosphate) removed by filtration from sugar samples from 4 factories was determined as well as the viscosity of the filtrates. The viscosities of the filtrates were only very slightly higher than those of the sugar solutions and differed very little between themselves. The proportions of non-sugars removed differed considerably. Since more gums are removed than the other non-sugars combined, they appear to play an important part in sugar filtrability. The effect of starch, phosphate, silica and gums on refined sugar filtrability when added in various quantities was studied. Phosphate up to 100 mg/kg of sugar caused a marked drop in filtrability, after which there was no further decrease. Silica had only a slight effect up to 100 mg/kg, after which filtrability dropped. Starch caused a rather small but steady decrease in the filtration rate with increase in the amount added. Gums from cane juice had no effect; these are different from molasses gums, however, having a mol.wt. of 10,000 compared with 140,000. Phosphate + silica up to about 150 mg/kg had an effect between that of the components, while at higher concentrations the effect on filtrability was greater than that of each component. Phosphate + starch had the same effect up to about 100 mg/kg (equal parts of phosphate and starch), but after this the filtrability continued to decrease, this effect being greater than with any single non-sugar or mixture tested. The effect of phosphate + gums was largely the effect of the phosphate alone, whatever the quantity of gums added. Molasses viscosity determinations showed it to be inversely related to purity. Molasses from mills were found to be of lower viscosity and Brix than during the previous season; this is attributed to dilution of the considerably greater quantity of molasses (resulting from lower purity mixed juice) in order to increase the throughput of the *C*- centrifugals. Tests to determine the amount of Brix-free water in fibre by measuring the change in concentration of an aqueous salt solution when mixed with washed and dried fibre were inconclusive. Studies were also made in which the change in weight of a washed, dried and pulverized fibre sample exposed to air of different R.H. was determined. In studies of solids determination by drying, it was found that drying for 4 hr at 105°C in an oven under atmospheric pressure and provided with a fan gave the same results as 16 hr in a Gardiner oven at 65–70°C under 70 cm Hg vacuum, sand being used as extender in each case. The results were then within approximately 0·3% of the true value. The effects of recrystallization of *A* and *B* sugars (remelting) on the purity (refining quality) of the raw sugars are tabulated; they include a pol increase of 0·12 and 0·24 units for the *A* and *B* remelted sugars respectively. Other data are tabulated. The aconitic acid content of a final molasses sample from Southern Rhodesia was found to be 3·7% on Brix, far higher than that of South African molasses (0·6–1·2% in 1950), although lower than a 1948 average for Louisiana final molasses (4·9%).

* * *

Statistical data analysis and factory control in the sugar industry. VI. W. SCHMIDT. *Zeitsch. Zuckerind.*, 1963, **88**, 318–330.—The advantages and disadvantages of regression and correlation analyses are compared and the partial correlation technique described. The determination of cane maturity is used as an example of the correlation technique.

* * *

Melting of khandsari third sugar with raw juice for the purpose of improving its quality. S. N. PANDIT. *Indian J. Sugarcane Res. & Dev.*, 1963, **7**, 168–170.—Results are given of tests in which third khandsari sugar (of 79·1 pol) was dissolved in raw juice (1% on the quantity of cane crushed) and the juice then processed as normally (sulphitation, boiling, crystallizing and curing). The additional quantity of 97·70 pol 1st sugar obtained by melting 4 quintals of 3rd sugar represents a net profit of Rs. 36·50 and has the added benefit of disposing of low purity sugar otherwise difficult to sell, 59·5% of the 3rd sugar being recovered as 1st sugar.

* * *

Effect of iron crusher and boiling pan on the colour of gur from different cane varieties. ANON. *Indian J. Sugarcane Res. & Dev.*, 1963, **7**, 197–198.—Cane stalks from three varieties were crushed in an iron crusher, and some of the juice boiled in an iron pan, the rest in an aluminium pan. A second sample was boiled in the same way, the cane being crushed in a brass crusher, while a further sample was crushed in an iron crusher while enclosed in polyethylene tubes, followed by boiling in an aluminium pan. Considerable differences were found in the colour of the gur obtained, which was markedly reduced by preventing contact of the juice with iron; it is suggested that the anthocyanin and tannin in the juice react with iron producing dark-coloured substances, which become even darker when the juice is boiled in an iron pan.

* * *

Use of IBM system to collect and report data for payments for sugar cane to producers. J. A. TRIAS. *Sugar J.* (La.), 1963, **26**, (1), 56–58.—Information is given on the procedure used at Guánica in the reporting of weights and laboratory analyses of incoming cane. The scheme utilizes an IBM 347 Data Collecting System.

* * *

Programme to expand and improve operations at Guánica set in motion. ANON. *Sugar J.* (La.), 1963, **26**, (1), 60.—Details are given of modifications planned over the next 5 years; these include the installation of modern 200,000 lb/hr steam generator, improvements to the cane handling at No. 4 milling tandem, installation of a larger evaporator, a new continuous clarifier and other replacements. Six Silver centrifugals were installed in 1962/63 for curing of final massecuite.

* * *

Notes on the use of continuous centrifugals for low-grade massecuites. ANON. *Sugar J.* (La.), 1963, **26**, (1), 69–73.—Results obtained with BMA continuous conical centrifugals at Central Aguirre are discussed, and are compared with data for batch centrifugals. An average reduction of 0·18 cu.ft. of *C*-massecuite per ton of cane is boiled with the BMA machines, representing about 80 fewer low-grade strikes per season. The *C* massecuite purity has been reduced from 60·1 to 59·8, giving a molasses purity of 33·4 compared with 34·7 using the batch machines.

* * *

Controlling dust from bagasse burning boilers. ANON. *Sugar y Azúcar*, 1963, **58**, (7), 34.—Dust from the two 1500 h.p. Bigelow bagasse-fired boilers at Sterling Sugars Inc. is taken from the collectors, mixed with water and the slurry pumped to a nearby pond.

Pumping liquids with centrifugal pumps from vessels working under vacuum. K. N. SAVCHUK. *Sakhar. Prom.*, 1963, (7), 59–61.—Schemes are described for removal of syrup from a last evaporator effect and of condensate from the last effect condensate tank. The pump is operated in a closed circuit with the pan atmosphere and delivers via a separate pipe through a non-return valve.

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Continuous diffusion plants. G. MANTOVANI. *Ind. Sacc. Ital.*, 1963, **56,** 101–122.—A survey is made of continuous diffusers, including the RT, BMA, Buckau-Wolf, DdS, De Smet, Olier and J-type diffusers. The literature on these is reviewed, with 752 references, many to patent specifications, and the difficulty of making comparisons is emphasized.

* * *

Production control room for the supervision and control of the diffusers in a sugar factory. F. AUMAYR. *Wasserwirtsch. Techn. Ber.*, 1962, **14,** (2), 22–26; through *S.I.A.*, 1963, **25,** Abs. 534.—The new control room for the diffusion station of a large beet factory (unspecified) is described with a plan and photographs and an account of the different process variables under supervision. The plant consists of two Olier diffusers and a DdS diffuser, all directly visible from the control room. The throughput is regulated to maintain a constant juice level in the raw juice tank. Automatic interlocking of the main processes is provided. The control room protects the various measuring instruments in addition to improving the efficiency of personnel and of the overall process.

* * *

Optimum scheme for purifying and returning pulp press water to diffusion. A. A. LIPETS and I. M. LITVAK. *Sakhar. Prom.*, 1963, (8), 15–19.—Factory and laboratory tests revealed that heating press water to 70–80°C is insufficient and to kill bacteria present heating to 90°C is necessary, complete sterilization being afforded by adding 0·04% by weight of formalin. A scheme is described, whereby press water is held for 3-4 min in a tank with a sloping bottom (to prevent accumulation of sediment), transferred to a de-pulping cyclone whence the overflow passes to a heat-exchanger for the first heating stage (the heating medium being press water at 90°C on its way to diffusion). The water is finally heated to 90°C in a boiler-type heater and passes to a settling tank where the formalin is added. After 10 min retention at 90°C, the water is pumped via the heat-exchanger to the diffuser.

Rotary diffusers. V. A. SELYATITSKII. *Sakhar. Prom.*, 1963, (8), 19–20.—Average loss figures for continuous rotary, trough, chain and tower diffusers are discussed and shown to be approximately the same, although the quality of juice from trough and chain types is considered to be somewhat superior. Reasons are given for high maintenance costs and short life of rotary diffusers and their replacement by other more efficient types is called for.

* * *

Filtration of carbonatation juice. I. G. CHUGUNOV. *Sakhar. Prom.*, 1963, (8), 20–22.—Filters provided with means of mud removal by juice or condenser water are discussed, and in particular difficulties caused by $CaCO_3$ scale formation. This may be formed by reaction of ammonium carbonate in the condenser water with $Ca(OH)_2$ on the cloths or may precipitate from juice supersaturated with $CaCO_3$. Kieselguhr used to remove colloids from the juice may also remove some of the carbonate, while heating unfiltered 2nd carbonate juice will also reduce the carbonate content. Progressive pre-liming and return of muds to encourage aggregate formation are beneficial.

* * *

Determination of diffusion time and temperature in continuous diffusers. A. K. BURYMA. *Sakhar. Prom.*, 1963, (8), 22–27.—Simple mathematical relationships for determining a number of factors in diffusion are given in graph form for various continuous diffuser systems. The retention time was determined under different conditions (throughput per day for Buckau-Wolf and KDA-58 diffusers, rotary speed of screw for DdS and speed of moving element and juice level in a J-type diffuser). The effective diffusion time, i.e. the period from complete plasmolysis of the cossettes to their removal from the juice, was determined using a DdS diffuser and is demonstrated by a rather complex graph. The factor is important as it is related to the amount of sugar extracted and is of use in determining losses. It is given by KZ, where K is a coefficient

$$\left(=\frac{\text{total diffuser length—distance before plasmolysis}}{\text{total diffuser length}}\right)$$

and Z = cossette retention time. The main factors affecting the value of K are the temperature and amount of juice used for cossette scalding. Empirical values of K are given for the four types of diffuser mentioned above. The diffusion mean temperature is calculated for that section of the diffuser corresponding to the effective diffusion time. Empirical equations are presenting for each type of diffuser based on the mean graphical value.

More attention to the quality of beet cossettes. M. I. RYBALKIN. *Sakhar. Prom.*, 1963, (8), 27–29.—Reasons are given for poor cossette quality, including: inefficient cleaning of beet, excessive speeds of beet slicers, and poor maintenance of slicers and knives. Some data are given for centrifugal slicers, showing *inter alia* the cossette length and percentage of mashing and spoilage at given speeds. Certain types of slicers tested but not used for normal factory work are discussed. Recommendations on the allocation of labour for beet knife sharpening, which should be mechanical rather than manual, are given.

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Regulating the work of sugar-house sections. H. A. SINITSYN. *Sakhar. Prom.*, 1963, (8), 30–32.—Inefficient processing at Kshensk sugar factory, where the sugar loss to molasses was higher than the average for the other factories in the oblast (region), was studied; after certain remedies had been effected, the molasses sugar fell to the lowest in the oblast. Recommendations are listed on ways to effect further improvements.

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Working conditions of ion-exchange resins in juice purification. Z. B. SHAPOSHNIKOVA, M. A. ABRAMOVA, P. V. GOLOVIN. L. S. PETRENKO and A. A. GERASIMENKO. *Sakhar. Prom.*, 1963, (8), 38–41.—Laboratory tests were conducted on 2nd carbonatation juice purification with KU-1 cation and EDE-10 anion exchange resins, the factors determined including: resin consumption, optimum contact time, and juice pH, Brix, purity and purity rise, and colour. Both dynamic and fixed-bed methods were studied, the latter proving unsatisfactory with the anion exchanger because of high resin consumption and the long time needed to establish equilibrium. The extent of juice dilution was also determined in a 4-stage fixed-bed scheme (cation-anion-cation-anion exchanger) and found to be about 15%, rising to 20–25% when wash water was added to the juice after sweetening-off. The test data are given in tables.

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Heat utilization in sugar factories. M. L. VAISMAN. *Sakhar. Prom.*, 1963, (8), 42–46.—Despite the views of PONOMARENKO[1], the present author insists that three of the major causes of excessive steam consumption in evaporators are: high diffusion juice draughts, excessive dilution of the juice with filter wash-waters, and irregular vapour bleeding to vacuum pans. Tabulated data and calculations are used in support of these arguments.

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Automation in the sugar industry. L. HERSSENS. *Sucr. Belge*, 1963, **82**, 393–401.—Among the equipment controlled automatically at Hougaerde Grand-Pont factory are: (1) a lime kiln provided with a Cocksedge distributor, the limestone level being detected using a γ-ray emitter and Geiger counter probe which controls the feed—the advantages of the system are listed[2], (2) Funda filters[3] for syrup filtration and bag filters for carbonatation juice, and (3) the 1st strike centrifugals.

* * *

Method of approximating evaporator stations with uniform-size effects. P. FREUND. *Zeitsch. Zuckerind.*, 1963, **88**, 382–383.—Approximate calculations of the temperature gradient distributions and of the heating surfaces are possible with certain formulae that are presented. There are four sources of slight error (these are listed) and certain factors are known: heat loading of the effects (from the heat balance), the heat transfer coefficients (from the evaporator or juice Brix on discharge from each effect) and the available total temperature gradient. While normally a temperature gradient value is assumed for each effect, with this method each gradient is calculated and the introduction of suitable heat transfer coefficients into the calculations gives data for evaporators with effects of uniform heating surface and loading. A worked example is given.

* * *

Fully automatic control of the exaporator station and heat surface immersion. G. WEIDENFELD. *Zucker*, 1963, **16**, 373–376.—Evaporator control may be split into two sections: control factors outside the evaporator (quality and quantity of thin juice, thick juice, heating steam and vapour) and control factors within the evaporator (heating surface immersion in steam and juice). Control of the juice level is a prerequisite for fully automatic control of evaporation. A minimum juice intake will prevent "over-boiling" as well as ensure the shortest retention time and consequently maximum working efficiency. However, at a minimum juice intake the heating surface must be completely covered by a vapour-juice mixture flowing at greatest velocity and with minimum pressure loss. For adequate control, the intensity of the juice-vapour mixture leaving the upper tube ends can be measured, e.g. with optical instruments located over the upper tube plate which so regulate the juice feed or discharge through the appropriate valves that the heating surface is completely covered at all times and at minimum juice feed. An evaporator design is described in which two annular collecting chambers, divided into segments, surround the upper part of the calandria, with drainpipes leading to the juice compartment below the calandria. The outer annual segments deliver to the adjacent inner segment drainpipes. Guide plates above each segment are so arranged that with greater intensity of boiling, more juice flows to the inner segments via the outer segment.

* * *

The effect of low-grade massecuite cooling rate and Brix on molasses exhaustibility. K. WAGNEROWSKI, D. DABROWSKA and C. DABROWSKI. *Gaz. Cukr.*, 1963, **71**, 160–166.—See *I.S.J.*, 1963, **65**, 23.

[1] *I.S.J.*, 1963, **65**, 242.
[2] See also *I.S.J.*, 1958, **60**, 146.
[3] *I.S.J.*, 1963, **65**, 173–177.

NEW BOOKS AND BULLETINS

Spencer-Meade Cane Sugar Handbook. 9th Edn. G. P. MEADE. 845 pp.; $5\frac{1}{2} \times 8\frac{1}{2}$ in. (John Wiley & Sons Ltd., Glen House, Stag Place, London S.W.1.) 1963. Price: 180s 0d.

The obvious procedure in reviewing a book of this type is to compare it with the preceding edition, in this case one published nearly twenty years ago since when great strides have been made in all branches of sugar cane processing and analytical techniques. The new book contains 11 pages more than the 8th edition and is slightly thinner. This is the result of a deliberate limitation on the size of the book without restricting its scope, purely historical items or those of doubtful present-day usefulness being eliminated.

A new paragraph is included on sugar cane diseases and pests, while reference to modern methods of mechanical harvesting is limited to the Thompson harvester and the Hawaiian grab-rake, without mention of the more recent cut-chop-throw machines. The composition of cane is expanded to a new chapter in the light of more recent knowledge, while the section on cane wax is also expanded. A short section on cane diffusion refers only to work in the last century and to the Hawaiian experiments in 1958/9. It is stated that "preparation of cane is no more or less a problem in diffusion than in milling"; this is not the impression one gathers from the reports of investigations in South Africa, Australia and elsewhere.

Preparation of direct consumption sugar by use of vegetable carbon and ion exchange resins is mentioned but their uneconomic character pointed out. Modern methods for handling filter muds to avoid recirculating filtrates are newly described with an account of the "EimcoBelt" and "Fas-Flo" filters, the "Rapifloc" system using "Separan AP-30", etc. Recent studies on evaporator cleaning and explosions are mentioned, while the storage of juice and syrup during shut-downs is omitted; a curious point is that this has been the subject of considerable interest in Australia in the last year or two.

The section on calandria pans is expanded with accounts of the modern Webre pan with forced circulation, the Hamill low-head pan and the ring-type pan. Great attention is devoted to the control of pan boiling by means of boiling point elevation instruments, while the simpler and, in the opinion of many, as efficient conductivity technique is dismissed in one paragraph.

The treatment of low-grade boiling has been drastically revised, emphasis being placed on the new AC or two-boiling system used in Cuba and Puerto Rico, and the corresponding new three-boiling system used where the syrup purity is higher than 83. Descriptions of older systems have been dropped. The chapter on crystallization in motion was written by the late E. C. GILLETT and places a greater emphasis on theoretical considerations than in the 8th Edition, also mentioning more types of water-cooled crystallizer.

A new section on continuous centrifugals mentions only the Silver machine without indication that it is basically a Hein,Lehmann design; other centrifugals such as the BMA and Escher Wyss machines are ignored. No mention is made of the very high capacity machines developed of recent years by Buckau-Wolf, Fives Lille-Cail, etc.

The radical change in molasses usage from alcohol production to animal feeding is reported, as are modern studies on micro-organisms and yeasts in sugar products and the prevention of deterioration. A new section deals with bulk storage, contrasting it with bag storage, while the Powers ERH concept is also discussed. Modern filtrability test filters are described, while the former section on the dye test for colloids is reduced to a small paragraph because of the doubts as to its validity.

Carbonatation is now described in the section on clarification in the refinery, whereas formerly only phosphate defecation was described; the latter system is more fully treated in view of its predominance in U.S. refineries. Handling of muds is now described, while a new chapter by V. R. DEITZ and F. G. CARPENTER deals with decolorization using adsorbents, including fixed-bed bone char operation, the use of "Synthad", granular active carbon and ion-exchangers as well as moving bed operation such as the Continuous Adsorption Process with bone char and active carbon. Also discussed are treatment with powdered carbon and with kieselguhr. In this section descriptions are given of the Stordy and Herreshoff char kilns as well as the older retorts.

In the section on sugar finishing, the Link-Belt "Roto-Louvre" dryer is referred to extensively and it is stated that the Thames Refinery installed these dryers in 1960. The dryers installed were, of course, Dunford & Elliott Rotary Louvre dryers; these were made under licence by Link-Belt under the name "Roto-Louvre" until the Dunford patents expired.

Improvements in saccharimetry are mentioned, including the newer photoelectric and automatic instruments, while detailed treatment is given to the changes of view concerning the "lead error" in polarization and the consequences of a study by MESLEY[1] using unclarified solutions. A section on the effect of various salts on specific rotation does not mention the remarkable result obtained with borax and other salts as reviewed recently by LOPEZ[2] and TICHÁ & FRIML[3].

A number of modifications to the Lane-Eynon method for reducing sugars are given, while new material in the section on moisture in sugar products includes the Gardiner oven, dipping and continuous refractometers as well as new techniques such as the Karl Fischer and similar chemical methods, vacuum

[1] *I.S.J.*, 1962, **64**, 75.
[2] *I.S.J.*, 1963, **65**, 46, 72, 107.
[3] *I.S.J.*, 1963, **65**, 308.

distillation and dielectric and nuclear magnetic resonance methods. Up-to-date thinking on the measurement of colour and turbidity is reviewed, while the section on cane analysis now includes disintegrators for cane and bagasse analysis. Grist and specific gravity of sugar are now included in the section on its examination, as are the sedimentation test, and measurement of moisture and starch contents. The bagasse and filter-cake analysis section are now combined, while the "AutoAnalyzer" system for continuous monitoring of waste water for sugar is described. A new chapter is provided on special techniques in sugar analysis while that on chemical control is revised thoroughly. A valuable new chapter is that on the statistical treatment of measurement and errors. The tables provided are brought up to date by inclusion of new values and measurements obtained since the 8th Edition was published.

Many of the sections not mentioned have been rewritten and brought up to date with recent references, some as recent as 1962, and many new illustrations have been provided. The chapter and sub-section headings have been set in a different type and the effect of these and the new illustrations is much clearer than in the previous edition. The index has been based on the system used in this *Journal.*

The two principal defects, in the reviewer's opinion, are the prominence given to U.S. equipment to the exclusion of other products or diminution of their significance, and the rather high price. The enormous value of the work as a whole is, however, such that these factors are unlikely to have an inhibiting effect on the sales of the book which will undoubtedly be as successful as its predecessors.

* * *

The South African Sugar Year Book 1962-63. 300 pp.; 8½ × 11 in. (The South African Sugar Journal, P.O. Box 1209, Durban, Natal, South Africa.) Price: R1.00; 10s 0d.

The 33rd edition of this year book follows the pattern of previous editions, being divided into seven sections: Special Articles and Features (the articles are reprinted from the Proceedings of the 37th Congress of the S.A.S.T.A.); Industrial Reviews and Reports, including a 34-page summary of milling results, compiled by C. G. M. Perk; a Reference section giving information on the members and officers of the various millers' and planters' organizations, and on other bodies concerned with the South African sugar industry; a Statistical section, containing data on sugar production, crops, sugar prices, etc. including figures for 1963; a section on Sugar Milling Enterprises in Natal, Zululand and Swaziland, with information on sugar companies, followed by a section on sugar companies in Angola, Congo Republic, East Africa, Mauritius, Mozambique, Somalia and Southern Rhodesia. The final section outlines the developments of a number of sugar equipment manufacturers with information on their products. A loose map, compiled by the Mt. Edgecombe Experiment Station, is enclosed showing the normal annual rainfall in the South African cane area.

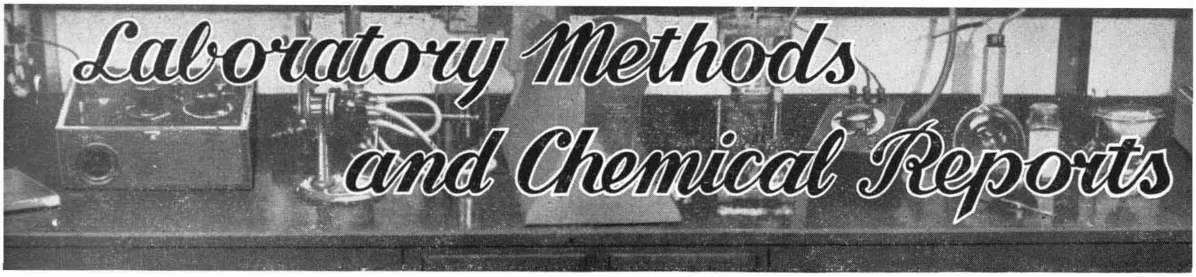
* * *

Anuario Azucarero de Cuba 1961. (Cuba Sugar Year Book.) 84 pp.; 9 × 12 in. (Ministerio del Comercio Exterior, Apartado 2549, La Habana, Cuba.) 1963. Price: $5.00.

This is the 25th edition of the Cuba Sugar Year Book, formerly published by *Cuba Económica y Financiera* and now compiled by the Cuban Government Office of Information, Publications and Translations. It is published in both Spanish and English, and includes an alphabetical list of sugar factories by their new names. Eight mills to be dismantled for the 1963 crop are summarized in a section on rationalization of the sugar industry, while certain data for the 1962 crop are also tabulated. More detailed information is given for the 1961 crop, by factories grouped in provinces, and in a general summary. Stocks, production, exports and consumption of sugar in Cuba during 1956/61 are also tabulated and a table showing the mill producing most sugar in each year from the 1902/03 crop, together with its out-turn. Crushing capacity and production of each mill in 1961 are tabulated, together with the maximum production achieved and the year of this attainment.

A table is also provided of sugar and molasses production statistics from 1955 to 1961, while another lists the proportions of Cuban sugar production by provinces from 1902/03 to 1962. A large table gives details of the crop period, cane crushed, sugar yield, sugar and molasses and syrup production, their prices and the value of the sugar crops for the years 1900 to 1961. Other tables give the years of sugar crops in groups separated by one-million-ton intervals, groups separated by differences of 1 cent per pound of sugar, exports by destination for 1954/61, and by type of sugar for 1957/61. Tonnages and prices of sugars exported to the U.S. from 1890 to 1960 are listed, there being no such exports in 1961. A further table gives corresponding figures for sugar exported to other destinations, and a three-page folding section provides a map of Cuba showing the locations of the mills. The "Sugar Barometer" is a collection of Cuban and world data for 1960 and 1961 together with percentage changes. Cuban exports of sugar are tabulated by ports and by calendar months, as are cane crops, sugar prices, INRA offices, etc.

It will be seen that there is a tremendous amount of information to be found in this book. It is, of course, of major interest as the first authoritative source book to be published by the Cuban Government since its take-over of the sugar industry. It is nevertheless rather high-priced for such a small number of pages, but no doubt this will not be a deterrent to anyone seeking the information it contains on the Cuban sugar industry.



Complexometric determination of calcium in the regeneration of bone char. K. ČÍŽ. *Listy Cukr.*, 1963, **79**, 137–139.—A proposed method of determining Ca in bone char is described. The finely ground bone char sample (0·5 g) is dissolved in about 20 ml HCl (1:1) and boiled for 10 min after the finish of gas evolution. The solution is cooled, diluted and filtered, the filtrate then being neutralized and made up to 500 ml. Fifty ml of this stock solution is then used for titration, being diluted in an Erlenmeyer with water to about 200 ml. About 10 ml of a 30% aqueous solution of triethanolamine (or 5 ml of a 10% KCN solution) is added to eliminate the heavy metals and the pH adjusted to 11 with about 25 ml of a buffer solution (54 g NH_4Cl + 350 ml 25% ammonia solution per litre). Eriochrome Black T indicator (0·2 g in NaCl, 1:100) is added and titration carried out with 0·05M EDTA sodium salt (18·6126 g of "Complexon III" in 1000 ml water) until a clear blue colour develops. Murexide may be used as indicator, in which case 10 ml triethanolamine solution is added and 25 ml 1N NaOH to adjust the pH to 12. The same amount of EDTA is used as above, the end-point being indicated by a change in colour from rose-pink to violet. In both cases, 1 ml of 0·05M EDTA is equivalent to 2·004 mg of Ca. Results of tests are given alongside those given by the Scheibler method of determining $CaCO_3$ in bone char. To check the process, bone char was extracted with sodium EDTA solution and the excess back-titrated with magnesium salt. No reproducible results were obtained, probably because of interference from phosphate ions; this did not occur when HCl was used. To determine how much CO_2 is liberated from bone char completely saturated with colouring substances, a 41°Bx refined sugar or molasses solution of 44·5°St. colour content was passed through an "S" polystyrene cation exchanger (Na form) to remove the Ca. The $CaCO_3$ content in the unused bone char was determined by the Scheibler method and the char then used to decolorize the delimed sugar solution. Decolorizing continued until there was no practical difference in the colour content of the solution before and after char treatment. The char was sweetened-off and dried, and the $CaCO_3$ content again determined. The difference proved to be the equivalent of 0·03% Ca. This must be taken into consideration when determining the amount of acid needed for char regeneration.

* * *

Sorbic acid as a preservative for (cane) syrup. M. FALCONE. *Engenharia*, 1961, **19**, 657–661; through *S.I.A.*, 1963, **25**, Abs. 372.—The fungistatic action of sorbic acid at levels of 0·2–2·0 g/litre was tested in 70·8°Bx samples of cane thick juice or melado (directly consumed in Brazil on a large scale). The sterilized samples were inoculated with *Hemispora* sp., *Penicillium* sp., *Mycoderma vini*, *Hansenula anomala*, *Debaryomyces guilliermondii*, *Saccharomyces* sp., and *S. cerevisiae*, and stored for 90 days. Growth of *Hemispora* sp. was inhibited at 0·2 g of sorbic acid per litre, and that of the other mould species was inhibited at 0·4 g/litre. CO_2 production by the two *Saccharomyces* spp., at levels of up to $1 \cdot 8 \times 10^9$ cells/litre, was inhibited at 0·6 g/litre. The activity of the sorbic acid was not affected by heating the syrup at 110°C for 30 min or at 120°C for 20 min.

* * *

Colorimetric micro-determination of carbohydrates. J. C. TOWNE and J. E. SPIKNER. *Anal. Chem.*, 1963, **35**, 211–214; through *S.I.A.*, 1963, **25**, Abs. 373. To 1·0 ml of solution containing 0·2–2·0 μg of a sugar or keto-acid is added 1·0 ml of reagent containing 100 μg of *o*-phenylenediamine in 50% H_2SO_4. The solution is made up to 3·0 ml with 50% H_2SO_4 and heated at 120–125°C in a stoppered flask for 3 hr. The fluorescence of the solution is then measured in a spectrofluorimeter after cooling and making up to 5 ml with 50% H_2SO_4. The fluorescence is stable and directly proportional to the concentration of a given sugar within the specified range. Numerous sugars produced varying yields of the same unidentified fluorescent compound having excitation and fluorescence wavelength maxima at 360 and 460 mμ respectively.

* * *

Determination of reducing sugars by oxidation in alkaline ferricyanide solution. T. E. FRIEDEMANN, C. W. WEBER and N. F. WITT. *Anal. Biochem.*, 1962, **4**, 358–377; through *S.I.A.*, 1963, **25**, Abs. 376. Five ml of a solution containing 0·3–13 mg of D-glucose are heated with 5–15 ml of 0·04M potassium ferricyanide in 5·0% Na_2CO_3 for 30 min in a water bath at 80°C. The residual ferricyanide in the solution cooled to 20–25°C is then determined either spectrophotometrically at 418 mμ, or iodometrically with $ZnSO_4$, KI and $Na_2S_2O_3$ (Mohr's method). Spectrophotometry is preferred. The amount of ferricyanide reduced is linearly proportional to the amount of glucose within the range of 15–75% reduction. The equivalent reduction by other sugars is greater than or equal to the reduction obtained by the Shaffer-Somogyi method. The reducing capacity of D-fructose is 99% of that of D-glucose. A detailed study of the method is reported. It appears to be generally preferable to the Shaffer-Somogyi method (apart from a greater sensitivity to other reducing substances), particularly at altitudes of $>$5000 ft where the solution cannot conveniently be heated at 100°C.

Some problems of the microbiology of consumption sugar. O. VAJDA. *Elelmezési Ipar*, 1963, **17**, 10–15; through *S.I.A.*, 1963, **25**, Abs. 556.—A rapid test method has been devised with the use of a new yeast agar culture medium containing 100 g of yeast, 20 g of sucrose, 20 g of agar, 5 g of peptone, and 1000 ml of water at pH 7. For counting thermophiles and flat sours 0·4 g of bromcresol purple is added. Anaerobes were tested with the use of liver extract. Mesophiles and sulphide-spoilage organisms were not measured. The tests are carried out with 2 ml of a 20% solution of the sugar to be tested, added to each of five Koch plates (three plates in a shortened method), incubated for 48 hr at 56°C. For CO_2 and H_2 producers, three plates may be sufficient. For reference, a sugar solution boiled for 20 min is used. Results of tests with many Czech and other countries' sugars are tabulated; counts with Czech sugars were not at all large in comparison with figures for other sugars. The literature on the microbiological problems in the sugar industry in general is reviewed (32 references).

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Partition chromatography on ion-exchange resins. Separation of sugars. O. SAMUELSON and B. SWENSON. *Anal. Chem. Acta*, 1963, **28**, 426–432; through *S.I.A.*, 1963, **25**, Abs. 566.—The sugars were added to a 10 × 840 mm column of fine (45–75μ) particles of "Dowex 1X-8" resin (sulphate form) in 75% ethanol solution. Separation of glucose, sucrose and raffinose was effected by elution with 74% ethanol at 0·4 ml/sq.cm./min. The sugars were eluted in approximate order of increasing molecular weight. The elution was accelerated at lower ethanol concentrations: 65% ethanol was suitable for separation of raffinose, stachyose and verbascose.

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Polarography of the fructose-borate system. W. B. SWANN, W. M. MCNABB and J. F. HAZEL. *Anal. Chim. Acta*, 1963, **28**, 441–449; through *S.I.A.*, 1963, **25**, Abs. 568.—The polarographic wave of fructose was determined in a 2·15 mM solution in 0·1M LiCl with 0·01M LiOH at 30°C at varying concentrations of boric acid. The height of the fructose wave in μA was reduced in the presence of borate, but its starting potential (—1·70V) was unaltered. The results are analysed and are consistent with the formation of a 1:1 complex of borate with the enol form of fructose, causing a fall in the concentration of keto (reducible) fructose. The formation constant K for the overall reaction (fructose) + (borate) $\rightleftharpoons$ (complex) is 13×10^2.

* * *

Spectrophotometric determination of sodium potassium and calcium as an automatic control element in certain sugar manufacturing processes. H. ZAORSKA. *Przemysl Spozywczy*, 1962, **16**, 575–577 (Dissertation abstract); through *S.I.A.*, 1963, **25**, Abs. 571.—The technique of flame photometric analysis was investigated, and in particular the influence of the pressure of illuminating gas and air, temperature, and sucrose concentration. A method was devised for temperature regulation by means of a resistance thermometer (Pt-Pt/Rh). The effect of temperature on Na and Ca readings was ten times as great as for K readings. A flame photometric system was used for continuous control of thin juice Ca content in one campaign[1]. The method might also be used for control of ion-exchange processes, and for detection of traces of sucrose in boiler water by means of the correlated K content.

* * *

Study of the nucleation of supersaturated aqueous solutions of sucrose by means of viscometry. N. TIKHOMIROFF, G. PIDOUX and R. FILIPPI. *Compt. Rend. Acad. Sci.*, 1963, **256**, 3671–3673; through *S.I.A.*, 1963, **25**, Abs. 574.—Solutions of 1·2–1·6 supersaturation at 20°C were prepared by cooling from 90°C. An increase in viscosity with time was observed in solutions of 1·28 supersaturation and above. The viscosity reached a limiting value which remained constant for several hours until crystallization began. The rate of increase of viscosity was greater at higher supersaturations and was accelerated by stirring. The phenomenon is ascribed to pre-crystallization[2].

* * *

Qualitative determination of colouring substances in sugar factory products. A. R. SAPRONOV. *Sakhar. Prom.*, 1963, (8), 32–35.—The ultraviolet absorption method previously described[3] was used to determine the proportion of colouring substances in molasses samples from various Soviet factories. The major portion of the colouring substances (70–80%) *by weight* in the molasses was composed of products of alkaline degradation of invert sugar, whereas measurement of the colouring intensity (light absorption coefficient = optical density of colour bodies solution in 1 cm film at given concentration) showed that melanoidins besides the invert degradation products made up the bulk of the colouring substances. Sucrose caramelization products had no real effect on the colour, and could be disregarded. Two equations are presented for calculation of the content by weight of these two groups of substances. In molasses from one and the same factory, the ratio of invert sugar degradation products to melanoidins fell noticeably from September onwards, the total colour of the molasses thus increasing. This is explained by a drop in the titratable alkalinity of products (with a resultant fall in invert sugar degradation products) and a rise in the amount of noxious N in stored beet (with a consequent rise in melanoidins). The content of sucrose caramelization products remained virtually unchanged, since these are not dependent on the time at which the beet are processed. The trends are demonstrated by a graph of light absorption values, comparing molasses from one factory and from different factories.

[1] *I.S.J.*, 1959, **61**, 217.
[2] *Cf. Compt. Rend. Acad. Sci.*, 1961, **253**, 1944–1946.
[3] *I.S.J.*, 1963, **65**, 343.

BY-PRODUCTS

Production of fungal protein. F. A. Racle. *Sugar y Azúcar*, 1963, **58**, (7), 35–36.—Various sugar and molasses samples were used in tests to determine the amount of protein obtainable by growing *Cladosporium cladosporioides* on them. The molasses samples were found to be the most promising sources, and further tests were carried out with high-nitrogen blackstrap molasses at 26, 39 and 52 g per litre of medium. On the basis of the results, a concentration of 39 g per litre was used, this giving 140·7 mg of total protein, with 629 mg of fungus grown. A four-day cycle was found necessary for a yield of this order. Adding zinc sulphate to the medium increased the total protein yield. While sea water gave lower yields than distilled water in fermentation, sea water + $MgSO_4$ gave a far higher yield than distilled water. The only other additive required is corn steep liquor.

* * *

Studies on the rust preventive powers of sucrose fatty acid esters. M. Okahara, S. Komori and A. Shinsugi. *Kogyo Kagaki Zasshi* (*J. Chem. Soc. Japan, Ind. Chem. Sec.*), 1963, **66**, 221–227, A 14; through *S.I.A.*, 1963, **25**, Abs. 481.—The effectiveness of rust preventive oils, prepared by adding 2–3% of various sucrose esters to lubricating oils, in inhibiting the rusting of steel strip was studied under humid or salt-spray conditions. The di- and polyesters of myristic, palmitic and erucic acids (particularly the tri- and tetra-esters) were as effective as sorbitan mono-oleate, but the monoesters were unsuitable owing to their low oil solubility. Polyesters of sucrose with dibasic acids were particularly effective in salt-spray tests.

* * *

Further experiments on the recovery and nutritive value of cane juice protein. E. C. Vignes and R. de Froberville. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1962, 103–104.—Coagulate obtained from mixed juice centrifuged in a Westphalia KG 10006 batch separator was analysed. Pre-centrifuging, storing and heating to above 90°C with live steam and re-centrifuging hot gave a product having a lower fats and wax content. The amount of hard wax was lower than with cold centrifuging. The product was oven-dried at 105°C (a lower temperature could not be used since the oven was being used for other purposes) and then used in hen feeding trials. Inclusion of 15% cane juice protein in the feed mixture increased intake but did not adversely affect egg yield or quality.

* * *

The digestibility of rations composed of cane tops, molasses, and scums. D. H. Parish. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1962, 105–110. Rations containing (i) 48% oven-dried filter-cake, 12% molasses and 40% cane tops, (ii) 38% air-dried filter-cake, 14% molasses and 48% cane tops, and (iii) 77% cane tops and 23% molasses were fed to sheep. The average crude protein of the cane tops was 5–6% on dry solids and of the filter muds 12% (the usual content is 17%). The protein digestibility for the 1962 crushing season was found to be low.

The cultivation of torula yeast on Taiwan molasses. S. F. Lin and Y. T. Liu. *Rpt. Taiwan Sugar Exp. Sta.*, 1963, (32), 165–173.—A dried yeast yield of 45–50% on total sugar (4 g dry yeast per 100 ml fermented mash) was obtained in tests in which *T. utilis*-NRRL-Y-900 was grown on molasses from 29 Taiwan factories. The 20-litre media were treated in a 60-litre propagator with a new type of aerator (not described) at an agitator speed of 1200 r.p.m., a retention time of 4 hr and an air rate of 1:1 per min. Urea assimilation was excellent, and since this was the only N source used, the pH of the mash during propagation remained almost constant.

* * *

Sucrose acetoacetates. L. K. Dalton. *J. Appl. Chem.*, 1963, **13**, 277–281.—Sucrose was reacted with diketene in dimethylformamide in the presence of triethylamine to give a mixture of sucrose acetoacetates. The lower esters obtained by partial esterification were glasses which could be ground to white amorphous powders of high hygroscopicity, and which in air quickly formed syrups. The more highly substituted esters obtained with excess diketene ranged from viscous syrups to a soft solid. Fractionation of the product obtained by adding 3 moles of diketene per mole of sucrose yielded principally tri-, di- and mono-acetoacetates. Properties of these three classes of sucrose acetoacetates are tabulated. Sucrose esters of acetoacetate acid alone, or mixed esters with another acid, e.g. sucrose acetoacetate *n*-butyrate, condensed with formaldehyde to yield resins.

* * *

Experience in beet drying at Kupyansk sugar factory. S. V. Kudrya and Kh. Kh. Babich. *Sakhar. Prom.*, 1963, (8), 46–48.—A scheme is described for the drying of beet cossettes intended for storage and subsequent use as animal fodder. The cossettes can be stored longer, suffer less sugar loss and are more easily transportable than whole beet.

* * *

Utilization of carbonatation press mud for the manufacture of Portland cement. P. K. Mehta. *Indian Sugar*, 1963, **13**, 157–165.—Tests on various raw mixes containing press mud have yielded a mix which gives a Portland cement clinker of satisfactory slow-setting properties. This mix contains 86% press mud (ignited), 10% flint, 3% iron oxide and 1% fluorspar. The phosphorus in the press mud contributes to the slow-setting properties, which can be increased by eliminating tricalcium aluminate, making the cement suitable for oil well application. The press muds contribute less than 2·5% P_2O_5 to the clinker. The advantages of press muds for use in cement are listed.

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.

"Arkon 1600" liquid flow recorder. Walker Crosweller & Co. Ltd., Cheltenham, Gloucestershire.

The "Arkon 1600" flow recorder measures and records flow of liquids as a function of the hydrostatic head built up when the flow is directed through a V-notch, this head being measured by the corresponding pressure developed in a dip tube to which is taken a small supply of air. Details are given of the recorder, integrator unit, air supply, weir tank, etc. in a new leaflet, together with illustrations of typical installations.

* * *

Forged steel valve. Dewrance & Co. Ltd., Great Dover St., London S.E.1.

The main feature of the new screw-down design is the elimination of a pressure-resistant cover joint or pressure seal closure. The body is of forged steel to which is attached a one-piece forged yoke by means of steel pins. The hard-faced disc is free to turn on its stem and the seat is also hard-faced. Valve internals are withdrawn through the stuffing box after removing the packing rings and unscrewing the yoke bush. Automatic non-return valves are included in the range which can operate up to 2600 p.s.i. pressure and 1060°F

* * *

Instant photomicrographs. W. Watson & Sons Ltd., Barnet, Herts.

A new camera will accept a wide range of microscopes and possesses a magnification factor of unity, producing a print of the same magnification as the microscope image seen through the viewing eyepiece. It is fitted with a Polaroid Land back, producing direct paper positive prints $3\frac{1}{4} \times 4\frac{1}{4}$ inches (82 × 108 mm) within 10–40 seconds of exposure. Use of "PolaScope" film, rated at 10,000 ASA, makes photomicrography feasible under lighting conditions which would hitherto have been considered impossible. Phase contrast and fluorescence microscopy yield prints of excellent quality and definition, and any correction of focus, contrast or exposure can be made in a matter of seconds from the first exposure —a significant point when recording transient phenomena. The camera saves time consuming photographic processing and consequently permits a photographic print to be attached to the report concerned with a minimum of delay. A colour film is expected to be available in early 1964.

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PUBLICATIONS RECEIVED

PRESSURE PUMPS WITH LIQUID SEAL. CEKOP, P.O. Box 112, Warsaw, Poland.

The pumps described in this new leaflet may be used in the sugar industry either for CO_2 gas or as vacuum pumps in cooperation with condensers. They comprise a plain bearing-mounted motor-driven shaft carrying a blade rotor eccentrically mounted in relation to the liner of the cast iron body. This eccentricity forms suction and pressure cells, sealed from each other by the water in the body of the pump, which are connected by semi-circular channels in the side covers to the suction and pressure pipes leading from the pump.

* * *

LINK-BELT SCREW CONVEYORS AND SCREW FEEDERS. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

The many applications of Link-Belt screw conveyors and feeders are featured in a new booklet, No. 3089, which also gives complete data on dimensions, weights, etc. of the screws and accessories. A simplified method of selecting recommended conveyor components is one of the book's chief new features. Advantages of the screw conveyors which are noted include compactness, simplicity, versatility, economy, and the possibility of total enclosure.

* * *

SMITH SUGAR CANE MILLS. A. & W. Smith & Co. Ltd., 21 Mincing Lane, London E.C.3.

This new booklet, available in both English and Spanish ("Trapiches"), is printed in three colours and illustrates and describes the components of Smith cane mills and their manufacture, including headstocks, side covers and bearing adjustment, turnplates, bedplates, scraper gear, top covers and hydraulics, bearings and lubrication, rollers, intermediate carriers, pinions, juice trays, etc. A table of capacities and h.p. requirements is given for various sizes of mill, while a series of photographs feature mills and tandems of various size and location. Further sections describe and illustrate gearing and steam engine and turbine drives. Lists are given of complete factories and of milling plants and extensions supplied by Smiths since 1953.

Bulk delivery in South Africa.—By purchasing a special Leyland Octopus tanker, Hulett's Sugar Refineries Ltd., of Rossburgh, Natal, have become the first operator in South Africa to use a bulk delivery vehicle to carry refined granulated sugar. The tanker illustrated has Bonallack & Co. Ltd. "Pneumajector" equipment consisting of a low-pressure 3-

compartment light alloy tank which can hold 15 tons of sugar, and Edbro front-end tipping gear to assist discharge. A blower provides the necessary 690 c.f.m. air flow at 10 p.s.i., and sugar is presently being delivered in this way to large users in the Durban area.

U.S. Supply Quotas, 1964

	Basic quotas	Global quotas	Total Entitlements
	(short tons, raw value)		
Domestic Beet	2,698,590	—	2,698,590
Mainland Cane	911,410	—	911,410
Hawaii	1,110,000	—	1,110,000
Puerto Rico	965,000	—	965,000
Virgin Islands	15,832	—	15,832
Philippines	1,137,913	25,279	1,163,292
Peru	192,096	33,314	225,410
Dominican Republic	322,096	21,840	343,936
Mexico	192,096	133,269	325,365
Brazil	182,363	—	182,363
Colombia	30,346	—	30,346
Nicaragua	25,193	20,555	45,748
Costa Rica	25,193	35,350	60,543
Ecuador	25,193	30,780	55,973
Haiti	20,326	—	20,326
Guatemala	20,326	21,200	41,526
Argentina	20,000	—	20,000
Panama	8,832	10,260	19,092
El Salvador	10,306	10,373	20,679
French West Indies	30,346	—	30,346
British West Indies & British Guina	91,325	52,170	143,495
British Honduras	974	5,250	6,224
Australia	40,366	175,000	215,366
Fiji	10,020	44,828	54,848
Southern Rhodesia	—	10,600	10,600
India	20,326	96,195	116,521
South Africa	20,326	101,872	122,198
Taiwan	35,499	48,300	83,799
Ireland	10,000	—	10,000
Belgium	182	—	182
Quota not yet allocated	123,664	—	123,664
Global quota not yet allocated	122,985	—	122,985
Global quota not yet authorized	504,341	—	504,341
	8,923,465	876,535	9,800,000

International Society of Sugar Cane Technologists

The 12th Congress of the I.S.S.C.T. will be held in Puerto Rico from the 28th March to the 10th April 1965. This is the second time that Puerto Rico has been host to the Society, the 4th Congress having been held there in 1932.

MANUEL A. DEL VALLE, General Chairman for the Congress, announced at a meeting of the local sugar producers organization that the programme will include a week devoted to technical discussions, plenary sessions and commissions, in which, for the first time, facilities would be provided for simultaneous interpreting into and from English, Spanish and French[1]. The sugar industry of Puerto Rico will be visited, with its scientific and technological centres, and an excursion will be made to the neighbouring Dominican Republic to learn about its sugar industry. An optional post-Congress excursion will be made to Florida.

The dates will allow the Congress to take place before the onset of the heavy rains and after the tourist season, so as to reduce costs for delegates.

Brevities

Science, Food Science and Further Education. This is the title of a residential course to be held in the Procter Dept. of Food and Leather Science of the University of Leeds during the 6th —10th April 1964. Details of the programme and costs are available from the Department.

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Errata.—A number of abstracts of articles appearing in 1963 issues of *Gazeta Cukrownicza* have given the volume number of this Polish journal as 65. This should read 71, although the volume number for 1962 was 64, since there are to be no volumes 65–70.

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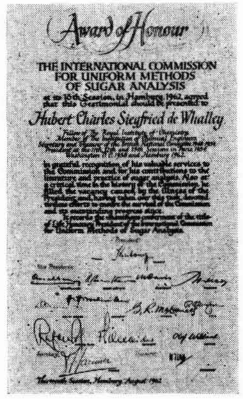
ICUMSA.—Illustrated is the Award of Honour made to the Past President of the Commission, H. C. S. DE WHALLEY, at the 13th Session at Hamburg, in 1962.



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Sankey sugar refinery developments.—A new high-production plant for brewing sugars, syrups, treacles and glucose/sugar mixture is now in operation at the Earlestown refinery of the Sankey Sugar Co. Ltd., a member of the Manbré & Garton Group. Specially selected sugar from the main refinery is treated, filtered and concentrated in the new plant. A recent tank installation enables the refinery to operate as the Northern England depot for liquid glucose from another member of the group, and permits manufacture of some thirty different mixtures for individual customers. The building is being extended so that it will in due course house the whole filtration department. A five-storey building to hold 800 tons of granulated sugar in 16 silos is being constructed; it is steel-framed with aluminium and glass cladding and incorporates a lift. It has four times the capacity of the silos used at present and will be in full operation at the end of this year. Five grades of sugar will be brought by a 120-ft conveyor from the main refinery to the store. Eight of the silos will be used for blending prior to packing and eight for storage. Three high-performance packing machines with a combined capacity of 40 tons/hr will pack the sugar into 1 cwt paper sacks and 1- and 2-cwt jute bags. Bulk delivery to large users of sugar in Northern England is now being carried out on an increased scale by Sankey's fleet of road tankers.

* * *

New factory for Ecuador[2].—A new firm, Compañía Azucarera Tropical Americana (CATASA) has been established by a local group in Guayaquil, with a capital of more than 200 million sucres, to produce sugar, honey and syrup. The company is to instal a sugar mill capable of producing 75,000 tons of sugar in a 100–120-day season, the project having been approved by the government industrial development agency, CENDES.

[1] *Sugar y Azúcar*, 1963, **58**, (12), 55.
[2] *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 861.

BREVITIES

Sugar factory for Tanganyika[1].—Gutehoffnungshütte Sterkrade A.G. of Oberhausen, Germany, has secured an order from Kagera Saw Mills Ltd. for the erection of a cane sugar factory in Tanganyika.

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Paraguay sugar production 1963[2].—Sugar production in Paraguay in 1963 amounted to 34,850 tons, an increase of 2050 tons over production in 1962. The home market is expected to consume 31,000 tons of this output.

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Bagasse newsprint in Brazil[3].—The Ministry of Agriculture, in conjunction with the Instituto do Açucar e do Alcool, has approved a plan for building a factory to make newsprint from a mixture of straw and bagasse.

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Mozambique sugar factory expansion[4].—The Companhia Colonial do Buzi is to spend £500,000 on raising the cane crushing capacity of its sugar factory from 100,000 tons to 400,000 tons a year.

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Factory replacement in British Guiana[5].—The Demerara Co. Ltd. has announced that it is to invest 2¾ million West Indies dollars (about £550,000) in erecting a new mill to replace two existing installations. The plant should be ready to crush the sugar cane crop of autumn 1965.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 17th January* 1964)	s d
Anglo-Ceylon (5s)	21/9
Antigua Sugar Factory (£1)	9/6
Booker Bros. (10s)	21/6
British Sugar Corp. Ltd. (£1)	32/3
Caroni Ord. (2s)	4/1½
Caroni 6% Cum. Pref. (£1)	15/–
Demerara Co. (Holdings) Ltd.	9/1½
Distillers Co. Ltd. (10s units)*	26/1½
Gledhow Chaka's Kraal (R1)	29/6
Hulett & Sons (R1)	73/–
Jamaica Sugar Estates Ltd. (5s units)	5/3
Leach's Argentine (10s units)	17/6
Manbré & Garton Ltd. (10s)	56/–
Reynolds Bros. (R1)	28/3
St. Kitts (London) Ltd. (£1)	20/–
Sena Sugar Estates Ltd. (10s)	9/1½
Tate & Lyle Ltd. (£1)	50/9
Trinidad Sugar (5s stock units)	3/4½
United Molasses (10s stock units)	41/6
West Indies Sugar Co. Ltd. (£1)	28/–

CLOSING MIDDLE

New York Stocks (*at 16th January* 1964)	$
American Crystal ($10)	87¾
Amer. Sugar Ref. Co. ($12.50)	23⅞
Central Aguirre ($5)	35½
North American Ind. ($10)	18¾
Great Western Sugar Co.	47⅝
South P.R. Sugar Co.	37¼
United Fruit Co.	21⅛

* 2 for 5 scrip issue.

Large Australian sugar sale to Japan[6].—Japan has agreed to buy 450,000 tons of sugar from Queensland's 1964 cane sugar crop. Sales to Japan from the 1963 crop will be in the vicinity of 360,000 tons.

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Nyasaland sugar industry investigation[7].—Detailed investigations are being carried out for a project providing for the establishment of a sugar industry in the lower river area. It is understood that the preliminary investigations have shown the scheme to be feasible and that the investment in the scheme may total £4,000,000, including the erection of a £1,000,000 sugar mill. The Company concerned with the development is one of the Lonrho (London and Rhodesian Mining and Land Company) group of companies. Should agreement on details be reached, planting is expected to begin this year and the first sugar produced two or three years later.

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Czech sugar factory for the U.S.S.R.[8]—The Czechoslovakian foreign trade agency Technoexport and the Soviet foreign trade organization Techmaschimport have recently signed a contract for the supply of a complete sugar factory with a daily capacity of 3000 tons.

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British Guiana sugar production in 1963[9].—Final production in 1963 was 317,137 long tons. This tonnage compares with the original crop estimate of 330,000 long tons and has been achieved despite eleven weeks interruption in production caused by the general strike which occurred during the spring crop. Production in 1962 amounted to 326,023 tons.

* * *

Queensland sugar crop, 1963[10].—Crushing of the 1963 sugar cane crop has now been completed in Queensland, where the 31 mills handled about 11,500,000 tons of cane to produce approximately 1,640,000 tons of raw sugar. The 1963 production is lower than the record 1962 crop when 12,098,582 tons of cane were crushed for a raw sugar output of 1,770,084 tons. Dry weather in some Northern districts and severe frosts in Mackay and Southern districts contributed to the reduction in the 1963 crop. About 12·8% of the crop was harvested mechanically.

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British Sugar Corporation Ltd.—Negotiations on the new arrangements[11] have proved much more complex and protracted than had been expected, Sir Edmund Bacon, Chairman of the Corporation reported to the Annual General Meeting last December. It had been hoped that a new financial arrangement could be negotiated and ready for submission at the end of 1963; considerable progress had been made but final agreement remained to be achieved. He added that "shareholders can be assured that within the next two months either a scheme will have been agreed which, if adopted by members and approved by Parliament, is intended to come into effect on April 1st, or the board will have to report the breakdown of negotiations."

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Ghana sugar factory[12].—The £G5,500,000 state-owned factory at Asutsuare near Akuse is expected to go into production in 1966.

[1] *Zeitsch. Zuckerind.*, 1963, **88**, 643.
[2] *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 1009.
[3] *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 1016.
[4] *Fortightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 1021.
[5] *Commonwealth Producer*, 1963, (398), 197.
[6] *Queensland Newsletter*, 6th December 1963.
[7] F. O. Licht, *International Sugar Rpt.*, 1963, **95**, (13), 203.
[8] F. O. Licht, *International Sugar Rpt.*, 1963, **95**, (Supp. 23), 309.
[9] C. Czarnikow Ltd., *Sugar Review*, 1963, (642), 15.
[10] *Queensland Newsletter*, 8th January 1964.
[11] *I.S.J.*, 1963, **65**, 285.
[12] *Overseas Review* (Barclays D.C.O.), December 1963, p. 61.