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NOTES AND COMMENTS

International Sugar Agreement.

On the 18th September, the Preparatory Committee set up by the International Sugar Council in July met for the first time in London to lay down its programme of work "to study the bases and framework of a new agreement" as described in the Council's statement[1]. Although a stop-gap extension of the 1958 Agreement has been arranged for 1964 and 1965, a new agreement could be introduced, with regulatory powers, before the end of 1965, and it is evident that the Council have borne in mind the possible desirability of this in view of the severe fluctuations in sugar prices over the past year and their possible continuation next year.

* * *

British Sugar Corporation Ltd.

A Statement made by the Chairman, Sir EDMUND BACON, at the Annual General Meeting of the Corporation on 2nd August referred to correspondence with the Minister of Agriculture concerning the limitation on dividends, and new arrangements under negotiation. Such a scheme must fulfil certain conditions. It must be equitable to the farming industry on whose behalf the Corporation was originally set up. It must be workable in so far as the Government has its responsibility to consumers and it must be fair to shareholders. Further it is essential if agreement is to be reached in the reasonably near future that it should operate under existing legislation.

The proposed new basis in the broadest terms on which the Corporation's Directors are now working is that the Government will continue to fix the price of sugar beet at the February price review and will also continue to regulate the acreage of beet grown in England and Scotland. The Corporation will pay the grower the agreed price for beet as formerly.

The selling price of sugar will continue to be based on the world price after adjustment for surcharge or distribution payments made to or by the Sugar Board as heretofore. An economic price of beet relative to such sugar prices will be charged to the Corporation after allowing for the standard costs of production and distribution. The difference between this economic price and the price for beet agreed at the price review will be met by the Sugar Board. The Corporation thus will work under the terms of an operational formula. If it is efficient then it should make reasonable profits; if it is inefficient then it will of necessity be subject to losses and shareholders must be prepared to share in the varying fortunes of the Corporation. In other words shareholders must be prepared under the new arrangements to accept a great many of the risks normally associated with an ordinary commercial trading company.

* * *

Sugar Board distribution payments.

The U.K. Sugar Board distribution payments were reduced from 28s 0d to 9s 4d per cwt of refined sugar (from 3d to 1d per pound) from the 16th August, with corresponding reductions in the rate of distribution payments with decreasing pol. The change was made because the world price of raw sugar had fallen by about 24s 0d per cwt from the level at which it stood when the previous reduction is distribution payments was made on the 5th July[2] and this altered the Board's financial prospects.

A further reduction was made with effect from the 6th September when the payments were cut to 2s 4d per cwt (¼d per pound), in order to bring the Sugar Board's trading position more into line with the current level of world prices.

* * *

U.S. import rules[3].

Sugar import regulations in the United States have been modified to permit importers to extend to the maximum time limitations prescribed the date of importation specified in their agreements with the U.S. Dept. of Agriculture, according to a Department announcement of the 27th August. Extensions will not be beyond 31st December 1963, however. The terminal dates of 31st October and 15th November for importation of global quota sugar have been extended to 31st December. However, the date of

[1] *I.S.J.*, 1963, **65**, 221.
[2] *I.S.J.*, 1963, **65**, 221.
[3] *Lamborn*, 1963, **61**, 191.

แผนกห้องสมุด กรมวิทยาศาสตร์
กระทรวงอุตสาหกรรม

importation may not be extended beyond 235 days from the date of approval of the set-aside agreement, covering global quota sugar.

The regulations also permit the date of importation in set-aside agreements covering country quota and deficit allocation sugar to be extended to the maximum limitation of 140 days, but not later than 31st December 1963.

U.S.D.A. officials pointed out that heavy commitments to import foreign sugar were made during April and May when prices rose to peak levels and stockpiling took place. Subsequently the price of raw sugar has declined and the pressure for early importation has eased. Prospective imports of sugar from foreign countries for December are light. Permitting importation dates of sugar to be extended to later in the year will provide greater flexibility in scheduling arrivals and will promote a more orderly flow of sugar.

* * *

Queensland sugar industry Committee of Inquiry.

The Queensland Government has appointed a Committee of Inquiry to study a number of factors relating to the future of the Australian Sugar. The Committee includes Mr. O. WOLFENSBERGER, Chairman of the Queensland Sugar Board, and Mr. N.J. KING, Director of the Bureau of Sugar Experiment Stations. The Hon. Mr. Justice GIBBS, a Judge of the Queensland Supreme Court, is Chairman of the Committee, while the Secretary is Mr. C. L. HARRIS of the Queensland Dept. of Agriculture and Mr. P. T. WHEEN, Assistant General Manager of the C.S.R. Co. Ltd. is Technical Advisor.

The Committee have held discussions with F.A.O. officials in Rome, with International Sugar Council and U.K. Government officials and with Sir JOCK CAMPBELL, Chairman of the Commonwealth Sugar Exporters, in London, and on their way back to Australia were to hold further discussions in the U.S.A.

* * *

Philippine sugar in 1963/64.[1]

The first estimate of sugar production in the Philippines for the 1963/64 season is reported at 1,970,213 short tons against the first estimate for the previous season of 1,738,647 tons.

Owing to drought in the southern Philippines it is estimated that 27,500 short tons of the 1962/63 crop have been lost so far, and production is expected to be affected until the season closes.

Meanwhile the Government's Sugar Quota Board has increased the domestic quota of sugar (for local consumption) from 500,000 tons to 600,000 tons in an effort to stabilize the price of sugar.

Based on the latest Board Order, the Philippines has to produce a total of 1,862,000 tons for the crop year 1963/64 to fulfil the quota of 600,000 tons for local use, 1,050,000 tons for export to the U.S., 50,000 tons for the World Market and 162,000 tons for reserve.

World sugar stocks.

Stocks of sugar as at 31st August of this year are estimated at 9,445,387 metric tons, raw value, compared with 17,236,068 tons on 31st August 1961, according to F. O. Licht K.G.[2]

Licht reports that world stocks have "sunk to a standard which in time could endanger sugar distribution, even if there are certain invisible stocks available, for these too could not greatly influence the position for long. The estimated figures for beet and cane sugar production for 1963/64 must in any case be observed from the point of view that the campaign year 1963/64 will begin with unusually low stocks in hand." The figures are reproduced elsewhere in this issue.

* * *

World raw sugar prices.

Elsewhere is reported the seventh change in surcharge and distribution payments made by the U.K. Sugar Board this year. Such a number, in a factor where provision was made for infrequent changes, is a reflection of the instability of the world market. After the exaggeratedly high peak of over £100 per ton in May a long slow slide in prices occurred and the rate fell to just under £50 per ton at the end of August, when the European beet campaign was about to start.

There had been reports that the beet crops had largely recovered from their poor start, and memories of aggressive selling by East European countries had been effective in lowering prices. More recent information indicated, however, that the beet crops were not going to be so great and the market has strengthened in consequence, the London Daily price at the time of writing being £69·50 per ton.

Further factors which may have had an influence on the market are the withdrawal of Chile from the market, reports of losses through frost damage to cane in Sao Paulo, Brazil, where the original 1963/64 harvest estimate of 1,710,000 metric tons was first thought to have been lowered to 1,500,000 tons and later by 40%[3]. Again, F. O. Licht has produced a survey recently in which the stocks of sugar in the world are compared with those of two years ago, a fall of nearly 8 million tons or 45·2% being recorded (see above).

Gift for U.S. cane research.—The American Society of Sugar Cane Technologists have presented $1000 to the Louisiana State University Foundation for use in sugar cane studies.

* * *

New U.S. cane variety[4].—A new cane variety, CP 55-30, has been released by the American Sugar Cane League; reports say that it is a superior cane but it is unfortunately susceptible to mosaic. It was felt that its early maturity, good ratooning qualities and ability to produce in both sandy and heavy soils justified its release.

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[1] *Public Ledger*, 14th September 1963.
[2] *International Sugar Rpt.*, 1963, **95**, (Supp. 16), 211-215.
[3] *Fortnightly Review* (Bank of London & S. America Ltd.), 1963, **28**, 729, 766.
[4] *Sugar y Azúcar*, 1963, **58**, (8), 32.

SUGAR CANE BREEDING AT COIMBATORE

TWO Annual Reports, for 1959–1960 and for 1960–1961, of the Sugar Cane Breeding Institute, Coimbatore, India, contain a wealth of detailed information concerning the various research projects and other activities carried out by that institution. These two reports run to 164 and 171 pages respectively.

The main function of the Institute is to evolve improved sugar cane varieties for commercial cultivation in the sugar growing areas of India, varying as they do so much in climate and edaphic conditions. A sub-station intended for varieties suited for sub-tropical rather than tropical conditions has been established at Karnal, East Punjab. Another out-station of Coimbatore is that at Taliparamba, on the West Coast (Kerala State) where a world-wide collection of sugar cane varieties is maintained under conditions where the incidence of disease, mosaic disease in particular, is not high. This should constitute a rich collection of germ plasm, a world bank of germ plasm in fact, for breeding work, if and when required.

The Institute consists of several sections, viz. Botany, Cytogenetics, Physiology, Mycology, Entomology and Chemistry, all of which assist generally or indirectly in the breeding work. The work of each section is dealt with individually in these reports, a useful summary of all the work being given by the Director (Dr. N. R. BHAT) in his introductory remarks.

1959-1960

During 1959-1960 "a reprientation was initiated in the methods of breeding. Region-wise crosses were effected to fulfil the requirements of the regionalised breeding work which is to follow in future years for the seven broadly distinct regions of the country". Eighteen new varieties were raised to the "Co" (Coimbatore) status (Co 1309–1326). Eight of these had been selected for their performance at Coimbatore, eight for their performance at Karnal and Lucknow, the remaining two "on their proved merits at Karnal." Selection of Co canes is to be done on a regional basis in future, after trials and testings in the different regions. A number of seedlings were raised using forms of *Saccharum robustum* as male parents and certain commercial varieties as female parents. An intergeneric hybrid between *Sclerostachya* and *Sorghum versicolor* was produced.

Botanical studies on the time of flowering of variants of *Saccharum spontaneum* at Coimbatore and Karnal have indicated that the differential flowering behaviour of the various latitudinal populations at the two places is the result of the combined effect of important climatological factors e.g. day length, rainfall, humidity and temperature operating on clones adapted to different environmental conditions.

The importance of day length on time of flowering is brought to light in the physiological studies or experiments in extra-dark treatment. By increasing or reducing the total period of darkness to which sugar cane plants are subjected, it has been found possible to control the time of flowering, causing late flowering varieties to flower earlier and early flowering varieties to flower later, if so desired. This means that a late and an early flowering variety which it is desirable to cross, may be induced to flower at the same time, an immense advantage in breeding work.

Studies in the resistance of varieties to water-logging of the soil or to immersion for fairly long periods is another line of work that has claimed the attention of Coimbatore physiologists. In many parts of India, notably the Gangetic plains, flooding of cane fields commonly takes place and it is of importance that the varieties grown should be able to withstand a certain amount of flooding.

Mycological studies were concerned with various pathogens of sugar cane, particularly red rot (*Glomerella tucumanensis*). Some sixty-eight varieties were found to have consistently shown a fair degree of resistance during two to four years of testing. The resistance of a number of varieties to pineapple disease (*Ceracystis paradoxa*) was also tested.

1960-1961

Work on the incidence of borers on cane crops planted in different months of the year was continued and interesting observations recorded. Damage by the early shoot borer (*Chilotraea infuscatellus*) ranged from 0·5 to 28%, high infestation prevailing in the March planted crop. The top borer (*Scirpophaga nivella*) caused most damage (25·6%) to the July planted crop. With the internode borer (*Proceras indicus*) attack was throughout the year, beginning with the time of joint formation.

Schemes for the control of sugar cane seedling pests are explained. Insecticides applied to three weeks old seedlings reduced mosaic incidence from 30% to 5–14%. Pretreatment of "fluff" with systemic insecticides gave vigorous healthy seedlings, free from pest damage. Soil fumigations with D.D. and "Nemagon" indicated that D.D. was a better nematocide in regard to all the varieties tried.

On the chemical side juice analyses of seedling varieties under observations in the various test plots claimed a good deal of attention. A complete chemical analysis of twelve new Co varieties (Co 1328, Co 1333 to Co 1343) selected at Coimbatore was carried out and the jaggery-making quality of their juice tested. Co. 1339 registered the highest value for sucrose content (20·54%). It also produced the best jaggery, of good crystalline structure. Studies on maturing characteristics (sucrose content) of a number of commercial varieties was carried out.

Cultivation trials of sugar beet varieties were continued at the request and under the technical guidance of the Director, Indian Institute of Sugarcane Research, Lucknow.

F.N.H.

SUGAR CANE IN PUERTO RICO

Annual Meeting of the Association of Sugar Technologists of Puerto Rico, 1962.

ATTENTION has been drawn recently[1] to the difficulties that face the Puerto Rican sugar industry; it was considered that while the difficult conditions and obstacles facing the industry are serious they are not insurmountable. Other sugar producing regions, such as Hawaii, have faced the same or similar problems but solutions have been found through laborious but steady efforts.

Within a short time Hawaiian interests in Puerto Rico have laid plans covering agricultural research on soils, fertilizers, cane varieties, planting methods, ripening, quality, age and cutting time for cane, the mechanization of various field operations, the training of general personnel and the selection of young agronomists for agricultural research. However, it is pointed out that the cane grower in Puerto Rico should realize that neither labour conditions, nor mechanization, nor the Government—despite its demonstrated good intentions — can solve his problems. His economic salvation lies in various factors, but rests fundamentally in a larger sugar production per unit of ground, and this larger production can only be achieved in the long run by broadening scientific research.

In his address of welcome to the conference which included visitors from Jamaica, Trinidad and the Dominican Republic, the President of the Association (C. HAEUSSLER) also stressed the need for research, and more research, for the rehabilitation of the industry and that means must be found to finance this research. Such research should, in his opinion, "develop machinery for cultivating and harvesting; create new planting and irrigation techniques; foster new fertilizing practices; provide for testing and developing of pre- and post-emergence herbicides and solve transportation and disease problems."

In a paper on the influence of topping of sugar cane on its yields and economic returns, carried out on six varieties of cane of various ages, the authors (S. ALERS-ALERS and G. SAMUELS) considered low topping was more profitable than high topping.

The effect of a delay in grinding harvested sugar cane on its sucrose content was studied by E. GONZALEZ TEJERA and G. SAMUELS. Unburned cane showed a greater sucrose loss than burned cane. The application of aircraft in sugar cane production is the subject of a paper by R. C. GOODWIN (Head of Aerial Spraying and Dusting, Luce & Company) who considers it in relation to (1) insect control applications, (2) weed control applications, (3) fertilizer booster applications, (4) maturity ripening or desiccant applications and (5) field inspection trips.

Attention is focussed on the importance of labour problems in Puerto Rican cane fields and factories at the present time by the fact that several papers were devoted to them, e.g. "Effects of Labour Legislation upon the Puerto Rican Sugar Industry" by E. IRIZARRY, "Experiences and Results of Harvesting Cane under Incentive Plans at Central Igualdad, Mayaguez" by H. Q. QUINONES. The latter author regards the incentive plans outlined as successful but difficult to introduce and expresses the hope that more farms will adopt them for the following year.

Other papers read at this annual conference included "The Response of Sugarcane to Fertilizers as influenced by Irrigation" by G. SAMUELS and F. GONZALEZ VELEZ, "Twelve versus Twenty-Four Month Cropping for Sugar cane in Puerto Rico; Preliminary Results" by S. ALERS-ALERS and G. SAMUELS, and "The Outboard Roller Cane Carrier" by M. ZYNIECKI.

F.N.H.

Mauritius Sugar Industry

Crop Results

ACCORDING to the Annual Report of the Mauritius Department of Agriculture for the Year 1961 (p. 12–13) the total area under cane was 200,000 arpents* of which 186,410 arpents were reaped compared with 201,610 arpents and 188,360 arpents respectively for 1960. Climatic conditions were somewhat abnormal in that during the growing period rainfall was below normal while it was greater than usual in the first few months of the maturation period. This, coupled with the fact that temperatures were generally higher than normal throughout the year, resulted in the overall production of more cane than in 1959 but reduced the sucrose content at harvest with the result that sugar production fell to 552,800 metric tons, about 26,400 tons less than in 1959. The yield of sugar per arpent was 2·97 metric tons while in 1959 it was 3·17 metric tons. The average crushing rate was 92·8 metric tons per hour compared with 87·7 in 1959 and the average daily crushing rate was 1,750 tons compared with 1,797 in 1959.

In order of importance, the main varieties making up the 1961 crop were the following: Ebène 1/37, M 147/44 and M 134/32. The above mentioned varieties accounted for about 65 % of the crop and the remaining 35% was made up of B 37172, B 3337, M 31/45, M 202/46, B 34104 and other varieties.

Exports of sugar were 402,435 long tons to the United Kingdom and 101,830 long tons to Canada, making a total of 504,265 long tons.

F.N.H.

* 1 arpent = 1·043 acres.

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

Analysis of tillering behaviour in an autumn sown sugar cane crop under varying crop density. H. P. VARMA and M. S. TOMAR. *Proc. 30th Ann. Conv. Sugar Tech. Assoc. India*, 1962, 1–5.—Work on tillering at Sugar Cane Research Station, Shahjahanpur, U.P. of autumn (Oct.) planted cane showed that late developing tillers had little chance of survival and that the early developed tillers contributed mainly (70%) to the formation of millable canes.

* * *

On the use of "Simazine" as weedicide in sugar cane fields. P. S. MATHUR and R. P. SINGH. *Proc. 30th Ann. Conv. Sugar Tech. Assoc. India*, 1962, 11–19.—Results are given of weed control trials at the Government sugar cane research station at Shahjahanpur using "Simazine", 2,4-D and "Nata" (sodium salt of T.C.A.). "Simazine", at 4 lb to the acre, proved to be the most satisfactory, successfully suppressing most of the weeds—monocotyledons and dicotyledons. Even at 8 lb per acre there was no harmful effect on cane. "Nata" affected cane growth and reduced tillering: 2,4-D was ineffective against grasses and *Portulaca oleracea*.

* * *

Studies on the characteristics of saline and alkaline patches in Maholi Cane Development Zone, District Sitapur, U.P. N. S. SINHA and K. S. MATHUR. *Proc. 30th Ann. Conv. Sugar Tech. Assoc. India*, 1962, 129–133.— The writers claim that the areas under saline and alkaline soils in India are increasing. They here describe and analyse soil profiles from typical saline and alkaline patches.

* * *

Influence of the inclination of sugar cane stalks on their sucrose content. S. A. ALERS and G. SAMUELS. *J. Agric.* (Univ. Puerto Rico), 1963, **47**, (1), 24–27.—It is pointed out that there is a general belief that lodging in sugar cane exerts a harmful effect on sugar yield. A field test was carried out (on variety PR 980) to determine the influence that the degree of inclination of sugar cane from the vertical has on the sucrose components. Canes were inclined at angles of 30°, 60° and 90° from the vertical for 30, 60 and 120 days. There was no appreciable difference in sucrose components that could be attributed to the degree of inclination.

* * *

The Romana programme of agricultural research. T. O. ELLIS. *Sugar J.* (La.), 1962, **25**, (5), 11–17.—Research at Central Romana, San Domingo, commenced in 1947 with W. J. LUKE as agronomist; in 1956 G. ARCENEAUX was appointed consultant for agricultural research. The largest section is devoted to work connected with varietal breeding with a description of the methods adopted but, so far, none of the seedlings raised appear to have reached a commercial status. Meanwhile large changes have taken place in the relative varietal position since 1953/54. Then, 74% of the total area was under POJ 2878 with no other variety over 10%. In 1961/62, this area had fallen to 23% with 28% under B 4362, 21·5% under B 41227 and 20% under B 43337. The last and B 37161 are being rapidly eliminated as too susceptible to mosaic. Notes are given on soil fertility, irrigation and cultural studies. Screening of seedling population by inoculation for mosaic is a routine process. A programme of biological control by *Lixophaga diatraeae* was initiated for borer control on new cane lands but has been discontinued. On old cane land this predator has established a natural control.

* * *

Soil testing and its use. W. J. PEEVY. *Sugar J.* (La.), 1962, **25**, (5), 39–40.—The author describes in simple terms the sources and uses of lime and humus.

* * *

Flood fallowing. H. EVANS. *Sugar J.* (La.), 1962, **25**, (6), 27–30.—Flood fallowing has been practised in British Guiana for generations as an empirical cultural system. The chemical processes involved were investigated by F. HARDY[1] and are here described in the light of subsequent work, the main consequences being the production of an excellent tilth, coating of soil particles with a layer of oxidized iron producing a persistent crumb structure, release of ammoniacal nitrogen, greater availability of all other nutrients with leaching of salts present in toxic amounts, and the destruction of numerous pests. The major disadvantage lies in the time the land remains unproductive. Thus, in a field experiment covering 0–12 months at 3-monthly intervals the yields were: 0 months 30·4 tons, 3 months 33·3 tons, 6 months 36·6 tons, 9 months 39·3 tons and 12 months 47·3 tons. In the last two ranges, the response to fertilizers is small.

* * *

Variety trials on everglades peat, Florida, 1957-60. B. A. BELCHER and E. R. RICE. *Sugar J.* (La.), 1962, **25**, (7), 58–62.—The area commanded by the warm waters of Lake Okeechobee is now almost fully developed with sugar cane and other crops, but there are large areas of peat-land beyond reach of these waters where cold is too intense for stubble production. Frost-resistant varieties are required. From the trials reported the most promising varieties are, in descending order, CP 50-28, CP 52-68 and CP 52-107, but the first two are susceptible to mosaic and ratoon stunting disease.

[1] *Proc. B.W.I., Sugar Tech. Conf.*, 1951.

Fertilizer from coal. ANON. *Int. Fertilizer Correspondent*, 1963, **4**, (3), Item 558.—A new organic fertilizer is described which is produced from rather volatile bituminous coal, pulverized, treated with concentrated nitric acid and neutralized with concentrated ammonium hydroxide.

* * *

Minah bird pest. ANON. *Australian Sugar J.*, 1962, **54**, 595.—The Indian passerine Minah or Mynah, first introduced in 1883, has a pest value only in built-up areas where it acts as a scavenger and is, therefore, of no direct application to the sugar industry. Its story is, however, of interest as illustrating the risk of casual importations and release of potential pests. It invades houses, infesting them with lice and the only remedy appears to be bird-proofing houses. Incidentally the Minah is a bird readily domesticated and taught to talk and mimic.

* * *

Mechanical harvesting trends. ANON. *Australian Sugar J.*, 1962, **54**, 585–589.—The brief text is accompanied by a wealth of illustrations of the Massey-Ferguson harvester. A rapid development in mechanical harvesting is taking place, the 235,000 tons harvested in 1961 was increased to 484,000 tons in 1962.

* * *

Estimate of loss caused by the stalk borer. M. NORTH COOMBES and O. DAVIDSEN. *Rev. Agric. Sucr.* (Mauritius), 1962, **41**, 201.—The particular borer is *Proceras sacchariphagus* and is the worst cane pest in Mauritius. The observations recorded refer to the Benares sugar estate. Comparisons showed percentages of stalks undamaged 48·70, 1 or 2 nodes attacked 36·46, 3 or 4 nodes attacked 11·71 and 5 nodes or over 3·13. Juice percentages by weight and sucrose in the same 4 groups were (1) 49·36 and 16·81, (2) 35·06 and 15·86, (3) 12·66 and 14·63 and (4) 2·29 and 14·38. From these figures the loss on a 120,000 ton cane crop works out at Rs. 305,000.

* * *

Decreasing sugar yields in Puerto Rico. C. E. BEAUCHAMP. *Sugar y Azúcar*, 1962, **57**, (12), 62, 64.—The island's average yield of sugar per unit area has shown a downward trend since 1950 and this result is attributed to various causes: increased mechanical loading, high precipitation in recent years, the fertilizer programme with high N, too great an emphasis on yield of cane in varietal choice and lack of co-ordination between field and factory leading to delays in milling. The two major remedies discussed are pre-testing before cutting and the breeding of varieties capable of giving a high sugar content, particularly at the beginning and end of the season.

* * *

White leaf disease of sugar cane. K. C. LING. *Taiwan Sugar*, 1962, **9**, (3), 28–32.—This disease appears to be a new one first observed in 1958. The symptoms are described in some detail. The method of transmission is so far unidentified and hot water treatment appears only partially effective.

Trials with herbicides in Veracruz. D. ONTIVEROS H. *Bol. Azuc. Mex.*, 1962, (161), 5–12.—The article is a record of trials with the three herbicides, "Simazine" "Esteron T-T" and 2-4 Dow F-40.

* * *

Revolutionary vehicle may prove useful in cane fields. ANON. *Sugar y Azúcar*, 1962, **57**, (12), 70.—A description is given (with photographs) of an unusual tractor-like vehicle (the "Polligon IV") claimed to be of value in opening up swampy cane lands and traversing roadless terrain impassable to other vehicles. Low pressure pneumatic bags appear to take the place of the chain drive on a caterpillar tractor.

* * *

Sugar cane in southern Spain. Cultivation, abnormalities in growth and the inversion of the vegetative cycle. P. RIVALS. *Rev. Agric. Réunion*, 1962, **62**, 89–101; through *Plant Breeding Abs.*, 1963, **33**, 236. Information on the varieties grown in southern Spain and on the breeding work carried out at the research station at Malaga is provided. The possibility of breeding forms capable of commencing growth in spring and ripening in the autumn is discussed.

* * *

The availability of nitro-phosphate to sugar cane. T. P. PAO and S. C. YANG. *Rpt. Taiwan Sugar Exp. Sta.* 1963, (30), 31–47.—Results are given of an elaborate series of field experiments comparing the manurial effects of nitro-phosphate as against a combination of ammonium sulphate and calcium superphosphate. In the early stages tillering was superior with nitro-phosphate but later there was no notable difference, nitrophosphate having probably leached out in the rainy season. Final sugar yield was about 2% less with nitro-phosphate.

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Effect of filter-press cake on crop yields and soil properties. G. ACEVEDO-RAMOS *et al. Compost Sci.*, 1963, **3**, (4), 34–38.—The beneficial effect of sugar cane filter-press cake on pineapple growth and production is outlined. An analysis of Puerto Rican filter-press cake is given and its manurial value assessed.

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Insect pests of sugar cane in Réunion. L. CARESCHE. *Agron. trop.*, 1962, (7–8), 632–646; through *Plant Breeding Abs.*, 1963, **33**, 237.—Varietal differences in sensitivity to sugar cane borer (*Proceras sacchariphagus*) are recorded, the three varieties R380, R386 and Co·421 being most resistant.

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Canes for rich land. ANON. *Producers' Review*, 1963, **53**, (3), 95.—Barring cyclones and floods Queensland cane varieties normally remain erect except in rich pockets of land and especially on alluvium in valleys and along river banks. The anti-lodging virtues of the variety Q57 are emphasized. From 1957 to 1962 the percentage of Q57 in the Babinda crop rose from 6·8 to 62.

Control of Fiji disease in Madagascar. B. SIGWALT, G. LAUFFENBURGER and P. LACOSTE. *Agron. trop.*, 1962, (7–8) 589–601; through *Plant Breeding Abs.*, 1963, **33,** 237.—The resistance of some 20 varieties to this disease was studied and the following recorded as highly resistant—Ragnar, Pindar, Trojan, Q57, S17 and M31/45.

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Plant population and nitrogen use for sugar beets. J. W. AYLESWORTH. *Up and Down the Rows* (Canada & Dominion Sugar Co. Ltd.), 1963, (132), 4.—The author, who is Officer-in-charge, Soil Sub-station, Woodslee, Ont., gives an account of field trials designed to test the value of nitrogenous fertilizer application to sugar beet coupled with differences in spacing. To reap full benefit from heavy dressings closer spacing than normal is advised.

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Sugar beet trials 1956–58.—A. I. WILLEY. *J. Nat. Inst. Agric. Bot.*, 1961, **9,** 45–47.—Sugar content, yield, bolting, nitrogen content and juice purity for four varieties are compared. *Zwaanesse III* is recommended for Britain.

* * *

Research on sugar beets. F. V. OWEN. *Bull. Utah Agric. Expt. Sta.*, 1961, (431), 11–19.—A history is given of sugar beet research and breeding in the United States.

* * *

Technical and economic aspects of sugar production in the Antilles. M. GUILLAUME. *Agron. trop.*, 1962, (7–8), 431–471; through *Plant Breeding Abs.*, 1963, **33,** 236.—This article includes a brief account of the organization of the varietal improvement programme in Guadeloupe and Martinique. The characteristics of the varieties at present grown and of recent introductions of promise are also given.

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The use of varieties in the control and eradication of sugar cane diseases in Queensland. C. G. HUGHES. *Sugar J.* (La.) 1962, **25,** (6), 31–32, 36.—An account is given of the organization set up for the control of sugar cane diseases in the various cane districts of Queensland, the writer being himself an officer of the Bureau of Sugar Experiment Stations. The diseases discussed include—gumming disease (*Xanthomonas vasculorum*), leaf scald (*X. albilineans*), red stripe and top root (*X. rubrulineans*), downy mildew (*Sclerospora sacchari*), red rot (*Glomerella tucumanensis*), yellow spot (*Cercospora keopkii*) and certain virus diseases (Fiji disease and Mosaic).

* * *

Sugar cane breeding in Réunion: new introductions and tendencies. E. D'EMMEREZ DE CHARMOY. *Agron. trop.* 1962, (7–8), 546–559; through *Plant Breeding Abs.*, 1963, **33,** 236.—An account is given of results achieved in breeding work in Réunion and of future prospects or possibilities. A table is given showing the reactions of 24 local and introduced varieties to 8 different diseases present on the island.

A new chemical for economic cane desiccation. ANON. *Sugar y Azúcar*, 1963, **58,** (2), 17–19.—The chemical referred to is "Paraquat" or "Gramoxone," best known as a weedkiller. Its virtues in cane desiccation, prior to burning at harvest time, are outlined. It is of special value where high rainfall prevents a good burn and where mechanical cutting or harvesting is practised. To be effective it must be applied by air, 2 pints in 5 gallons of water, per acre, being sufficient.

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Leaf scald of sugar cane in Sergipe, Brazil. E. FRANCO. *Brasil Açucareiro*, 1962, **60,** (3 & 4), 6–14.—An account of this disease (due to *Pseudomonas albilineans* Ashby) as it occurs in the State of Sergipe. Details are given of its world occurrence, symptoms, mode of transmission, control and varietal resistance in Sergipe.

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Fertilizing sugar cane in North India. AMBIKA SINGH. *Fertilizer News*, 1963, **8,** (4), 9–13.—This is largely a discussion of the value of organic versus inorganic sources of nitrogen in cane growing.

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Preliminary studies on the genetics of sugar cane smut, *Ustilago scitaminea* Sydow. S. MUHAMMAD and A. GHAFOOR. *Biologia*, 1962, **8,** 65–74; through *Plant Breeding Abs.*, 1963, **33,** 236.—Material examined included that from Lyallpur, Sargodha and Tandojam. Four Lyallpur lines or strains and four from Tandojam showed differences in response to temperatures ranging from 20 to 35°C and pH values from 3·5–8·2. Injections with six sugar cane varieties led to the belief that five distinct pathogenic races of the smut were present.

* * *

Mosaic control seed cane programme. L. L. LAUDEN. *Sugar Bull.*, 1963, **41,** (14), 176–7.—Louisiana cane growers will again be able to buy heat-treated and mosaic-rogued seed of several commercial varieties. The method of ensuring this is explained and the warning given that ratoon stunting disease may be spread rapidly by the cane knife at harvesting.

* * *

Sugar cane in the Congo. H. ROUZAUD. *Agron. trop.*, 1962, (7–8), 531–542; through *Plant Breeding Abs.*, 1963, **33,** 236.—Information is given on the main economic characteristics of introduced varieties under test at the Loudima Station in the Congo.

* * *

Seeds and stands. M. R. BERRETT. *Up and Down the Rows* (Canada & Dominion Sugar Co. Ltd.), 1963, (132), 2.—The great importance of a good stand with sugar beet is emphasized and factors affecting it are discussed such as—soil condition, seedbed preparation, seed, drill, depth of planting, management and weather.

WORLD SUGAR PRODUCTION POTENTIAL

A recent survey was made by F. O. Licht K.G.[1] on the potential capacity of various regions of the world for producing the greater quantities of sugar which will be needed in future years. Assuming only a 5% annual increase in requirements and ignoring the likelihood of an increased rate of increase with rising living standards (compared with an actual figure of 6·06% over the past ten years), plus a 5% increase per year in production (compared with an actual 5·26% over the past ten years), Licht estimates that there would be a deficit of 7·9 million tons by 1972/73.

Where this expansion of production capacity will occur is a good question. First of all, those countries which cannot meet their own sugar requirements and which have difficulties in attempting to import sugar will certainly be among the regions of sugar expansion. A classic example of the case is **China**. Other Asiatic and African countries are in much the same situation. Therefore we are likely to hear much of new sugar factory projects and the building of new factories in those regions in the coming years, especially since the greatest possibilities for an increase in consumption and for export also lie in these regions.

The development in **India**, which contains practically boundless production possibilities but also very high production costs, and the developments in **Australia** and the **Republic of South Africa** will also be of great importance. These three countries show at present the best possibilities for future increase of sugar production. **Taiwan** could certainly easily double its production if the prices offer an appropriate incentive. Any increases in Chinese sugar production could be speedily consumed inside the country, and even if China were to increase its production by many times as much, it would still need to import sugar from the world market.

Judging from the development of the Indonesian sugar industry until now it is hardly to be expected that **Indonesia** will play such a rôle in the foreseeable future as Java has previously held in the sugar economy.

There are certainly great possibilities for increasing the sugar production potential in Asia and Africa. Many regions are only at the beginning of their sugar economic activity, and other, older regions have certainly not exhausted their production possibilities. But they will certainly attempt to raise their potential in the next decade and to play a more important rôle in the world sugar scene.

South America, because of its unlimited cultivation possibilities for cane sugar, is also worth regarding in the future of the sugar economy. **Brazil** will be of special importance. Since the cane-sugar producing regions of South America are already older, we assume that an increase in production can be more quickly reached there. There is also plenty of sugar cane land in other countries in this region.

In **Central America** the production prospects are considerably more limited than on the South American continent, partly because of the smaller size of the countries. This does not mean, however, that significant amounts of sugar cannot also be mobilized here. The development in **Cuba,** which has one of the greatest sugar producing potentials in the world, will be decisive in the near future. The steady recession which has been observed in the Cuban production of the last few years has had nothing to do with the exhaustion of the production possibilities, but is to be explained by the political upheaval. The future of Cuban sugar production will depend upon whether the present government there is able to put a stop to this recession.

The **United States of America** will be of special importance for the future shaping of the world sugar production picture. Since the lifting of all government restrictions, home-grown cane and beet sugar production has been rising steadily. This tendency will certainly be furthered by the scarcity on the world market and by the high prices. The size of this country offers enough land to meet all domestic requirements, and the construction of new sugar factories would only be a question of guarantees of a profitable market. Will the U.S. government stick to this system or retain the former one of importing large amounts of sugar? Only the future can tell.

There are also expansion possibilities in **Europe.** The sugar production policies of most of the Western European countries are, however, set up upon the basis of meeting the domestic needs rather than upon an export basis. With world sugar market prices at 3·25 cents, or the minimum price declared in the International Sugar Agreement, exporting represents a losing business for the European beet sugar producing countries. Sugar is therefore usually exported only when there are excess supplies on hand. World market prices between 8 and 10 cents would, of course, change the situation for some countries. Since much scepticism has been expressed about the development of prices in the last decade in the European beet sugar areas, a fundamental expansion of acreage for exporting purposes is out of the question. The difficulties existing in the chief producing countries in securing a large enough working force will also act as a brake. Any increase in sugar production in the Western European countries will, therefore, be confined within the framework of increasing market possibilities within the countries themselves.

The same tendency can be expected in the Soviet Union and the majority of the south-eastern European countries. East Germany, Czechoslovakia, Poland and Hungary will probably remain in the same relation to the sugar supply on the world market, because of

[1] *International Sugar Rpt.*, 1963, **95**, (Supp. 14), 183–188.

their foreign currency situation. The sugar exports cannot be forced up by higher prices, either.

The European beet sugar sector will probably meet the increased demands in world sugar consumption only within the framework of its own market region. It will certainly be no decisive factor for the sugar supply for the rest of the world.

This supply must come from the cane sugar areas, in which case considerable changes from the present situation are to be awaited."

FURTHER STUDIES IN THE DRYING OF WHITE SUGAR

By T. RODGERS, C. L. LEWIS and J. D. OSBORNE

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

PART II

To make a closer study of the results obtained from pans of different designs, further tests were carried out in which the standard (3 hr) moisture was measured, also the moisture release in the humidity oven and the total moisture, all on freshly produced sugar and from the four pans. Again the test numbers for

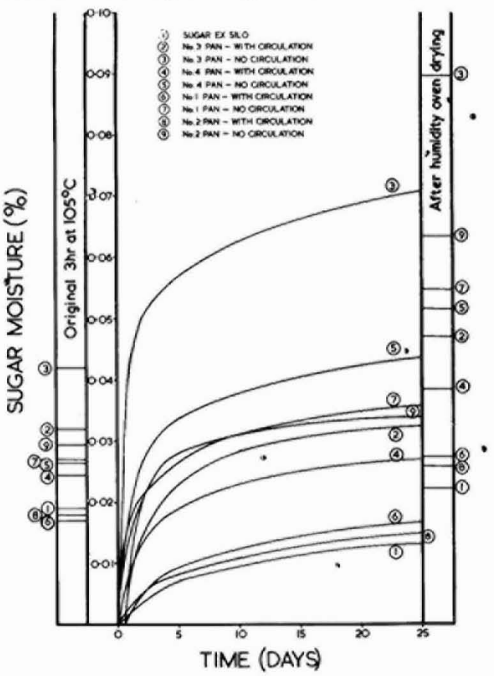

Fig 7.

each pan correspond to the same time so that variations in juice quality, etc. were as far as possible eliminated. The results for pans Nos. 1 and 2 are recorded in Table IV, and for Nos. 3 and 4 in Table V. Table VI records the results with silo sugar using the same test. Also included in Tables IV and V are results of one test on sugar boiled in each pan with no forced circulation. All these results are plotted in the usual way in Fig. 7, and the plot for each pan representing the results using forced circulation is the average of the number of tests recorded. Tables IV, V and VI also contain a screening analysis, ash and invert determinations and an attempt to measure the percentage of conglomerates in the various samples.

Figs. 8–11 show photographs of the sugar produced from each pan with no forced circulation. The striking difference can be seen between these photographs and those in Figs. 3–6. It should also be noted that with no circulation, pans 1 and 2 have no better crystal formation than pans 3 and 4.

Fig. 8

Pan No. 1. No forced circulation. Date 16.12.62. Conglomerates 35%

Confirming the previous results, it can be seen from Tables IV and V that for all four pans, forced

circulation has reduced the initial (3 hr) moisture determination, the amount of moisture released in the humidity oven (measured as a percentage of the original), and finally, of course, the total moisture measured in the samples. The percentage of conglomerates is also less with circulation. The results confirm too the improvement in results obtained in pans Nos. 1 and 2 compared with pans Nos. 3 and 4 —again both in initial moisture, total moisture and percentage conglomerates, although there appears to be in these tests much less difference in the % moisture released in the humidity oven between pans 1 and 2 and pans 3 and 4. This could be affected to some extent by the considerably longer period (28 days compared with 72 hr) that the tests were performed. However the important practical results—the initial and final moisture are very much in favour of Nos. 1 and 2 pans.

Table IV

Test No.	% Moisture: Initial 3 hr at 100°C	After days: 7	14	24	Final 3 hr at 105°C	% Increase	Screen analyses: On 18	On 25	On 36	Through 36	C.V.	M.A.	Ash %	Invert %	% Congl.
Pan 1:															
1	0·0158	0·0106	0·0145	0·0168	0·0244	54·4	12·4	51·4	28·8	7·4	24	0·0265	0·010	0·001	15
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	0·0125	0·0065	0·0090	0·0143	0·0240	92·0	17·4	37·5	31·4	13·7	32	0·0255	0·008	0·002	11
4	0·0138	0·0062	0·0115	0·0125	0·0216	56·5	11·2	48·4	29·3	11·1	28	0·0240	0·007	0·001	12
5	0·0174	0·0109	0·0134	0·0144	0·0257	47·7	12·8	42·2	25·9	19·1	32	0·0250	0·008	0·004	17
6	0·0255	0·0198	0·0215	0·0264	0·0400	56·8	5·9	44·9	21·0	28·2	33	0·0230	0·012	0·004	34
Average	0·0170	0·0109	0·0139	0·0169	0·0271	59·4	11·9	44·9	27·3	15·9	30	0·0248	0·009	0·003	—
No circln.	0·0270	0·0290	0·0307	0·0362	0·0548	102·9	40·9	40·7	14·1	4·3	26	0·0315	0·010	0·003	38
Pan 2:															
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	0·0188	0·0072	0·0127	0·0128	0·0213	13·3	20·6	32·6	31·7	15·1	34	0·0255	0·014	0·004	5
3	0·0175	0·0085	0·0093	0·0149	0·0259	48·0	11·1	45·4	28·7	14·8	28	0·0255	0·008	0·002	12
4	0·0136	0·0042	0·0065	0·0093	0·0197	44·9	15·4	55·6	22·6	6·4	24	0·0275	0·006	0·001	9
5	0·0197	0·0131	0·0156	0·0175	0·0298	51·3	16·5	37·8	28·2	7·5	34	0·0250	0·009	0·006	10
6	0·0210	0·0168	0·0188	0·0199	0·0332	53·3	10·1	55·9	26·1	7·9	25	0·0260	0·010	0·006	2
Average	0·0181	0·0099	0·0126	0·0149	0·0259	43·1	14·7	45·5	27·4	12·4	29	0·0259	0·009	0·004	—
No circln.	0·0293	0·0366	0·0388	0·0434	0·0631	115·4	30·7	43·2	19·6	6·5	27	0·0300	0·011	0·002	35

Table V

Test No.	% Moisture: Initial 3 hr at 105°C	After days: 7	14	24	Final 3 hr at 105°C	% Increase	Screen analysis: On 18	On 25	On 36	Through 36	C.V.	M.A.	Ash %	Invert %	% Congl.
Pan 3:															
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	0·0503	0·0409	0·0479	0·0493	0·0641	25·4	7·3	44·1	36·2	12·4	26	0·0245	0·021	0·002	33
3	0·0189	0·0181	0·0201	0·0262	0·0367	94·1	14·1	49·4	26·0	10·5	26	0·0265	0·009	0·003	16
4	0·0240	0·0159	0·0237	0·0257	0·0376	56·7	8·3	49·4	29·6	12·7	26	0·0250	0·008	0·001	29
5	0·0344	0·0263	0·0300	0·0319	0·0521	51·4	14·4	45·7	26·6	13·3	29	0·0260	0·013	0·008	33
6	0·0332	0·0227	0·0272	0·0288	0·0447	34·6	32·4	47·9	16·0	3·7	27	0·0300	0·010	0·004	25
Average	0·0321	0·0248	0·0298	0·0324	0·0470	46·4	15·3	47·3	26·9	10·5	26	0·0264	0·012	0·004	—
No circln.	0·0418	0·0590	0·0631	0·0707	0·0896	114·4	31·8	37·3	20·1	10·8	34	0·0290	0·016	0·003	40
Pan 4:															
1	0·0173	0·0154	0·0196	0·0220	0·0277	60·1	41·9	37·2	14·8	6·1	29	0·0320	0·011	0·001	15
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	0·0196	0·0208	0·0230	0·0284	0·0360	83·7	4·7	44·1	36·7	14·5	25	0·0240	0·009	0·002	21
4	0·0265	0·0245	0·0322	0·0311	0·0424	60·0	16·5	45·4	25·5	12·6	29	0·0265	0·010	0·001	29
5	0·0257	0·0194	0·0224	0·0230	0·0390	51·8	2·0	39·5	44·4	14·1	23	0·0230	0·010	0·005	29
6	0·0333	0·0245	0·0254	0·0307	0·0465	39·6	19·7	58·6	17·6	4·1	22	0·0290	0·011	0·006	20
Average	0·0245	0·0209	0·0245	0·0270	0·0383	56·3	16·9	44·9	27·8	10·4	26	0·0269	0·010	0·004	—
No circln.	0·0263	0·0298	0·0301	0·0349	0·0516	96·2	35·4	42·4	17·7	4·5	21	0·0305	0·011	0·003	35

Table VI

Test No.	% Moisture: Initial 3 hr at 105°C	After days: 7	14	24	Final 3 hr at 105°C	% Increase	Screen analysis: On 18	On 25	On 36	Through 36	C.V.	M.A.	Ash %	Invert %
Ex Silos:														
1	0·0176	0·0080	0·0111	0·0129	0·0213	21·0	20·7	37·1	30·6	11·6	21	0·0265	0·010	0·002
2	0·0190	0·0098	0·0111	0·0129	0·0193	1·6	18·1	41·9	28·7	11·3	29	0·0265	0·011	0·003
3	0·0170	0·0067	0·0091	0·0145	0·0232	36·4	15·0	45·5	28·6	10·9	28	0·0260	0·011	0·003
4	0·0232	0·0091	0·0130	0·0148	0·0244	5·2	17·2	44·9	25·3	12·6	29	0·0265	0·009	0·003
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	0·0189	0·0097	0·0099	0·0124	0·0240	27·0	13·1	49·0	31·5	6·4	23	0·0265	0·010	0·003
Average ..	0·0191	0·0086	0·0107	0·0135	0·0224	17·3	16·8	43·7	28·9	10·6	28	0·0265	0·010	0·003

Fig. 7 illustrates the differences. The "conditioned" silo sugar has the best moisture characteristics, Nos. 2 and 1 pans with forced circulation following closely. Nos. 4 and 3 pans with circulation follow, and, finally, the four samples with no circulation are worst of all.

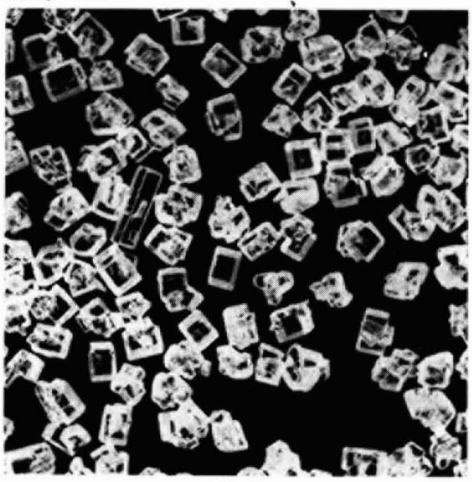

Fig. 9

Pan No. 2. Date 29.11.62.
No forced circulation. Conglomerates 45%

Fig. 10

Pan No. 3. Date 16.12.62.
No forced circulation. Conglomerates 40%

It may be suggested that the results for no circulation are made worse because of the stationary propeller being in the pan. The facts are, however, that the results obtained this year, and quoted in Tables IV and V, with the propeller in pans 1, 3 and 4 stopped, are no worse than those found last year when the same pans were tested in the same way before propellers were fitted. The fact that a stationary propeller is in a pan does not therefore seem to have a significantly adverse effect on the crystals, although obviously it must hinder the natural circulation to some extent.

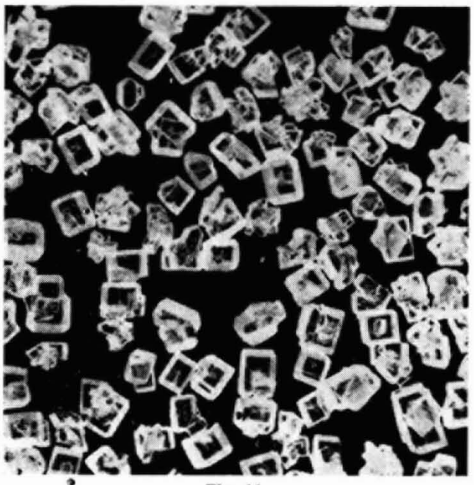

Fig. 11

Pan No. 4. Date 16.12.62.
No forced circulation. Conglomerates 35%

Despite the variation in results between pans 1 and 2, and 3 and 4, the authors did feel that the results at this stage were a confirmation of those obtained last year when the suggestion of Bound Moisture, and its reduction by forced circulation, was put forward.

The next problem was to explain the quite significant difference in results between Nos. 1 and 2 pans and Nos. 3 and 4.

The pans were of course different in design, one important feature being the diameter of downtake, with its previously mentioned effect on propeller capacity. It was logical therefore to find out if we could correct this reduction in propeller diameter by increasing its speed. Consequently, the circulator drive was altered on pans 3 and 4, so that it was running at 80 r.p.m. Immediately prior to this change, typical results for the four pans were as follows:—

Pan	*Circulator r.p.m.*	*Original moisture %*	*Ash %*
No. 1	75	0·013	0·009
No. 2	93	0·014	0·008
No. 3	75	0·026	0·010
No. 4	75	0·021	0·010

After this change, the results were:—

Pan	*Circulation r.p.m.*	*Original Moisture %*	*Ash %*
No. 1	75	0·015	0·010
No. 2	93	0·014	0·010
No. 3	80	0·022	0·012
No. 4	80	0·023	0·012

Table VII

Pan No.	64 r.p.m. %C	64 r.p.m. %M	75 r.p.m. %C	75 r.p.m. %M	80 r.p.m. %C	80 r.p.m. %M	93 r.p.m. %C	93 r.p.m. %M	100 r.p.m. %C	100 r.p.m. %M	No Circulation %C	No Circulation %M
1	12	0·0143	10	0·0161	—	—	—	—	—	—	38	0·0270
2	—	—	—	—	—	—	8	0·0160	—	—	35	0·0293
3	—	—	27	0·0262	24	0·0305	—	—	25	0·0320	40	0·0418
4	—	—	20	0·0212	23	0·0227	—	—	—	—	35	0·0263

This change therefore showed no significant improvement (Fig. 12). It was decided therefore to further

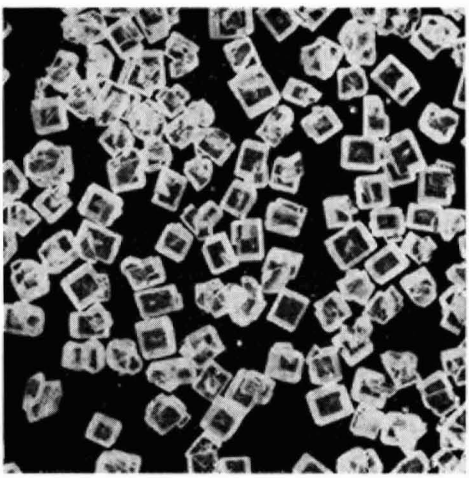

Fig. 12

Pan No. 3. Date 29.11.62.
Circulator speed 80 r.p.m. Conglomerates 33%

increase the speed on No. 3 pan, and to run this circulator at 100 r.p.m. The results are quoted below for the new conditions, and again all four pans were tested to eliminate as far as possible any changes in juices or other operating variables.

Pan	Circulation r.p.m.	Original Moisture %	Ash %
No. 1	75	0·0175	0·010
No. 2	93	0·0148	0·010
No. 3	100	0·0231	0·010
No. 4	80	0·0228	0·011

Again there was no great significant change in these results and no marked reduction in the proportion of conglomerates (Fig. 13).

The only other circulator speed change made in the campaign was to reduce the speed of No. 1 from 75 to 64 r.p.m. Crystal formation was judged as good at 75 r.p.m. in No. 1 as at 93 r.p.m. in No. 2, and as there are advantages on power at the slower speed, it was considered worth while to experiment to see if 64 r.p.m. was as good as 75 r.p.m. In fact, there was a very slight deterioration as indicated by an increase in conglomerates, although the moisture and ash showed no significant change (Fig. 14). From the practical point of view, the boiling of the pans was slightly slower and the sugar boiler found it more difficult to judge his grain.

Fig. 13

Pan No. 3. Date 3.1.63.
Circulator speed 100 r.p.m. Conglomerates 25%

Fig. 14

Pan No. 1. Date 9.12.62.
Circulator speed 64 r.p.m. Conglomerates 12%

Table VII summarizes these results. This shows the percentage conglomerates and the original (3 hr) moisture determination on each pan operating at different speeds.

(To be continued)

CHROMOGENIC REDUCING SUBSTANCES IN MOLASSES

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PART I

INTRODUCTION

THE colour forming interaction between amino acids and reducing sugars has become known as the Maillard reaction, since MAILLARD was the first to make a systematic study of the formation of dark brown products on heating these compounds together[1]. The interaction is of considerable importance to many food processing industries and has therefore been studied by literally hundreds of investigators.

The comprehensive reviews of the progress in this field, published by DANEHY[2] and PIGMAN[2], HODGE[3], ELLIS[4] and many other authors, have helped to classify the available information and it is quite clear that no single chain of chemical reactions is involved but a considerable diversity of competing mechanisms can produce an almost infinite number of products. Except in the early stages of the reaction, very few of the products have been chacterized, but even in the two component glucose-glycine reaction at least 24 definite compounds have been identified. From model experiments, however, it is now apparent that one of the most important initial chains consists of a 1:1 condensation of amino acid and reducing sugar followed by an Amadori rearrangement, that is, the isomerisation of an *N*-substituted aldosylamine to an *N*-substituted 1-amino-1-deoxy-2-ketose.

Such products have been prepared in artificial two-component systems by GOTTSCHALK and PARTRIDGE[6], GOTTSCHALK[6], and by ABRAMS *et al.*[7] as amorphous material, while crystalline derivatives were obtained by CHICHESTER *et al.*[8], DUBOURG and DEVILLERS[9], and ANET[10]. Initially there was some uncertainty as to the true nature of these compounds because of the possibility that they might be *N*-aldosylamines but, from their chemical behaviour, it is now generally agreed that the compounds are Amadori rearrangement products.

With the exception of studies by ANET and REYNOLDS[11], the formation of simple reaction products in the complex food processing systems has received little attention. Even in artificial systems designed to study browning reactions, conditions have generally been chosen to parallel those prevailing in the long term storage of food materials, where relatively high concentrations of reducing sugars, low water content and low temperature are encountered.

Amino acid deoxyfructose production has not previously been demonstrated under circumstances similar to those encountered in the sugar beet process, where the concentrations of reducing sugar and of water, and the time, temperature and pH conditions are very different from those outlined above. The present work describes the detection and identification of amino acid deoxyfructoses in beet factory liquors. These intermediates in colour formation have been estimated, together with other reaction products of invert, and are shown to represent a considerable proportion of the apparent reducing sugars in molasses.

ANET[12] has synthesized a double Amadori product, difructose glycine, in which both *N*-hydrogen atoms of the amino acid are replaced by the 1-deoxy-2-ketose, and has produced evidence to suggest that production of compounds of this nature from the single Amadori products might provide the main precursor for the brown pigment found in stored dried fruit.

This type of double Amadori product was not detected in examination of beet syrups but the degradation of difructose glycine was studied in model experiments. Although difructose amino acids may provide a pathway to colour formation in juice, it was found that the compounds were so labile under the prevailing conditions that the maximum concentration during sugar production would not be expected to represent more than a minute fraction of the single Amadori products.

From an examination of factory process samples, it was established that amino acid deoxyfructoses only accumulate in significant concentrations in the sugar end syrups. Radioactive tracers and model experiments with synthetic amino acid deoxyfructoses have been used to demonstrate that as the amino acid deoxyfructoses are formed under the process conditions, a simultaneous decomposition yields a vast number of degradation products including coloured complexes which incorporate amino acid units both from the Amadori products and from free amino acids. The rate of colour formation, from interaction of amino acids and glucose, is lowered with decreasing pH, within the factory range, despite the

[1] *Compt. rend.*, 1912, **154**, 66.
[2] *Advances in Food Research*, 1951, **3**, 241.
[3] *J. Agric. Food Chem.*, 1953, **1**, 928.
[4] *Advances in Carbohydrate Chem.*, 1959, **14**, 63.
[5] *Nature*, 1950, **165**, 684.
[6] *Biochem. J.*, 1952, **52**, 455.
[7] *J. Amer. Chem. Soc.*, 1955, **77**, 4794.
[8] *J. Amer. Chem. Soc.*, 1952, **74**, 3418.
[9] *Bull. soc. chim. France*, 1957, 333; 1962, 603.
[10] *Australian J. Chem.*, 1957, **10**, 193.
[11] *Nature*, 1956, **177**, 1082; *Australian J. Chem.*, 1957, **10**, 182.
[12] *Australian J. Chem.*, 1959, **12**, 280, 491.

increased glucose concentration due to sucrose inversion at the lower pH levels, while at constant pH the rate of colour formation differs markedly with different amino acid species.

Detection and Identification of Amino Acid Deoxyfructoses in Molasses

In the course of an examination of molasses samples by paper electrophoresis in acetic acid:formic acid buffer at pH 2·0, it was observed that a series of cationic components, less mobile than the principal amino acids, could be detected both with alkaline silver nitrate and with alkaline tetrazolium. These components were not found in thin juice but at least 5 reducing cationic bands were detected in the molasses samples and, as cationic reducing substances had not previously been identified in beet process liquors, ion exchange separation of the unknown constituents was attempted.

In an initial examination, cations were absorbed from a solution of molasses on a polystyrene nuclear sulphonic acid ("Zeo-Karb 225," H^+ form). The resin was washed free from sugars and then fractionally eluted with 0·1N ammonia to yield a strongly reducing fraction which was eluted before the bulk amino acids but contained trace amounts of aspartic acid. This fraction contained four of the cationic reducing bands from the molasses sample and an aliquot was made 2N with respect to acetic acid and heated for 2 hours at 100°C. The product was found to contain a series of amino acids, including leucine, valine, α-alanine, glutamic acid and serine, and in addition a non-ionic reducing substance had also been formed. This latter compound reacted with α-naphthol: phosphoric acid spray and proved to be 5-hydroxymethylfurfural. As the amino acid deoxyfructoses yield the parent amino acid and 5-hydroxymethylfurfural when heated in acid at 100°C[11], a number of these products were synthesized from amino acids and glucose for comparison with the reducing cations in molasses.

The amino acid deoxyfructoses were synthesized by a procedure based on that described by Anet and Reynolds[11] and Anet[10]. Glycine deoxyfructose was obtained as a colourless crystalline product containing 5·8% nitrogen and with specific rotation $[\alpha]_D^{20} = -69{\cdot}0$, c = 1·0 in water ($C_8H_{15}O_7N$ requires N, 5·9%). Anet[10] has reported N, 5·6%, $[\alpha]_D^{20} = -68{\cdot}8$, c = 1·2 in water, for anhydrous glycine deoxyfructose.

The corresponding derivatives of glutamic acid (sodium salt), aspartic acid (sodium salt), serine and γ-amino-butyric acid were obtained as amorphous products equivalent, on a nitrogen basis, to 92–93% unhydrated amino acid deoxyfructose. Similar preparations from asparagine, leucine, valine, tyrosine and α-alanine were only carried to the syrup stage to provide chromatographic standards.

The synthetic products could be detected chromatographically with alkaline silver nitrate, or with alkaline tetrazolium, and also gave a linear colour response at 485 mμ when subjected to the conditions of the tetrazolium method of Carruthers and Wootton[13] for determination of reducing sugars. The colour response with glycine deoxyfructose was about 5% greater than with an equimolar solution of invert sugar and, at equivalent nitrogen concentrations, the amorphous derivatives gave the same response as glycine deoxyfructose.

The amino acid deoxyfructoses also reduced Fehling's solution to an extent rather greater than an equimolar solution of invert sugar. In contrast, the response with Müller's solution represented only 50–75% of that of invert sugar.

The separation of the single reducing fraction from "Zeo-Karb 225" proved inadequate for a quantitative examination of the ionic reducing materials in molasses because one of the cationic bands was not eluted before the principal amino acids, and also because it was later established that synthetic glutamic acid deoxyfructose was only weakly held on the cation exchanger and was sometimes removed during washing of the resin. Furthermore, synthetic aspartic acid deoxyfructose was not absorbed by "Zeo-Karb 225." For complete absorption the molasses solution was passed in series through "Zeo-Karb 225" and then through a weak anion exchanger, "De-Acidite M."

In a typical experiment, 300 ml of 5% (w/v) molasses was applied to a 50 ml column of "Zeo-Karb 225" (50μ mesh size, 5% divinylbenzene, H^+ form) in series with a 50 ml column of "De-Acidite M" (14–52 mesh size, OH^- form). After washing with 450 ml of water, the eluate from the columns gave no tetrazolium reaction for reducing sugars and the columns were then separated. The "Zeo-Karb" column was eluted with 0·1N ammonia and 16 ml fractions were collected automatically at 26 minute intervals. Samples of fractions were spotted on paper and sprayed with alkaline silver nitrate and ninhydrin spray reagents. Reducing material was measured on all fractions by the tetrazolium method, and the initial fractions, approximately 300 ml, containing no reducing material were discarded. In the subsequent eluate, up to the breakthrough of ammonia, the concentration of reducing material rose to a maximum and then fell to a relatively low value and these fractions, approximately 100 ml in total, were combined as "Zeo-Karb" eluate A. The next 100 ml of eluate also contained reducing material, the concentration increasing to a second peak value and then falling to zero; these fractions were combined as "Zeo-Karb" eluate B.

The "De-Acidite M" column was eluted with 0·1N hydrochloric acid. The first 750 ml of eluate gave no reaction and was discarded. The next 450 ml contained tetrazolium reducing material and was

[13] *I.S.J.*, 1955, **57**, 193.

retained, neutralized and finally concentrated by vacuum distillation. Further elution yielded no reducing substances.

The two "Zeo-Karb" fractions and the "De-Acidite M" fraction were examined, in comparison with the synthetic amino acid deoxyfructoses, by chromatography in Solvent 1 (3:1 *n*-propanol:N acetic acid), and in Solvent 2 (77:13:10 *n*-butanol:formic acid: water) and by electrophoresis at approximately 100 V/cm in 1:1 1·5M formic acid:2M acetic acid. The papers were sprayed with alkaline tetrazolium (1:1 1% tetrazolium salt in ethanol:N sodium hydroxide) and heated at 100°C for approximately 3 minutes to detect the reducing compounds.

The component bands were also isolated in larger quantities by applying approximately 0·5 ml of each fraction in a 10 in wide strip along the start line of chromatograms which were then developed in Solvent 1. The position of the bands was detected by spraying the outer half-inch of each chromatogram and, in positions corresponding to positive tetrazolium tests, the untreated areas of the chromatograms were cut out and eluted with 0·5 ml water. Approximately 25 µl glacial acetic acid was added to one half of each eluate, which was then heated for 16 hours in a sealed tube. The eluates, before and after acid treatment, were examined by chromatography and electrophoresis and it was found that each component had yielded 5-hydroxymethylfurfural together with at least one free amino acid, as shown in Table I. Distances moved on the paper, RGDF and MGDF, are expressed with respect to the distance moved by glycine deoxyfructose.

Table I

Amino acids formed by acid treatment of chromatographic bands separated from ion exchange fractions from molasses

Ion exchange fraction	RGDF *of band*	*Constituent amino acids*
"Zeo-Karb" A	0·83	Asparagine (2 hours heating) Aspartic acid (16 hours heating)
	1·1	Glycine, Glutamic acid, Serine
	1·3	α-Alanine
	2·1	Valine
	2·5	Leucine
"Zeo-Karb" B	1·7	γ-aminobutyric acid
	2·1	Tyrosine
"De-Acidite M"	0·85	Aspartic acid

The mobilities of the components of the untreated fractions and of the synthetic amino acid deoxyfructoses are recorded in Table II.

The production of hydroxymethylfurfural plus free amino acid, in combination with the measured mobilities, provides conclusive evidence of the presence in molasses of the 10 amino acid deoxyfructoses listed in Table II.

From "Zeo-Karb" fraction A, the amino acid deoxyfructose derivatives of asparagine, α-alanine, valine and leucine were each resolved into separate bands by solvent 1. The production of asparagine, and no aspartic acid, when the least mobile band was heated for short periods demonstrates that this was the asparagine and not the aspartic acid derivative. Moreover aspartic acid deoxyfructose is not retained on "Zeo-Karb 225". The deoxyfructose derivatives of serine, glutamic acid and glycine were not resolved in solvent 1, so giving only 5 chromatographic bands from the 7 components of fraction A, but glutamic acid deoxyfructose was resolved in solvent 2 while the glycine derivative was separated by electrophoresis.

Table II

Chromatographic and electrophoretic comparison of ionic reducing fraction from molasses with synthetic amino acid deoxyfructoses

	Solvent 1 RGDF	*Solvent* 2 RGDF	*Electrophoresis* MGDF
Constituents of "Zeo-Karb" fraction A from molasses	0·83, 1·1, 1·3, 2·1, 2·5	0·52, 0·90, 1·3, 1·8, 4·2 6·0	0·72, 0·83, 0·94, 1·0
Asparagine deoxyfructose	0·81	0·45	0·76
Glutamic acid deoxyfructose	1·1	1·3	0·77
Serine deoxyfructose	1·1	0·87	0·84
Glycine deoxyfructose	1·0	1·0	1·0
α-Alanine deoxyfructose	1·3	1·8	0·92
Valine deoxyfructose	2·1	4·3	0·89
Leucine deoxyfructose	2·7	6·3	0·87
Constituents of "Zeo-Karb" fraction B from molasses	1·7, 2·1	1·7, 3·0	1·3, 0·68
γ-Aminobutyric acid deoxyfructose	1·7	1·9	1·4
Tyrosine deoxyfructose	2·1	3·3	0·72
Constituents of "De-Acidite M" fraction from molasses	0·85, 1·3,*	0·80, 2·6,*	0·68, 0·0,*
Aspartic acid deoxyfructose	0·78	1·0	0·68

Fraction B contained 2 components one of which was γ-aminobutyric acid deoxyfructose while the other was tyrosine deoxyfructose.

Only one of the constituents of the "De-Acidite M" fraction, aspartic acid deoxyfructose, was identified. This fraction also contained a component with a higher RGDF together with other material, marked *, which was revealed as a smear rather than a discrete spot.

The total ionic reducing material in each of the 3 molasses fractions was determined by the colorimetric tetrazolium method and for uniformity the results were calculated from the colour response of standard invert solution and expressed as "mg invert sugar equivalent." The concentrations of the identified amino acid deoxyfructoses were also estimated chromatographically, and expressed as "invert sugar equivalent", by matching with standard amounts of synthetic amino acid deoxyfructose. All the components in fraction A were estimated relative to glutamic acid deoxyfructose, fraction B was compared with γ-aminobutyric acid deoxyfructose and the "De-Acidite M" fraction was assessed by comparison with aspartic acid deoxyfructose. The results for two samples of molasses are recorded in Table III.

Table III

Contribution of identified amino acid deoxyfructose to total ionic reducing material in molasses fractions

Constituents	*Identified amino acid deoxyfructose (mg invert sugar equivalent)*		*Ionic reducing material (mg invert sugar equivalent)*	
	King's Lynn	*Kidder-minster*	*King's Lynn*	*Kidder-minster*
Fraction A				
Asparagine deoxyfructose	7	6·5		
Serine deoxyfructose Glutamic acid deoxyfructose Glycine deoxyfructose	10	8		
α-Alanine deoxyfructose	4·5	3		
Valine deoxyfructose	4·5	3		
Leucine deoxyfructose	11·5	7·5		
Total	37·5	28	38·3	29
Fraction B				
γ-aminobutyric acid deoxyfructose	14	11·5		
Tyrosine deoxyfructose	trace	3·5		
Total	14	15	30	31·5
"De-Acidite M" fraction				
Aspartic acid deoxyfructose	4·5	5	24·5	17·5
Grand total	56·0	48·0	92·8	78·0

Approximately 60% of the total ionic reducing material in either sample of molasses is accountable as identified amino acid deoxyfructoses. Almost all of the discrepancy between the two values lies in the "Zeo-Karb" B and the "De-Acidite M" fractions. The former fraction is presumed to contain material which reacts less readily with tetrazolium spray than with the reagent in solution, while the latter fraction contained tetrazolium reducing components which are unidentified.

The relative concentrations of the amino acid deoxyfructoses do not parallel the order of concentration of the free amino acids in beet process liquors. In particular, the concentration of glutamic acid deoxyfructose represented only about 30% of the three derivatives estimated together, and is low relative to the deoxyfructose derivatives of leucine, asparagine and γ-aminobutyric acid.

The precise course of the interaction between glucose and amino acids and the absolute configuration of the crystalline product is still, in part, uncertain.

On the basis of the available evidence, current opinion, in general, favours the formulation illustrated in Fig. 1:

Glucose (I) is considered to react with the amino acid (II) initially to yield the N glucosyl amino acid (III) which then undergoes an Amadori rearrangement through the 1,2-enol form (IV) to give the amino acid deoxyfructose (V). Other possible forms of the rearrangement product are the 2,3-enol[9], the 2-keto form and the furanose ring form. It may be that any of the possible structures could exist to different extents in different reaction mediums but ANET[12] has shown that the infra-red spectrum is not consistent with keto or enolic forms, so that the Amadori products must exist in a ring form, and that the furanose form is less likely to be stable than the pyranose form (V).

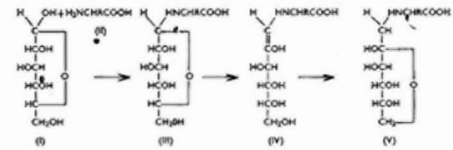

Fig. 1

Regardless of the configuration of the Amadori products, the rearrangement requires loss of asymmetry at carbon atom 2 so that reaction between amino acid and either glucose or mannose, which are epimeric on C_2, should give identical products.

This postulate was tested by preparing a derivative from glycine and mannose according to the method employed for the preparation of glycine deoxyfructose. A brown crystalline product, similar in appearance to glycine deoxyfructose, was obtained. This was recrystallized once from 60% aqueous ethanol to give slightly coloured crystals containing 5·8% nitrogen and with a specific rotation $[\alpha]_D^{20} = -72°$, c = 1·0 which compare well with the results obtained for glycine deoxyfructose. The product was also not separable from glycine deoxyfructose on paper chromatography and electrophoresis. An Amadori rearrangement must therefore have occurred as product (III) cannot be formed from mannose.

Furthermore, all the synthetic products, and "Zeo-Karb" fraction A from molasses, reduced both *o*-dinitrobenzene and 2:6-dichlorophenolindophenol rapidly in alkaline solution, which provided further evidence that structure (III) was not applicable since *N*-glycosyl amino acids only reduce these reagents slowly.

Determination of Ionic Reducing Compounds in Factory Process Liquors

A combination of ion exchange separation, for removal of non-ionic reducing material, and tetrazolium assay was used to assess the amount of amino acid deoxyfructose in factory process liquors. Since about 40% of the tetrazolium reducing material is as yet unidentified the procedure must be regarded as a determination of total ionic reducing compounds and not solely as an estimate of amino-acid deoxyfructose.

For this bulk determination, separation into 3 groups of ion exchange fractions was unnecessary and the syrup for assay was diluted to contain not more than 100 mg potassium in 100 ml (the maximum safe exchange capacity) and applied at the rate of 3 ml per minute to a 9 cm bed of "Zeo-Karb 225" (52–100 mesh, 8% D.V.B., H^+ form) superimposed upon a 9 cm bed of "De-Acidite M"

(14–52 mesh, OH^- form) contained in a single column 28 cm long × 1·1 cm i.d. The column was washed until 4 ml of the effluent gave no tetrazolium reaction for reducing sugars and then eluted with 100 ml of 1·0N ammonia. Total ionic reducing material was determined directly on a 4 ml aliquot of the ammoniacal eluate by the tetrazolium method. As the ammonia increased the colour response by about 2%, standard solutions of invert sugar for calibration were dissolved in 0·5N ammonia.

Samples from raw sugar factories, thick juices and some samples of high green syrup usually contained less than 4 mg ionic invert sugar equivalent per 100 mg of potassium, and under these circumstances it was necessary to concentrate the eluate to obtain a measurable colour in the final determination. The column wash, after application of these liquors, was also concentrated to an equal extent in determination of freedom from reducing sugars before elution.

The choice of "De-Acidite M", for absorption of the ionic reducing material not held on "Zeo-Karb 225", was dictated because, out of 10 weakly basic exchangers tested for the determination, only 6 resins gave complete absorption of glutamic and aspartic acid deoxyfructose and, of these, a satisfactory release on elution with 1·0N ammonia could only be obtained with "De-Acidite M."

Even using "De-Acidite M" in the resin combination, recovery from aqueous solution of synthetic aspartic or glutamic acid deoxyfructose was only about 90%, whereas recoveries of 94–100% were obtained with the other amino acid derivatives but, under the specified conditions, recoveries within 10% of theoretical were obtained when approximately equimolar mixtures of glycine deoxyfructose and glutamic acid deoxyfructose were added to solutions of factory liquors.

The analytical values for a number of molasses samples are recorded in Table IV in comparison with apparent invert concentrations which were determined by the tetrazolium method[18].

It will be noted that approximately 30% of the apparent invert in the molasses samples is not in fact glucose and fructose but is ionic reducing material. Despite the large difference in apparent invert between raw and white sugar factories, the ratio of ionic to apparent invert is remarkably similar.

Very little ionic reducing material was found in thin juice and production of this material in the later stages of the factory process can be assessed from the analysis of matched samples recorded in Table V. The results are expressed as a percentage of the potassium content, to eliminate the apparent concentration due to removal of sucrose, and also as a percentage of the apparent invert concentration.

The values show that most of the ionic reducing material is formed in the vacuum pans and crystallizers and, despite the different process conditions at the three factories, the ratios of ionic invert to apparent invert in any one product are fairly similar. It therefore appears that high absolute concentrations of amino acid deoxyfructoses are, in general, associated with high invert concentrations.

Table IV

Comparison of ionic reducing material and apparent invert in molasses

Molasses sample		*Ionic reducing compounds (invert sugar equivalent %)*	*Apparent invert %*
White sugar factories			
Allscott	w/e 1/1/62	0·34	1·13
Bardney	w/e 1/1/62	0·46	1·48
Brigg	w/e 1/1/62	0·33	1·06
Cantley	w/e 1/1/62	0·29	1·07
Cupar	w/e 30/12/61	0·33	1·18
Felsted	w/e 1/1/62	0·39	1·37
Ipswich	w/e 1/1/62	0·36	1·06
Kidderminster	w/e 1/1/62	0·42	1·66
Newark	w/e 1/1/62	0·48	1·71
Nottingham	w/e 7/1/62	0·27	0·84
Selby	w/e 4/1/62	0·34	1·10
Spalding	w/e 1/1/62	0·41	1·27
York	w/e 1/1/62	0·34	1·28
Raw sugar factories			
Bury	w/e 1/1/62	0·10	0·36
Ely	w/e 1/1/62	0·13	0·49
Peterborough	w/e 1/1/62	0·09	0·39
Wissington	w/e 1/1/62	0·07	0·27

Table V

Accumulation of ionic reducing material in sugar end syrups

Sample	*Ionic reducing material % potassium*	*% apparent invert*	*pH*
Wissington — Raw Sugar Factory			
Thin Juice	<0·35	<4	8·97
Thick Juice	2·1	9	7·90
Green Syrup	3·5	17	7·68
Molasses	4·9	33	7·68
Nottingham — White Sugar Factory			
Thin Juice	<0·35	<2	—
Standard liquor	2·6	5	7·33
High Green	3·0	9	7·27
Low Green	4·4	16	7·26
Molasses	7·6	32	6·40
King's Lynn — White Sugar Factory			
Thin Juice	<0·4	<2	—
Thick Juice	2·5	5	7·48
Standard liquor	2·8	5	7·30
High Green	3·3	6	6·70
Low Green	11·5	20	6·40
Molasses	16·0	28	6·18

(To be continued)

1963 Cuban crop[1].—The 1963 sugar crop in Cuba was finally completed with 3,820,323 metric tons of cane sugar having been manufactured as compared with production in the previous season of 4,815,234 tons. When grinding commenced in the second half of January a crop in the region of four million tons was envisaged but as milling progressed it became increasingly apparent that yields were not coming up to expectations and that by the beginning of April doubts were being entertained in many quarters as to whether output would reach 3·5 million tons. Production continued, however, well into July, albeit at only a few mills, and the crop closed with the final figure not far short of original forecasts.

[1] C. Czarnikow Ltd., *Sugar Review*, 1963, (621), 136.

SUGAR HOUSE PRACTICE

A statistical approach for determination of final molasses exhaustion index from its chemical composition. R. J. GUILLERMO. *Sugar News* (Philippines), 1962, **38**, 786–796.—Results of molasses analyses using 34 weekly composite samples from the Victorias Milling Co. were subjected to statistical analysis; of the three factors examined—reducing sugars, ash and organic non-sugars—only the last was found to have any significant effect on the molasses exhaustion. The correlation between true purity and the organic non-sugars % non-sucrose was expressed by a first degree linear regression equation; from this relationship was derived another regression equation for calculation of the minimum target true purity (y) which takes the form: $y = 45{\cdot}9271 - 0{\cdot}2195\,x$, where x = the organic non-sugars % non-sucrose. For every unit increase in the value of x, the target true purity would fall by a value of 0·2195. The exhaustion index is the ratio of the molasses true purity to its minimum target true purity. A value greater than unity for the index indicates poor exhaustion, while a value of $\leqslant 1$ is an indication of good exhaustion.

* * *

Decolorizing ion exchangers. XIX. Comparing new types of decolorizing ion exchangers. J. ŠTAMBERG and Z. VAŠÍČEK. *Listy Cukr.*, 1963, **79**, 33–39.—Decolorizing ion exchange resins were compared for their initial decolorizing capacity, ageing, change in exchange capacity, and regeneration. The polyamines ("Dekolorex A4", "Asmit 224" and "Amberlite XE-168") and polystyrenes ("Dekolorex A5" and "Amberlite IRA-401 S") proved to have higher sorption capacities when decolorizing molasses and lower exhaustibility with repeated cycles than did the polycondensates ("Dekolorex A2" and "Asmit 259"). The fall in decolorizing capacity of "Amberlite XE-168" and "Dekolorex A5" was very slight. The causes of resin degeneration are discussed (destruction of exchange groups, incomplete regeneration and clogging by colour bodies) and it is pointed out that since regeneration has only a short-lived effect when used to remedy this, it is preferable to use resins which are not so easily clogged by colour bodies.

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The charging of absorption columns. G. PIDOUX and L. MIRABEL. *Ind. Alim. Agric.*, 1963, **80**, 17–23.—See *I.S.J.*, 1963, **65**, 146.

* * *

Decolorizing white sugar liquors with "Wofatit E" decolorizing exchange resin. W. PLATO and M. SCHOPF. *Zuckererzeugung*, 1963, **7**, 36–39.—Tests were carried out at Halle refinery to reduce the amount of low quality white sugar (melis) in favour of more high quality refined sugar. Affination and re-boiling were rejected, the former because some of the colour substances would be transferred to other products, the latter on economic grounds. The tests were carried out with a battery of 6 resin columns; each contained 1·5 cu.m. of "Wofatit E" resin and was used to decolorize 16·8 cu.m. of 64°Bx liquor per cycle. The changes produced were recorded: the invert sugar content was increased from 0·07% to 0·11%, the ash content fell from 0·38% to 0·37%, and the pH fell from 7·7 to 7·1. The colour content, measured as the extinction coefficient at 560 mμ and at pH 7·0 was reduced by 73·8%, however. The results are considered satisfactory as regards the increased quantity of premium-selling sugar.

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Two-boiling system of manufacture. E. LEE E. *Bol. Azuc. Mex.*, 1962, (162), 28–30.—In the process which is described and illustrated by a flow-sheet, *A*-strikes of 80 purity are boiled using syrup of 78–80 purity and a footing of 83 purity made by mingling the *C*-sugar with *A*-wash liquor. This produces an *A*-raw sugar of 98·0 pol, *A*-molasses of 58·0 purity and wash liquor of 74·0 purity. Part of the wash is used for mingling with *C*-sugar and the remainder, with the *A*-molasses, used for boiling the *C*-strike. The final molasses from the latter is of 36·0 purity. At Ingenio Tamazula, the technique is estimated to have increased boiling house capacity by 10–15% and centrifugal capacity by 16%. At Ingenio Cuatotolapam the increase of both was 18%. The single product is of high quality, so reducing the task of the refinery section. Steam consumption is reduced while *C*-sugar quality is high; control is easy and molasses exhaustion equal to that with a 3-boiling system, while the short time in process reduces inversion and losses in the materials handled.

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Florida: some factory data. ANON. *Sugar y Azúcar*, 1963, **58**, (3), 49–52.—Details are given of the equipment installed in Okeelanta (South Bay), Bryant, Moore Haven, Glades, and Talisman factories and in Moore Haven refinery. A sample mill balance is given as a guide to Florida conditions.

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Generation of steam in an old sugar mill. M. MUKHERJEE. *Indian Sugar*, 1963, **12**, 625–628.—The inefficient operation of four old Babcock & Wilcox W.I.F. water-tube boilers at a mill designed for 1000 tons of cane daily is discussed. Difficulties in burning all the available bagasse to generate sufficient steam for a daily crush of 1200 tons of cane are attributed to operation of the furnaces on natural draught, whereas they were designed for forced draught operation, while the chimney (one for all four boilers) cannot overcome the grate resistance sufficiently to increase the induced draught. Certain remedies are suggested, including reducing the bagasse moisture content and replacing the boilers with a more modern type, so permitting surplus bagasse to be used for paper production.

Raw sugar production in Cuba. A. V. KAMENETSKII. *Sakhar. Prom.*, 1963, (3), 68–74.—Information is given on the processes used and data from six factories are tabulated. A typical flow-sheet is presented and some details of the man-power requirements are included.

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Design of a juice liming and sulphitation tank. A. N. SARDANA. *Sharkara*, 1962, **5**, 90–95.—Details and diagrams are given of a design for a continuous sulphitation tank which may be used for pre-liming or pre-sulphitation and which has a dished bottom; it provides for a 10-minute retention of the juice. The lime is added by means of a device described by MARCHES[1]. Dimensions are given by way of an example for a tank in a mill crushing 1400 tons of cane per day. Information is also given on the operational procedures. A sulphitation tank of the type described has given satisfactory service during two seasons at one mill, with a mixed juice pH of 4·5.

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Manufacture of sugar from palms. J. BARTOŠEK. *Czechoslovak Heavy Ind.*, 1963, (4), 40–46.—The processes involved in sugar production from palms are outlined. Centrifugals driven by a small moped petrol engine are being introduced for cottage-industry sugar production. Some information is provided on the Škoda equipment in a factory with a daily output of 50 tons of palm sugar installed in Cambodia. A 6-massecuite system is suggested (3 raw and 3 refinery massecuites). While the factory will be in operation throughout the year, the actual collecting season will last only 4–5 months. Illustrations are presented and further information is to be given later.

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Worthington turbines drive largest sugar mill in Mauritius. S. VAN DER LINDEN. *Worthington International Operations*, 1962, **8**, (3), 3 pp.—Details are given of the milling tandem and its drive at Flacq United Estates Ltd., Mauritius. This comprises seven Fives Lille-Cail mills with an average grinding rate of 222·4 metric tons/hr, each mill being driven by a Worthington type "S" multi-stage steam turbine. Full details are given of the turbines and of the mill openings, pressures, and surface speeds. Each turbine is controlled individually and the milling tandem is centrally controlled from a master panel, so that one operation may alter the speed of each turbine within the range 1500–5000 r.p.m. or of all the turbines simultaneously, and may stop individual turbines or all seven simultaneously. A tachometer for each turbine is provided on the central panel. Besides the individual control panels, containing pressure gauges, and the central control panel, each turbine is provided with a panel for checking the lubricating oil temperature at 5 points. The dial-type thermometers are equipped with alarm contacts and a signal lamp system. The turbines develop 600 h.p. with steam at 240 p.s.i. and total temperature of 600°F, and exhaust at 15 p.s.i.g.

Ion exchange adapted to confectionery in Puerto Rico. B. A. SMITH, F. SÁNCHEZ-NIEVA, R. VÁSQUEZ-ROMERO and L. A. CARLO-VÉLEZ. *Sugar y Azúcar*, 1963, **58**, (4), 33–36.—Details are given of laboratory and semi-pilot trials on ion-exchange treatment of a raw sugar melt to provide a liquid sugar suitable for use in confectionery manufacture. The raw sugar melt was first clarified before subjecting to six different procedures, two reverse cycle processes and the other four on direct cycle. After the laboratory experiments, four of these were rejected and subsequent semi-pilot tests revealed that the most suitable was a direct cycle process in which the melt passed through a "C 25" strongly acid cation exchanger, then an "A 7" weakly basic anion exchanger of the amine type (both resins are produced by the Chemical Process Co. of Redwood City, Calif.) and finally was treated with Rohm & Haas Co. "IRA 401" strongly basic anion exchanger. The ratio of anion to cation exchanger was 3:1. This procedure in the semi-pilot tests removed 69·9% ash and reduced the colour by 98·3% from 30·8 units to 0·5 units in the 1st product syrup fraction. (The effluent syrup was fractionated at the point of conductivity increase; continuing syrup feed until the product flow conductivity equalled that of the feed syrup provided a second fraction product syrup containing ten times as much ash as did the 1st fraction and of use for melting other raws.) The invert content increased from 0·74% to 1·64%. A flow rate of 100–120 gal/hr was found to be optimal. Although much cheaper than hydrochloric acid, sulphuric acid caused a reduction in the de-ashing capacity of the cation exchanger when used for regeneration, since Ca sulphate was precipitated in the bed. Hydrochloric acid is therefore preferable. Ammonium hydroxide regeneration of the anion exchangers was more suitable than using NaOH, since the latter required large amounts of rinsing water and the ash content of the 1st fraction syrups became excessive.

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How to increase capacity while grinding. M. ROMAGUERA. *Sugar J.* (La.), 1963, **25**, (10), 22–23.—Details are given of the techniques used to raise the pan station floor and roof by 10 ft at Ingenio Providencia (Colombia) in order to increase the boiling house working space, install new equipment and re-locate existing equipment. Since the Colombian grinding season covers a complete year, it was aimed to carry out most of the work during operation of the factory with as short a final shut-down as possible.

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Refined sugar production in Cuba. A. V. KAMENETSKII. *Sakhar. Prom.*, 1963, (4), 63–66.—Some information with a typical flow-sheet is given on the refining processes used by the 17 Cuban refineries. It is pointed out that while traditionally the refined sugar yield from raw sugar is taken as 93·46% and that most Cuban refineries give this as their standard yield, a more realistic approach is being made to sugar losses at some refineries so that the refined sugar yield is somewhat lower.

[1] *Proc. 9th Congr. I.S.S.C.T.* (Vol. II), 1956, 565–583; *I.S.J.*, 1957, **59**, 100.

Examination of automatically-controlled pre-defecation. S. ZAGRODZKI and H. ZAORSKA. *Gaz. Cukr.*, 1963, **65**, 45–52.—See *I.S.J.*, 1963, **65**, 24.

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Some errors in the article by A. P. Ponomarenko, "Heat utilization in sugar factories".[1] A. I. VOSTOKOV and I. P. LEPESHKIN. *Sakhar. Prom.*, 1963, (3), 38–41. The arguments (1) that using high temperature steam instead of juice vapour to heat vacuum pans will not raise but will reduce the boiling efficiency and (2) that inefficient heat usage at Soviet sugar factories is a result of bad guidance in the form of instructions are attacked. It is shown that using steam instead of vapour will not in fact alter the efficiency, but that the syrup concentration will remain normal at 65% and not 33% as suggested by PONOMARENKO. It is also asserted that the second error mentioned arises from misreading of the instructions in question.

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Some remarks on "Notes on the techniques and economics of beet sugar production." D. V. GORBAN'. *Sakhar. Prom.*, 1963, (3), 42–44.—Data supplied by PONOMARENKO[2] on the efficiency of Lokhvitsa sugar factory are analysed. It is shown that whereas an increased sugar yield % beet is claimed, the actual figure is lower than most of the values supplied by neighbouring factories, and that to increase the output, high raw juice draughts of 141% have been applied. The factory efficiency (sugar yield % on input) for the factory was lower and the fuel consumption higher, with higher molasses sugar, in the 1948–57 period than in 1931–37.

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The start-up of Bratushansk sugar factory. M. I. KOVAL'SKII. *Sakhar. Prom.*, 1963, (3), 45–49.—Some information is given on this 3000-ton sugar factory in Moldavia. The article is mainly a criticism of the various faults in the design of the factory and in the structure of the equipment supplied. The system of varnished aluminium bus-bar conductors for transmitting electricity which replaces the conventional ducted cable is described. The 3-metre sections were supplied by the Polish organization "Elektrim" and consist of three bus-bars forming a triangular section in a steel-plated sheath.

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Rational scheme for regulating the electric drive of a filter-press. G. M. SHNITSER. *Sakhar. Prom.*, 1963, (3), 49–50.—When certain types of Soviet filter-presses are under pressure, the electric motor can be, and sometimes is, switched on to stem the flow of juice between the plates and the frames. This causes overheating of the motor and damage to the frame supports. A control system has been designed to prevent this and is described.

A massecuite wheel. G. M. NIKOLAEV. *Sakhar. Prom.*, 1963, (3), 50–53.—The disadvantages of dropping massecuite from a vacuum pan through a pressure tube are listed and a massecuite wheel is described. This comprises an electrically-driven horizontal wheel placed between two stationary discs. The wheel contains sockets which the massecuite fills through holes in the upper disc, two at a time. As the wheel revolves, at e.g. 4·5 r.p.m., the sockets pass over two holes in the lower disc and the massecuite is discharged. Each socket in the test model has a capacity of 0·6 litres of massecuite, and the massecuite throughput is 29·9 metric tons/day.

* * *

Thermo-physical properties of sugar beet. V. Z. ZHADAN and M. Z. KHELEMSKII. *Sakhar. Prom.*, 1963, (3), 54–56.—Storage of beet in cold conditions has been studied and in particular the heat capacity, thermal conductivity, specific gravity and temperature conductivity. These four properties were determined as a function of the dry solids content of one variety of beet stored for 1–2 months at a temperature not exceeding +10°C. Empirical formulae are presented. The temperature conductivity was determined from the rate of cooling and the shape coefficient ($0{\cdot}73 \times 10^{-4}$). The maximum difference between measured and calculated values was 10%. The same applied to the differences between calculated and measured values of the s.g. The heat capacity was measured by the classic calorimeter method and a micro-calorimeter method. The thermal conductivity was determined from the other factors and the maximum difference between calculated and measured values was 9%. All data are tabulated.

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Modern automatic equipment in a beet yard. ANON. *Sucr. Franç.*, 1963, **104**, 85–86.—Further information is given on the layout at Bucy-le-Long[3], and particularly on the method used to wash the beets in the two dry flumes. A mobile bridge runs the length of each flume at a speed of 1 cm/sec (38 cm/sec with manual operation) and is provided with two oscillating nozzles which project water at the beet at a pressure of 2·3–2·5 kg/sq.cm. (3·5–4·0 kg/sq.cm. with very dirty beet). As the beet are withdrawn from the flume, so the bridge will follow and on reaching the end of the flume will commence the return journey. Control is photoelectric.

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The effect of over-carbonatation on the adsorption of colour by calcium carbonate. S. ZAGRODZKI and J. DOBRZYCKI. *Gaz. Cukr.*, 1963, **65**, 69–74.—See *I.S.J.*, 1963, **65**, 24.

[1] *I.S.J.*, 1963, **65**, 242.
[2] *I.S.J.*, 1963, **65**, 54.
[3] *I.S.J.*, 1962, **64**, 178.

Exergetic studies in the sugar industry. I. Exergy. II. Specific exergy of substances. T. BALOH. *Zucker*, 1963, **16**, 111–117, 194–202.

I. The concept of exergy (available energy in heat) is explained and the calculation of the exergy of a quantity of heat, in the case of substances and chemical reactions, is demonstrated. Causes of exergetic losses (heat transfer, throttling, cooling, etc.) are discussed, these being equal to electrical or mechanical energy. Exergetic studies take into consideration the ambient temperature. Enthalpy diagrams and balances do not provide information on the suitability of plant or processes, and direct comparison between enthalpy and exergy diagrams and balances is impossible since they generally use different reference temperatures.

II. Carrying out exergetic investigations necessitates a knowledge of the specific exergy of such substances in the sugar factory as fuel, steam, water, sugar and aqueous sugar solutions and for the last two depends on the concentration of the solution in the beet. The specific exergies are known for all except the sugar and sugar solutions and the specific exergy of these is obtainable only if their entropy is known. A new method of determining this is described: isothermal evaporation. The entropies for aqueous sugar solutions are tabulated for 0–140°C. At a juice concentration in the beet of 20°Bx and at 20°C ambient, sugar has a specific exergy of 4·15 kcal/kg. An exergy diagram is presented for studying aqueous sugar solutions, and calculation of the specific exergy of steam, fuel, cossettes and molasses is demonstrated.

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Researches on the storage of sugar beets. R. CHABLEY, R. LONGCHAMP, R. MESNARD, J. MESNARD amd R. J. GAUTHERET. *Ann. Physiol. Végétale*, 1961, **3**, 165–191, 223–288; through *S.I.A.*, 1963, **25**, Abs. 105.—A series of experiments carried out at Bucy-le-Long factory, France, in 1952–1956 is reported in detail with a historical review (135 references). A sampling technique was developed which enables the variability of the beets to be greatly reduced. Beets of a single size class only (usually 500–600 g) are sorted out of the whole population: in the case of storage in barrels containing 100 kg of beets, only the sorted beets are used; in the case of storage in clamps, lots of 50 sorted beets are placed in bags of wide-meshed net which are then buried in the clamp at different levels. Significant systematic errors due to sorting and topping by different individual workers were established. The rate of sugar loss was judged by the number of days which passed before sampling showed a significant sugar loss. The beets stored better (under French conditions) in clamps of 1·8 m height (losses after 19 days) than in clamps of 4–6 m height (losses after 6 days). The beets were also better preserved in clamps on soil than on concrete. The storage of beets sprayed with maleic hydrazide was compared with that of control samples. Contradictory results were obtained in different years. In general, the effect of maleic hydrazide was more beneficial in barrels than in clamps (in which the treatment often led to increased sugar losses). A positive reduction in sugar losses was obtained in 1956 with butyrylmaleic hydrazide and dichloracetylmaleic hydrazide.

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Research on methods of treating beet grown in warm areas. II. Effects of surface-active agents on the drying of beet cossettes. H. WATANABE, S. HASE, Y. OZAWA, N. MINAMI and S. SUZUKI. *Nosan Kako Gijutsu Kenkyu Kaishi* (*J. Utiliz. Agric. Products*), 1961, **8**, 133–138; through *S.I.A.*, 1963, **25**, Abs. 106. Cossettes cut from beets from six areas in Japan were dried, with or without preliminary spraying with 0·5% (on beet solids) of dodecyl benzene sulphonate suspension (one product with 65% of ash, another with 2% of ash), in the open air for 10 days or in an electric dryer for 40 min at 95°C. The surfactants caused an initial acceleration of drying (4–5 days in open air, or 15 min in the dryer) but caused little difference in the final result. The yield of solids on initial solids was best with machine drying without surfactants; surfactants had little effect in open-air drying, but decreased the yield in machine drying. The sucrose content was lower after machine drying than after open-air drying, and the loss was greater when surfactants were used; the effects on the reducing sugar content were the reverse, except with beet from certain localities. The nitrogen content was reduced equally in all methods of drying, but there were variations with the origin of the beets. Marc and ash contents were not affected.

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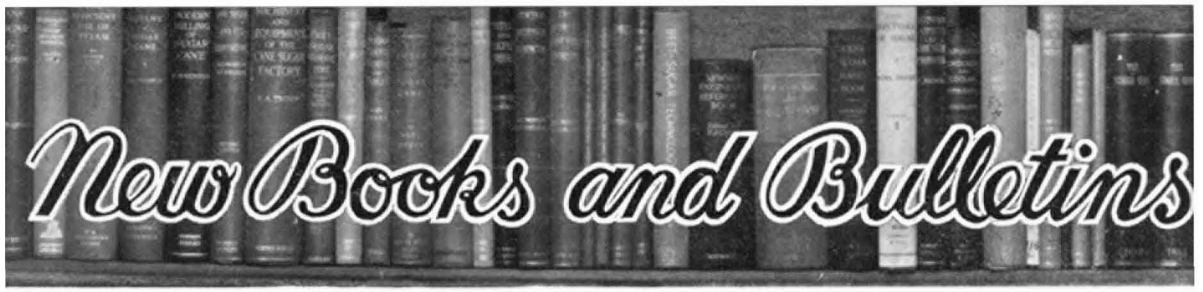
Research on methods of treating beets grown in warm areas. III. Changes in the constituents of dried beet cossettes during storage. H. WATANABE, S. HASE, Y. OZAWA, N. MINAMI and S. SUZUKI. *Nosan Kako Gijutsu Kenkyu Kaishi* (*J. Utiliz. Agric. Products*), 1961, **8**, 184–188; through *S.I.A.*, 1963, **25**, Abs. 107. Cossettes, with or without treatment with dodecyl benzene sulphonate (*cf.* preceding abstract), were dried in the open air or in an electric dryer and then stored in hemp bags in a closed concrete shed for five months. Sucrose contents were unchanged in the first month, decreased slightly during the next two months, and fell rapidly during the last two months. The loss was much smaller when surfactant with 2% ash content was used. Changes in reducing sugar content were the reverse. Nitrogen contents decreased slightly in the second and third months but increased considerably thereafter, except when organisms (much greater after open-air drying) increased rapidly in the last three months, and this was not affected by surfactants; the amount of heat-resistant micro-organisms was however kept down by surfactants. The temperature and humidity in the bags, and in the shed, increased considerably during storage. It is considered that the storage of dried cossettes makes them unsuitable for use in sugar manufacture.



The World Sugar Economy—Structure and Prices. Vol. I. National Sugar Economies and Policies. 311 pp; 8¼ × 10½ in. (The International Sugar Council, 28 Haymarket, London S.W.1.) 1963. Price 63s. 0d.

In his introduction to this work, Dr. H. J. SCHARMER, Chairman of the International Sugar Council, refers to it as "a comprehensive work of reference, assembling within its covers authoritative data about every sugar industry in the world, about the currents of trade, the organization of markets, the trends of consumption and the policies (in this sphere) of governments." It is divided into seven parts: Europe, North, Central and South America, Asia, Africa and Oceania, each being treated generally before dealing with the individual countries of the area, a total of 105 being covered.

Every effort has been made to obtain either information from the government of the country concerned or its confirmation of the data obtained from other sources; this has been collected and expressed in a standard manner, subdividing the information into sections on production (where applicable), consumption, external trade and sugar policies. Its authoritative and comprehensive detail make it a necessity for any student of sugar economics, whose thanks will be due to the compilers: Messrs. E. F. TACKE, A. S. STEPANOV, J. GORDON WALKER, L. ALI and H. HENNING.

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Proceedings of the 13th Session of the International Commission for Uniform Methods of Sugar Analysis (ICUMSA). vii + 125 pp.; 8½ × 11 in. 1963. Price: $4.00; 28s. 0d.; NF 19.00; post-free.

This volume, uniform with is predecessors, is the official record of the ICUMSA Session held in Hamburg during 26th–31st August 1962. Some 90 delegates and observers from 22 countries attended, and are shown in a group photograph which is in the initial section of the Proceedings together with other photographs of interest.

The plenary meeting and business meetings are reported as well as visits, social functions, an exhibition of photoelectric polarimeters, the second business meeting which closed the Session and the subsequent visit by most of the delegates to the Berlin Institut für Zuckerindustrie.

The bulk of the volume is, of course, devoted to the reports of the referees on the 29 subjects of the Commission, together with the ensuing discussions and voting on recommendations[1]. The work thus provides an authoritative source of reference to progress in chemical control in the sugar industry and thus must be an indispensible requirement for the bookshelves of both works control chemists and researchers alike.

It is available from the new Secretary of ICUMSA,

Monsieur R. SAUNIER,
Syndicat National des Fabricants de Sucre de France,
23 Avenue d'Iéna,
Paris 16e, France,

while orders from the Western Hemisphere should be addressed to

Dr. J. L. HICKSON,
Sugar Research Foundation Inc.,
52 Wall Street,
New York 5, N.Y., U.S.A.

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F. O. Licht's Internationales Zuckerwirtschaftliches Jahr- und Adressbuch 1962/63. (International Sugar Economic Yearbook and Directory 1962/63.) H. AHLFELD. 418 + 60 pp.; 8½ × 11½ in. (F.O. Licht K.G., Ratzeburg/Lbg., Germany.) 1963. Price: DM 38.-; £3.7s.6d.

The 1962/63 edition of this widely known publication has made its welcome appearance with the contents laid out in much the same matter as in the previous edition. We have the familiar sections on laws, agreements and contracts, German and other sugar organizations, sugar importers and exporters in Europe and elsewhere, details of German beet sugar factories and refineries, details of European and non-European beet sugar factories and refineries, details of cane sugar factories and refineries, three reports from the sugar machinery and sugar factory building industries and a large number of reports from individual manufacturers of machinery and complete sugar factories, maps of certain sugar countries (this time, of Japan and the West Indies), a Buyers' Guide, an English-German vocabulary and addresses of publishers of sugar periodicals (unfortunately, far from complete). An appended 60 page booklet contains world sugar statistics. Two new countries are included in the beet factory section—Algeria and Morocco. There are, however, a number of omissions, in particular the new Florida, U.S.A., factories, which have been widely publicized. The Preston (Idaho) beet sugar factory has closed down, but is still included in the new Licht. No details are given of the Thailand sugar industry. However, despite these omissions, the Yearbook is still a very useful guide to the world's sugar processing industry.

[1] *I.S.J.*, 1962, **64**, 323.

LABORATORY METHODS AND CHEMICAL REPORTS

Colour type series for quality evaluation of sugars: their preparation and present possibilities of defining the end point. W. STRUBE. *Zyckererzeugung*, 1963, **7**, 58–63.—The use of standard colour series for the evaluation of granular sugar quality is discussed and a procedure for preparation of colour type series is described. It is pointed out that up to now, no physical definition of colour type series has been given. The CIE coordinate system suggests wavelengths for red, green and blue, but no apparatus is available for measurement of samples at these wavelengths. The "Leukometer" is more promising but uses different wavelengths. In this instrument the light is split into two halves, each of which passes to two Ulbricht spheres, one a measuring, the other a reference, sphere; the latter has a shutter, displacement of which is read on the measuring drum. The diffuse reflection passes vertically out of the spheres to the incoming light via filters of the photocells. The instrument is adjusted with a milk glass standard of known reflectance for the different filters and for measurements in unfiltered light. A neutral wedge is placed between the measuring sphere and the photocells. The photo-voltage of the cells is applied to a single-filament electrometer and the voltage brought to null-point by bringing the shutter to the same light density in both spheres. The sensitivity of the instrument corresponds to approximately 0·03% reflectance. The effect of crystal shape on the results was demonstrated by the fact that the mean error in red light was greater than in green or blue. The unsuitability of optical instruments for colour type determination is discussed and it is doubted whether even such an instrument as the "Spaldinlab"[1] would create a photo-current that would give results within present-day permissible tolerances.

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Synthetic production of sugar. G. HENSEKE. *Zuckererzeugung*, 1963, **7**, 64–66, 78.—The chemistry of sugar is described (constitution, configuration and conformation) and the synthesis of sugar discussed. It is shown that while formaldehyde under the action of $Ca(OH)_2$, or $Ba(OH)_2$, forms a complex mixture of numerous sugars (a base-catalysed acylation-condensation reaction), the separation of this mixture into its individual sugars is very difficult. Using D- or L- forms of optically-active substances (e.g. glyceraldehyde) with fermentation will give synthetic sugar, but is completely uneconomical. A process for the synthesis of monosaccharides, but not disaccharides, has previously been described, and the question of sweetness is here discussed.

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Chromatographic study of phenolic derivatives from beet molasses. O. DELAUNOY. *Sucr. Belge*, 1963, **82**, 241–250.—Molasses was diluted with 4 volumes of water and the pH reduced from 7·5 to 2·5 by adding 5N HCl, then extracted with ether during 48 hr. The aqueous phase, containing a large portion of the nitrogenous fraction, the carbohydrates, salts and certain organic acids insoluble in ether, was then percolated through a 2·8 cm dia. column of "Amberlite IR 120" cation exchange resin at a rate of one drop per 5 sec. After the molasses had been percolated, the resin was washed with distilled water and eluted with 2 litres of 1·5 N ammonia. The percolated molasses filtrate and the washes were combined and the pH adjusted to 7·5 with 0·1N NaOH before adding to a column of "Amberlite IRA 400" anion exchanger, regenerated with acetic acid. After passing the molasses through, the resin was washed with water and eluted with 0·1N acetic acid and sodium acetate. This eluate was used to determine chromatographically the organic acids insoluble in ether and certain amino acids. The effluent from the anion exchanger and the wash waters were used for chromatographic determination of the sugars. The organic extract, containing fats, aliphatic acids and aromatic substances, notably aldehydes, phenols and phenolic acids, was cooled to below 15°C, dried by adding anhydrous sodium sulphate, and the Glauber salt formed was filtered through a Chardin paper and the solvent evaporated *in vacuo*. The extract was then made up to 100 g with ether and after mixing the organic solution was cooled with acetone/solid CO_2 to 80°C, allowing solidification of the fats and organic oils and precipitation of the orthorhombic sulphur. The fats and oils were separated by filtering. The residual solution was treated with saturated sodium bisulphite solution. This dissolves the aldehydes and ketones which are later decomposed by acidification with HCl, extracted with ether as a separate fraction, and determined chromatographically. The fraction containing the phenolic and stronger acids was made alkaline by adding 0·1N NaOH to pH 9·0. Seven consecutive extractions were then made at a different pH for each fraction. A fractionation diagram is given. The paper chromatographic determination (one- or two-dimension ascending technique) was made using 38 different solvents, details of which are given, and each substance was co-chromatographed with an authentic sample. Ten aldehydes were separated, but only three were identified. The R_f values in each solvent are given for the three identified (salicylaldehyde, *p*-hydroxybenzaldehyde and vanillin.) Seven phenolic acids were identified from 20 spots, and the R_f values in each solvent are again tabulated. Also given are the colours obtained with each of the eight indicators.

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Further observations on the use of lead sub-acetate during cane juice analysis at Shri Janki Sugar Mills Ltd., Doiwala. S. C. SEN and S. S. SIROHI. *Indian Sugar*, 1963, **13**, 645–651.—Daily analyses were made

[1] *I.S.J.*, 1958, **60**, 44–46.

of the molasses, bagasse, mixed juice and press-cake over two months with and without glacial acetic acid for neutralizing the basic lead acetate[1]. In all cases, use of the acetic acid gave a lower polarimeter reading than otherwise and so reduced the unknown losses figures. The analytical results are tabulated.

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Enzymatic determination of very small amounts of glucose in the presence of sucrose by means of a colorimetric method. H. SCHIWEK. *Zucker*, 1963, **16**, 170–176.—The method is based on the procedure used by HUGGET & NIXON[2] for determining blood glucose, but the phosphate buffer has been replaced by a solution containing tris-(hydroxymethyl)-aminomethane, 0·5 moles of which is dissolved in 750 ml of distilled water before adding 155 ml 2N HCl, plus sufficient, if necessary, to bring the pH to 7·8–8·0. The solution is then made up to 1 litre. To 100 ml of the buffer solution is added 25 mg glucoseoxidase, 4 mg peroxidase and 6·6 mg of *o*-dianisidine hydrochloride, and the mixture vigorously shaken. Refined or white sugar is added to four test tubes: 1 g per tube. To tube 1 is added 5·2 ml distilled water, and the extinction of the resultant solution is measured at 436 mμ. To tube 2 is added 0·2 ml distilled water and 5 ml of the buffer mixture, and the extinction of the resultant sugar mixture at 436 mμ measured after ½ hr. To tube 3 is added 0·2 ml of a glucose solution (50γ/ml) and 5 ml of the buffer and the same procedure carried out as in tube 2. To tube 4 is added 0·2 ml of another glucose solution (100 γ/ml) and 5 ml of the buffer mixture, and the same procedure carried out as in tube 3. The extinction of the buffer mixture is also measured at 436 mμ against water, and the glucose content is then given by the difference between the extinction of the mixture in tube 2 and the combined extinctions of that in tube 1 and that of the buffer solution alone. Raw, thin and thick juices as well as molasses solution should first be treated on a strongly basic anion exchange resin. The buffer solution inhibits the sucrose-splitting effect of the sucrose introduced with the glucoseoxidase.

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Determination of sucrose in the presence of invert sugar by direct polarization. B. TICHÁ and M. FRIML. *Listy Cukr.*, 1963, **79**, 57–63.—When borax is added to invert sugar solutions, it forms complexes with the glucose and fructose and reduces their specific rotation; adding 3 moles of borax to 1 mole of glucose completely nullifies the polarization, while adding borax to fructose in the molar ratio of 2:1 reduces the polarization to a minimum. To determine the sucrose in sugar solutions without interference from the reducing sugars, their polarization must be balanced one against the other. This has been shown, in the laboratory, to occur when the weight of borax added is equal to that of the combined reducing sugars (50% glucose, 50% fructose). However, if more than 0·5 g borax is added to 100 ml of a 0·25–1·0N sucrose solution, the polarization of the sucrose itself will be reduced. Clarifying agents mask a certain amount of the invert sugar, the effects of borax and clarifying agent being additive. Addition of 0·5 g borax to 100 ml of a 1·0N sucrose solution after clarification with basic lead acetate eliminates the effect of 2·3% invert sugar, or 4·6% in a 0·5N solution. Clarification with Herles' reagent further increases the amount of invert sugar eliminated, up to 6% in a 1·0N solution or up to 12% in a 0·5N solution. The procedures suggested for sucrose determination are: for solutions containing up to 2·3% invert, clarifying 200 ml of a 2N sucrose solution with basic lead acetate and 1 g of borax, then polarizing in a 200 mm tube. For solutions containing 2·3%–4·6% invert, 200 ml of 1·0N solutions are used and the pol reading doubled. For molasses containing up to 6% invert, 40 ml of Herles' reagent is added to 200 ml of a 4N solution, followed by 1 g borax. For molasses containing up to 6–12% invert, 200 ml of a 1:1 2N solution is used and the polarimeter reading doubled (Cf. *I.S.J.*, 1963, **65**, 46–48, 72–73, 107–109.)

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Colorimetric standards. III. Definition and properties of Stammer glasses. V. VALTER. *Listy Cukr.*, 1963, **79**, 63–74.—The CIE coordinate system was used to evaluate the colorimetric standards of Stammer glasses. The 0·5N glass at Modrany Sugar Industry Research Institute was compared with the Stammer glass as defined by the colour graph plotted by SPENGLER & LANDT[3]. Both glasses followed approximately the same colour curve, while all other colorimetric characteristics were identical. However, the total absorbance and thus the normality of the Modrany glass was only 0·75N compared with 1·0N of that of SPENGLER & LANDT. The hue of both standards was practically identical at the same total absorbance. Colour curves were drawn for normalities of 0·1–20 and colorimetric coordinates were calculated. The saturations of the glasses coincided. The total absorbance is not a linear function of normality, whereas saturation rises rapidly with normality. For each wavelength the Stammer glasses conform to Beer's law.

* * *

A rapid filtrability test filter for raw sugar. H. C. TSENG and W. CHEN. *Rpt. Taiwan Sugar Expt. Sta.*, 1963, (30), 119–127.—Details are given of the test filter, which has a small filter area and a more consistent septum structure permitting numerous laboratory tests to be carried out with smaller samples, needing less time and covering a wider range of determinations than with the conventional Elliot filter. The error percentage was 3·5% as opposed to 6% with the Elliot filter. Other advantages claimed for the filter are enumerated.

[1] *See I.S.J.*, 1963, **65**, 203–205.
[2] *Biochem. J.*, 1956, **66**, 12.
[3] *Zeitsch. Ver. Deutsch. Zuckerind.*, 1933, **83**, 223–234.

BY-PRODUCTS

Sugar cane as a source of animal foodstuff. D. H. PARISH. *Rev. Agric. Sucr.* (Mauritius), 1962, **41**, 308–311.—Sheep were used in trials to determine the nutritive value of rations composed of: (1) 48% oven-dried filter muds, 12% molasses and 40% cane tops; (2) 33% air-dried muds, 14% molasses and 48% cane tops; and (3) 77% cane tops and 23% molasses. The results are tabulated and show that about one-third of the crude protein in the air-dried muds was digested compared with one-seventh of that in the oven-dried muds. The digestible protein in ration (1) was less than in ration (3), although the actual protein content was almost double. Thus, the digestibility of the crude protein in both mud rations was lower than that of ration (3) and it is suggested that adding molasses would raise it.

* * *

Blackstrap and other cane molasses. S. L. CROCHET. *Sugar y Azúcar*, 1963, **58**, (3), 61–62, 78.—Standards and concise definitions are recommended for blackstrap molasses, cane feeding molasses, invert molasses and molasses blends. For the purposes of fodder manufacture and livestock feeding, the moisture and sugar content of molasses are considered unsuitable as standards, since both require accurate analysis.

* * *

Beet molasses as raw material for the production of glutamic acid. M. I. BARABANOV and E. A. GRIVTSEVA. *Sakhar. Prom.*, 1963, (3), 26–27.—It is felt that the data supplied by MELESHKO & EGOROVA[1] show too low a beet glutamic acid content for the region from which the samples were taken to be considered the best in which to establish a glutamic acid industry. The present authors supply evidence that glutamic acid yields from other areas are higher.

* * *

Cosmetic compounding: sugar esters. ANON. *Drug & Cosmetic Ind.*, 1962, **90**, 747–748; through *S.I.A.*, 1963, **25**, Abs. 142.—Sucrose monolaurate is recommended as a non-irritant detergent or solubilizing agent in shampoos, toothpastes, cleansing creams and brushless shaving creams, and to produce clear aqueous solutions of perfumes. Sucrose monooleate may be added to increase the viscosity.

* * *

German firm develops new "syndets" (synthetic detergents): sugar esters of hydroxy fatty acids, claimed to be 100% biodegradable. ANON. *Chem. Eng. News*, 1963, **41**, 55–56; through *S.I.A.*, 1963, **25**, Abs. 143.—Sugar esters of ricinoleic acid have been prepared by making the methyl or ethyl esters of castor oil fatty acids and then causing these to react with sucrose. A mixture of about 75% monoester and 25% di-ester is obtained, and can be used as a detergent without purification. Mono-, di-, and tri-hydroxystearic acid esters of sucrose have also been prepared; the optimum washing properties seem to be obtained intermediately between the mono- and di-hydroxystearic acid esters. All these esters lower surface tension by at least 50% (better than tetrapropylene benzene sulphonate [T.P.B.S.]); the wetting power of the mon- and di-hydroxystearic esters is equal to that of T.P.B.S.; the wetting power of the other esters is somewhat lower. The washing ability was greatest with the di-hydroxystearic acid ester. The ricinoleic acid ester is of course the cheapest and easiest to produce. These hydroxy-esters are non-toxic, low in foaming power, of high detergent power, and are claimed to be 100% biodegradable, which is important in view of the forthcoming legal requirement in Western Germany that detergents shall be $\leq$80% degradable (T.P.B.S. is only 25% degradable). The new esters have been developed by A. J. Zimmer Verfahrenstechnik, at Frankfurt.

* * *

A new method for economie utilization of bagasse. J. R. SHATTUCK. *Proc. Amer. Soc. Sugar Cane Tech.*, 1962, **9**, 98–109.—Information is given on the processes used at the National Bagasse Products Corporation bagasse board plant at Vacherie, La., U.S.A., in the production of "Fibron" board. The properties of the board are also discussed.

* * *

The preparation of sucrose monoesters. R. U. LEMIEUX and A. G. MCINNES. *Canad. J. Chem.*, 1962, **40**, 2376–2401; through *S.I.A.*, 1963, **25**, Abs. 289, 290.

A detailed account is given of the kinetic study[2] of the preparation of sucrose monomyristate from sucrose and methyl myristate by the Snell process. The K_2CO_3 was shown to act by homogeneous catalysis, and similar results were obtained with other alkalis, notably sodium methoxide. A preparation schedule giving a molar yield of 84% of sucrose myristate (including some diester) on methyl myristate is described, in which three moles of sucrose are used per mole of methyl myristate.

The monoester was shown to consist preponderantly of 6′-myristoyl sucrose [fructose-substituted], with about half the amount of 6-myristoyl sucrose and smaller amounts of other isomeric esters. Evidence for this was obtained from the gas-liquid partition chromatography, nuclear magnetic resonance spectroscopy and paper chromatography of the derivative hepta-*O*-methyl sucrose monomyristate and its degradation products.

* * *

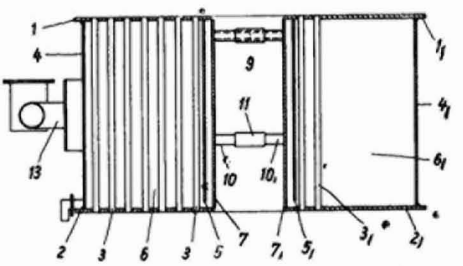
The feeding value of molasses. T. G. CLEASBY. *S. African Sugar J.*, 1963, **47**, (4), 260–267.—Molasses is the most valuable by-product of the sugar industry. It is much used in animal feeding and the manufacture of proprietory animal feeding stuffs including poultry and other pellets, where physical properties reduces the dustiness of the feed. A detailed account is given of composition of molasses and the various methods in which it may be employed in feeding cattle and other farm animals.

[1] *I.S.J.*, 1963, **65**, 154.

[2] MCINNES & LEMIEUX: *Chem. in Canada*, 1961, **13**, (5), 43–44.

UNITED KINGDOM

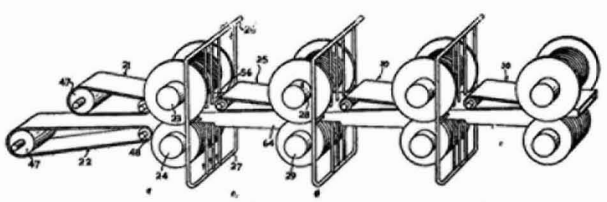
Bulk evaporator for concentrating sugar solutions. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT A.G., of Braunschweig, Germany. **925,306.** 8th August 1961; 8th May 1963.—The evaporator is provided with a split calandria each section 6, 6_1 of which has a top and bottom tube plate 1, 2, 1_1, 2_1, connected by tubes 3, 3_1, inner walls 7, 7_1, and outer walls 4, 4_1 which project beyond the ends of the inner walls and are welded together to form a cylindrical body. Both



calandria sections are connected to a steam chest 13 and are also inter-connected by stiffening pipes 10, 10_1 which are fastened together by sleeves 11. Inside the calandria sections are partitions 5, 5_1 welded to the upper tube plates which, with the bottom tube plates, form gaps for the passage of condensate from the interior of the sections. The gap 9 between the inner walls 7, 7_1 serves as the central downtake for recirculation of the evaporating juice.

* * *

Sugar cane crushing mills. W. M. LIVIE, of Seaforth, N.S.W., Australia. **925,606.** 20th October 1961; 8th May 1963.—The milling tandem may be either of two-roller units as illustrated or of three-roller units. Prepared cane is delivered to the first unit by two continuous band conveyors 21, 22 the lower surface of the upper conveyor and the upper surface of the lower conveyor, together with fixed vertical side plates, forming a closed feed chute. Maceration may be supplied through pipe 26 to the bagasse



discharged from the first mill and this is directed into a second feed chute towards the second mill, and similarly through the tandem. The second chute may consist of a pair of band conveyors between side plates, as in the first chute, or it may include an upper conveyor 25 and a fixed plate 64 the edge of which serves as a scraper plate for the bagasse roll of a three roll unit or the lower roll of a two-roll unit. The bands and plate 64 are provided with transverse strips or slats which grip the cane so that differential speeds of the conveyors cause the cane or bagasse to turn over during its passage through the chute.

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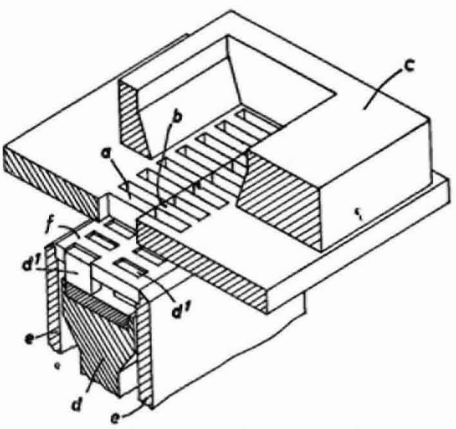
Press for the production of rectangular-section pieces formed of granular material (cube sugar). A. KUSTER, of Basle, Switzerland. **926,725.** 12th March 1962; 22nd May 1963. The matrix of the cube press consists



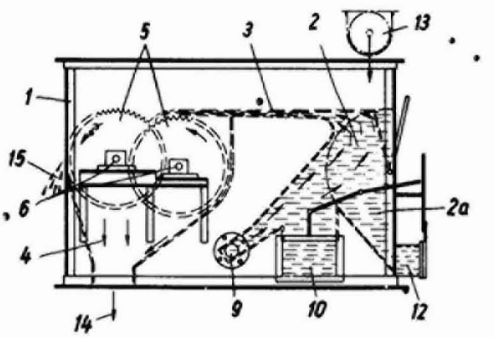
of a plate in two halves *a* and *b*, the teeth of the former exactly fitting into the corresponding grooves of the latter to provide rectangular holes. Above these is a charging hopper *c* with one side sufficiently long that when moved appropriately the rectangular holes in the matrix are completely covered. A movable punch *d* is located beneath the matrix, with lifting members *d'* directed into the rectangular holes by means of a guide plate *f* supported on side pieces *e*. In operation, granulated sugar falls into the rectangular holes the bases of which are formed by members *d'*, the hopper *c* moves so as to cover the holes, taking excess sugar

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

with it. The lifting members *d'* then rise slightly to give slight compaction of the upper and lower faces of the sugar, after which the members *d'* are lowered and the matrix halves *a* and *b* moved slightly towards each other, to give slight compaction of the horizontal faces. The matrix halves then return to their former position, the hopper moves over further and the lifting members *d'* rise to their full extent when their upper surface corresponds to the top surface of the matrix. The sugar tablets are lifted out and are then pushed aside by the hopper as it returns to its original position. The lifting members *d'* return to their lower position and more sugar enters the matrix for a new cycle.

* * *

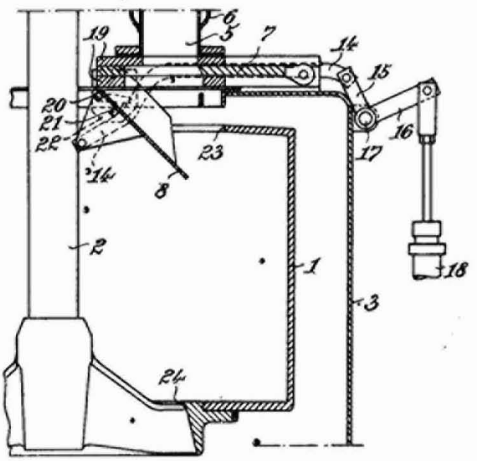
Apparatus for cleaning root crops (beet tails). ELFA APPARATE-VERTRIEBS-G.M.B.H., of Muelheim/Ruhr, Germany. **928,370.** 14th December 1961; 12th June 1963.—Beet tails are recovered from beet wash water by passing it along conveyor 13 and discharging into tank 1. Heavy material such as stones falls straight away to the bottom 2a and is discharged into trough 12. Sand is held partly in suspension by a rising current of water supplied through feed pipe 9 but settles in the sediment trap 10. Light materials including the beet tails, straw, grass, etc. are carried by the water to overflow 3 where



they meet the toothed or spiked discs 5 which are driven at different speeds and intermesh. The straw and grass are caught by the teeth or spikes and carried down with the discs, being washed off by the flow of water discharging from the overflow. Beet tails are too big for the teeth and are therefore carried over the top of the discs and are discharged separately at 15.

* * *

Charging of centrifugals. GUTEHOFFNUNGSHÜTTE STERKRADE A.G., of Oberhausen, Rhineland, Germany. **928,809.** 25th November 1959; 19th June 1963.—Access of massecuite from its hopper into the basket 1 of the centrifugal is by way of a gate valve 7 and a distributor plate 8, movement of which is controlled by linkages which may be connected to pneumatic cylinders, as at 18, for automatic control if required. The gate valve 7 operates in a horizontal direction across feed pipe 5 (having a heating jacket 6) and falls onto distributor chute 8 which is inclined downwards away from the axis of the basket. The chute is shown in its open position;



its movement is governed by the pins 20, 21 which move in appropriately slotted side plates 22. When the lever linkage 14–16 operates to close the chute, the latter pivots about pin 20 until it attains a small angle to the horizontal (when the edge of the chute is above the upper rim of the basket) and then moves along this line, sealing off the pipe and also extending over the top of the basket so that any drips will fall onto the outside of the latter instead of contaminating the sugar inside. After discharge of the sugar from the basket the chute moves in the reverse direction, i.e. first towards the centrifugal axis and then pivoting downwards, when the gate valve can operate to allow more massecuite to enter the basket.

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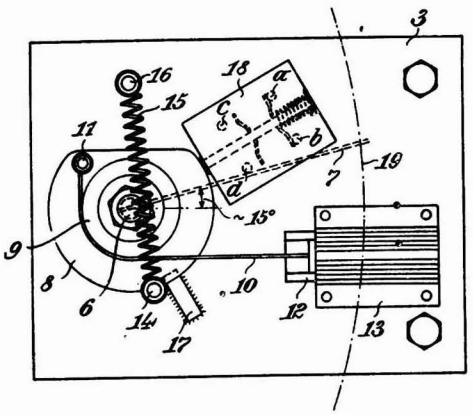
Control devices for centrifugals. GUTEHOFFNUNGSHÜTTE STERKRADE A.G., of Oberhausen, Rhineland, Germany. **928,810.** 25th November 1959; 19th June 1963.—A horizontal plate 3 mounted on the centrifugal casing has a cylinder fastened beneath it which carries a vertical shaft 6 at the lower end of which is a feeler arm 7 which projects inside the centrifugal basket. Above plate 3 the shaft 6 carries a cam 8 with a hub 9 and a point 11 from which a cable 10 passes round hub 9 and is connected to the armature 12 of an electromagnet 13 also mounted on plate 3. Also mounted on cam 8 is the end 14 of a spring 15, the other end of which is secured to plate 3 at point 16. A spring loaded cam follower shaft in switchbox 18 is governed by the position of cam 8. Before the centrifugal is charged the electromagnet 13 is energized; this rotates cam 8 until the spring securing point 14 is held by stop 17. The cam

follower is moved against its spring until contacts *a* and *b* are connected, when the loading mechanism is brought into operation. The wall of massecuite builds up inside the basket and eventually the feeler



arm 7 is caught by the clockwise movement of massecuite and carried round, penetrating the wall and then withdrawing until it rests on the surface. The cam turns at the same time, whereupon the cam follower shaft moves and makes a connexion between contacts *c* and *d*; this sets the rest of the centrifugalling cycle into operation, after which energizing the electromagnet resets the control for another cycle. The overcentre location of the spring 15 holds the cam in both its terminal positions.

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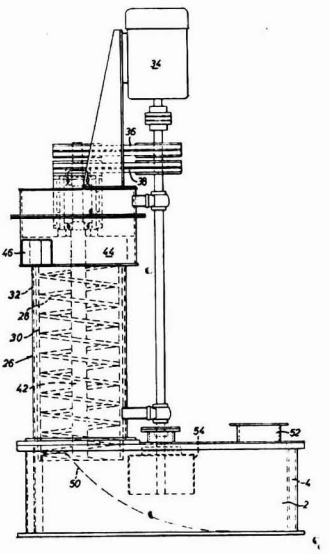
Preventing or reducing foam formation. FARBENFABRIKEN BAYER A.G., of Leverkusen, Germany. **928,906.** 24th November 1961; 19th June 1963.—Polyglycol ethers of oligosaccharides (sucrose) having anti-foaming properties are prepared by heating together in an autoclave 8–200 parts (80 parts) of an alkylene oxide (propylene oxide), 1 part of sucrose and 1% on sucrose of KOH, at e.g. 130°C. The ethers will prevent foaming of, e.g., alkali lye used for cleaning milk bottles, when used in a concentration of 0·01% with or without other anti-foaming agents.

* * *

Vertical separator for the removal of solids from solid-containing liquids. ROSE, DOWNS & THOMPSON LTD., of Hull, Yorkshire. **932,355.** 27th December 1961; 24th July 1963.—The solid and extraction liquid are thoroughly mixed in tank 2 and thrown outwards by the rotating drum 54 against the wall of tank 2 so that they are caught by the high-speed vertical screw conveyor 26. Under the centrifugal force exerted, the solid forms an annulus near the edge of the worm blades 28 while the liquid is forced into the central hollow core of the screw conveyor, dropping back into tank 2. The worm is held by pegs away from its shaft 42, while its surrounding sleeve 30 also rotates at high speed but slightly slower than the worm so that the annulus of solid is conveyed and is eventually discharged through opening 46. The separator is applicable to the increased recovery of sugar from pulp or for the separation of solid sugar from a mother liquor.



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UNITED STATES

Purification and decolorization of pretreated technical sugar solution. E. MOEBES, of Leopoldsdorf, Austria, *assr.* SUGAR CHEMICAL CO. ETBT. **3,090,707.** 15th September 1959; 21st May 1963.—Pretreated sugar juice is treated by passing (at 70–95°C) through an anion exchanger charged with carbonate or sulphate and a cation exchanger charged with ammonium (in a mixed bed) and the effluent treated with CaO (and CO_2), boiling to a pH of 7·5–8 and separating the $CaCO_3$ or $CaSO_4$. The NH_3 in the vapour produced during boiling may be collected and contacted with CO_2 to produce $(NH_4)_2CO_3$, which can be used to regenerate the ion exchangers; alternatively, this may be done with solutions of $(NH_4)_2SO_4$ and NH_4Cl or NH_4NO_3.

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Cane conveyor assembly for harvesters. J. M. PUGH and J. H. EDLEY, *assrs.* J. & L. ENGINEERING CO. INC., of Jeanerette, La., U.S.A. **3,095,679.** 30th October 1959; 2nd July 1963.

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.

The D.d.S. diffuser for cane. A/S De danske Sukkerfabrikker, Langebrogade 5, Copenhagen K, Denmark.

The D.d.S. diffuser is well-known in the beet sugar industry for extraction of sugar from cossettes. Since January of this year a unit has been in operation at the Arusha Chini estate of The Tanganyika Planting Co. Ltd. It has a capacity of 1500 tons of cane per day and is described in a new booklet.

The diffuser unit is similar to the beet equipment, with double scrolls in a sloping trough, but the scrolls are of perforated plate, rotating at 0·5–1·5 r.p.m., and bagasse is removed by a rake conveyor. The low pH of cane juice requires that the parts of the diffuser which come into contact with it are made of stainless steel or stainless-clad steel. The scrolls are continuous, without internal bearings, because of the tendency of the bagasse to form hard compressed blocks.

Cane is passed through two sets of cane knives and a three-roller crusher or crusher plus three-roller mill. This removes 60% of primary juice on cane, the bagasse being passed to the diffuser against a continuous counterflow of water. Heating to 65–70°C in the middle of the trough is provided by steam jackets. The wet bagasse from the diffuser (105% on cane) is passed through two conventional mills which reduce the water content to 47%, press water being returned, untreated, to the diffuser a short distance from the bagasse discharge end. A control panel is provided for juice draw-off, etc.

Over the first four months of operation, sugar in bagasse has averaged 1·51%, while mixed juice (primary plus diffusion juice) has totalled 97·6% on cane, the corresponding figures for the last four weeks being 1·38% and 97·0%. Cane during the period averaged 12·5—13% sucrose and 13·5–14% fibre. Average moisture in final bagasse was 46·8%—somewhat lower than with normal milling. Use of steam for heating the diffuser is compensated by the higher temperature of the mixed juice which requires less heating. Retention time in the trough is about 20 minutes for juice and 30 minutes for cane. Power consumption is about 40 h.p. while no bacteriological problems have arisen.

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Khuzestan sugar mill and refinery. V.M.F. Stork-Werkspoor N.V., Hengelo, Holland.

Issue No. 19 of the *V.M.F. Review*, dated January 1963, gives a detailed and illustrated account of the Khuzestan mill and refinery in Iran, supplied as a turn-key installation and completed in October 1961. Stork-Werkspoor supplied not only the factory but also pumping stations for irrigation of the cane plantations, foundations, canals and other civil engineering works.

The mill is of 3000 tons of cane per day capacity (with provision for extension to 6000 tons), cane passing through a cane cutter, Gruendler crusher and five 40×78 inch three-roller units, all individually steam turbine-driven. Each mill is provided with force-feed rollers, and external adjustment of the turn-plate. Juice is prelimed cold, heated, limed and settled. A quadruple-effect evaporator is provided with full automatic controls for juice supply, syrup Brix, etc., and a three-boiling system is used in the calandria-type pans, double-purged *C*-sugar serving as seed for the *A*- and *B*-strikes.

Fully automatic centrifugals are used, and the *A*- and *B*-sugar is melted continuously for refining. In the off-season, imported raw sugar is also melted and refined, the melt being limed and carbonatated automatically, filtered, and decolorized by a two-stage process using active carbon and kieselguhr. The liquor is filtered on Berkefeld candle filters and boiled to refined sugar.

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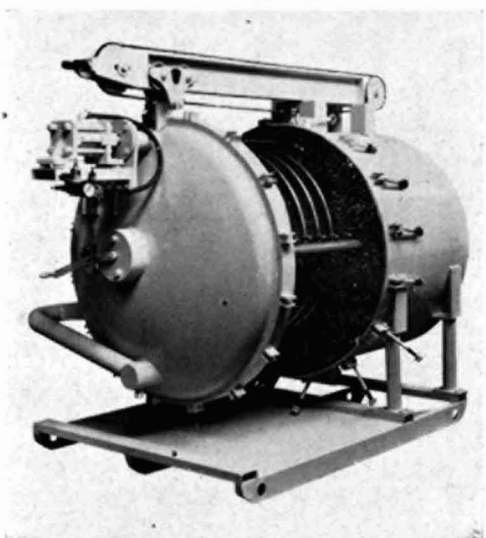
Industrial filters by Paterson. The Paterson Engineering Co. Ltd., 129 Kingsway, London W.C.2.

General European and South African rights for the manufacture and sale of the filters of Industrial Filter & Pump Manufacturing Co., of Chicago, Ill., have been acquired by The Paterson Engineering Co. Ltd. These filters find application in treatment of



water, condensates, syrups and other sugar solutions, and the range includes both horizontal and vertical types in a number of sizes. The horizontal pressure

filter Type 122 illustrated, for instance, is available from 12 to 2000 sq.ft. filter surface and uses vertical leaves covered with metal or textile cloth connected to a common outlet manifold and cleaned by a "Sluiceamatic" device. The filters are adaptable to semi- or fully-automatic operation and a variety of cleaning methods can be used.

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The "Mercobowl" centrifuge. Dorr-Oliver Inc., Stamford, Conn., U.S.A.

A new solid-bowl centrifuge, the "Mercobowl", applicable to the clarification of sugar beet wash water, includes in its features pressure discharge of overflow, high capacity, simple installation, low maintenance and precise cake moisture control. It is a continuous unit with a rotating horizontal conical bowl with an inner hollow-shaft conveyor scroll rotating at a slightly higher speed. Solids are collected by centrifugal force against the walls of the bowl and conveyed by the scroll to discharge ports at the small diameter end while clear overflow is discharged under pressure at the large diameter end. Initially two sizes are available with overflow capacities of 13 and 66 g.p.m.

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PUBLICATIONS RECEIVED

FLEXIBLE RUBBER BLOCK COUPLINGS. Holset Engineering Co. Ltd., Turnbridge, Huddersfield, Yorkshire.

The new RB range of couplings comprises ten sizes ranging from 0·03 to 4 h.p./r.p.m. and are thus small and of low cost. They can absorb high angular, radial and axial misalignment and provide good torsional flexibility, applications including reversing drives with torques in excess of 400 metre tons.

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THE "SPECTROCHEM" SPECTROPHOTOMETER. Hilger & Watts Ltd., 98 St. Pancras Way, Camden Rd., London N.W.1.

This newly designed instrument, described in leaflet CH 417/4, may be used for determining the concentration of solutions or plotting detailed absorption spectra in the range 340 to 750 mμ, and is designed to take 5 cells, 3 wide cells or a flow-through cell, the cell carriage being positioned precisely by means of a click-stop knob. Operational band widths of less than 3 mμ are provided throughout the range by the high quality grating, while absorbance measurement is indicated on an extensive logarithmic scale, using 4 switched ranges for 0–2.

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"LEWA" METERING PUMPS. Herbert Ott K.G., 725 Leonberg n. Stuttgart, Germany; A. J. G. Waters Ltd., 9a Clareville St., London S.W.7.

A new leaflet describes and illustrates the range of 20 types of "Lewa" metering pumps and metering control circuits ranging from the small types for use in laboratories and pilot plants to large multiple metering units.

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"WESTFALIA" AUTOMATIC DE-SLUDGERS. Centrico Inc., Englewood, N.J., U.S.A.

A new illustrated and detailed booklet describes the "Westfalia" range of automatic de-sludgers or solid-bowl centrifuges with self-cleaning bowls, together with their applications in clarification of fruit and vegetable juices, yeast plants, breweries, etc.

COCHRANE CHEMICAL PROCESS CAPABILITY. Crane Co., 17th St. & Alleghany Ave., Philadelphia 32, Pa., U.S.A.

The Cochrane Division of Crane Co., in a new Bulletin, features its long experience in fluid conditioning techniques, and describes its thickening technique—sedimentation, flotation and filtration—for liquid-solids separation, as well as the use of adsorption techniques including ion exchange resin treatment of sugar solutions.

* * *

LEWIS OF REDDITCH. The Lewis Spring Co. Ltd., Resilient Works, Studley Rd., Redditch, Worcs.

This booklet serves not only as a catalogue of the products of the Lewis Spring Co. Ltd., who were founded in 1919, but also provides a great deal of information on the applications, design, selection and properties of springs and spring materials, with conversion tables, gauge comparisons, etc.

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MUD PRESS WITH HYDROMECHANICAL REMOVAL OF MUD. SZAREJKO SYSTEM. CEKOP, P.O. Box 112, Warsaw, Poland.

The Szarejko filter[1] is available in two types, a single plate filter of 115 sq.m. (1238 sq.ft.) surface and the other a double plate unit of 225 sq.m. (2422 sq.ft.) surface. Both are suitable for separation of 1st or 2nd carbonatation muds, the juices being pumped at 85–90°C (185–203°F) into the cylindrical tank which holds the vertical leaves covered with "Steelon" cloths. The filtrate passes into the outlet tubes, which are provided with sight glasses, and at the end of the cycle, after the juice has been emptied the mud is sweetened-off with recirculation water and then pure ammoniacal water. The mud is then rinsed off by internal jets and spray nozzles and sent to settling tanks. The single plate type will handle 7 litres/min/sq.m. (0·143 gal/sq.ft./min) of first carbonatation juice over a 3½–5 hour cycle in which filtering time is 3–4 hours. With second carbonatation juice the filter will handle 11 litres/min/sq.m. (0·225 gal/sq.ft./min) over a 49–97 hour cycle in which filtering time is 48–96 hours.

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MEASURING ADSORPTIVE CAPACITY OF ACTIVATED CARBONS. Atlas Chemical Industries Ltd., Wilmington, Del., U.S.A.

This new 28-page booklet (D-87) makes it possible to compare either powdered or granular carbons for their adsorptive capacity for impurities found in the user's process, rather than with arbitrarily-chosen liquids, using the copyright "Darcograph" method of plotting adsorption isotherms. This method enables the user to obtain direct readings of carbon dosage to reach any purity level; to determine if two-stage or counter-current could be adopted when one-stage treatment is uneconomical, etc.

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ROTAMETER SERIES 825. The Rotameter Manufacturing Co. Ltd., 330 Purley Way, Croydon, surrey.

A new leaflet, No. 2640, gives full details of the inexpensive Series 825 range of lightweight instruments. They are intended primarily for use with non-corrosive liquids and gases but alternative models are available in corrosion-resistant contact materials. They can be fitted for in-line or panel mounting and certain models can be fitted with low-flow alarms.

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Associated Chemical Cos. Ltd.—The Head Office of Associated Chemical Cos. Ltd., formerly in Leeds, has been transferred to Beckwith Knowle, Otley Road, Harrogate, Yorkshire, while correspondence should be addressed to P.O. Box No. 28, Harrogate.

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

WORLD SUGAR STOCKS

Comparative stocks at 31st August are estimated by F. O. Licht K.G.[1] as follows:—

	1963	1961	Difference	%
	(metric tons, raw value)			
WESTERN EUROPE				
West Germany (*a*)	120,000	565,725	—445,725	—78·79
France (*a*)	339,000	893,082	—554,082	—62·04
Netherlands	105,555	186,889	— 81,334	—43·52
Sweden	160,000	194,076	— 34,076	—17·56
Italy (*b*)	110,000	556,428	—446,428	—80·23
Spain	45,367	201,477	—156,110	—77·48
Switzerland	138,889	121,084	+ 17,805	+ 14·70
United Kingdom	547,000	701,039	—154,039	—21·97
Other countries	364,411	790,144	—425,733	—53·88
Total	1,930,222	4,209,944	—2,279,722	—54·15
EASTERN EUROPE				
East Germany (*a*)	100,000	213,000	—113,000	—53·05
Poland	120,000	302,000	—182,000	—60·26
U.S.S.R.	720,000	1,335,000	—615,000	—46·07
Other countries	248,333	324,805	— 76,472	—23·54
Total	1,188,333	2,174,805	—986,472	—45·36
NORTH AND CENTRAL AMERICA				
U.S.A. (*c*)	1,130,000	1,172,135	— 42,135	— 3·60
Canada	170,000	172,589	— 2,589	— 1·50
Cuba	650,000	3,130,000	—2,480,000	—79·23
Mexico (*d*)	100,000	163,679	— 63,679	—38·90
Puerto Rico	122,000	166,000	— 44,000	—26·51
Dominican Republic	146,000	167,660	— 21,660	—12·92
Other Countries	143,000	99,740	+ 43,260	+ 43·37
Total	2,461,000	5,071,803	—2,610,803	—51·48

SOUTH AMERICA	1963	1961	Difference	%
Argentina (*e*) ..	60,000	362,817	—302,817	—83·46
Brazil (*a*)	200,000	619,326	—419,326	—67·71
Other countries	325,400	332,954	— 7,554	— 2·27
Total	585,400	1,315,097	—729,697	—55·49
AFRICA				
South Africa (*f*)	200,000	242,541	— 42,541	—17·54
Egypt (*f*,*g*)	119,000	107,491	+ 11,509	+ 10·71
Other countries	438,432	302,149	+ 136,283	+ 45·10
Total	757,432	652,181	+ 105,251	+ 16·14
ASIA				
India (*g*)	400,000	1,336,884	—936,884	—70·08
Indonesia (*f*) ..	400,000	380,612	+ 19,388	+ 5·09
Japan (*f*)	376,000	328,150	+ 47,850	+ 14·58
China (*d*)	200,000	540,000	—340,000	—62·96
Taiwan	150,000	166,749	— 16,749	—10·04
Other countries	647,000	617,398	+ 29,602	+ 4·79
Total	2,173,000	3,369,793	—1,196,793	—35·52
OCEANIA				
Australia (*f*)	310,000	363,245	— 53,245	—14·66
Other countries	40,000	79,200	— 39,200	—49·50
Total	350,000	442,445	— 92,445	—20·89
GRAND TOTAL ..	9,445,387	17,236,068	—7,790,681	—45·20

(*a*) 30th September
(*b*) 30th June
(*c*) Including Hawaii
(*d*) 31st December
(*e*) 31st May
(*f*) tel quel
(*g*) 31st October

BREVITIES

Cane agricultural research in Ghana[2].—The University of Ghana is to undertake preparatory work concerning the erection of a cane sugar factory at Akuse in Eastern Ghana. Through its Agricultural Irrigation Research Station at Kpong, the University is to prepare about 50 acres of land for planting of selected varieties. A total area of 8000 acres is due to be cleared by 1967.

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Bagasse fire in Hawaii[3].—Oahu Sugar Co., near Honolulu, suffered extensive damage in their bagasse store in late June when a fire started, apparently by spontaneous combustion. The mill was not shut down as a result of the fire.

* * *

Cane developments in Southern Rhodesia[4].—The Southern Rhodesian Government has begun work on an agricultural scheme in the low veld south-east of Fort Victoria, based on a new dam on the Chiredze river. The dam, headwater and other parts of the scheme are designed to enable the irrigation of between 10,000 and 15,000 acres of land, where the main crop likely to be produced is sugar. The dam should be completed in time for the 1964 growing season. Work has commenced on developing a further 6000 acres of land on Triangle Sugar Estates for planting to cane under spray irrigation, bringing the total area under cane to 21,000 acres. At the same time Triangle's old mill is to be moved to the new mill and both fitted with electric drives, so increasing the combined crushing rate to 200 tons of cane per hour. Additional plant is being installed to provide supplementary power to operate the mills and the irrigation pumps in the new area. A research station of approximately 250 acres is also to be developed for experimenting on other crops. It is estimated that the cost of the whole scheme will be not far short of £2,000,000.

Loss of output in British Guiana[5].—Bookers British Guiana Sugar Estates face a substantial drop in production as a result of the recent general strike, a spokesman for the Company stated in Georgetown. Even with the best possible conditions over the next few months the shortfall would still be at least 20,000 tons. The Company's original production target for 1963 was 264,000 tons but the spring crop was cut by 36,000 tons. To recoup the losses caused by the strike the Autumn crop would have to be 200,000 tons. However, the estimated maximum yield now in the fields is only 180,000 tons and this is dependent on three important factors. First, the weather must hold good until December; second there must be continuous factory performance and third, there must be wholehearted support from all employees.

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Sugar beet possibilities for Libya[6].—Libyan representatives have recently visited the sugar beet industry in Tunisia with a view to making recommendations for such an industry in Libya.

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Trinidad sugar production, 1963[7].—All factories have now completed their 1963 grinding operations. Total production amounted to 227,346 tons of sugar, which exceeds the 1962 output by 26,604 tons but is 18,335 tons less than the total production of 1961.

[1] *International Sugar Rpt.*, 1963, **95**, (Supp. 16), 211–215.
[2] *Sugar y Azúcar*, 1963, **58**, (8), 26.
[3] *Sugar y Azúcar*, 1963, **58**, (8), 32.
[4] *Overseas Review* (Barclays D.C.O.), September 1963, pp. 27–28.
[5] *Public Ledger*, 27th July 1963.
[6] *Overseas Review* (Barclays D.C.O.), September 1963, p. 47.
[7] *Overseas Review* (Barclays D.C.O.), September 1963, p. 63.

BREVITIES

Ethiopia sugar production[1].—Production of Wonji mill during the 1961/62 season totalled 37,400 tons, according to Verenigde H.V.A.-Mijen., of Amsterdam. This compares with 37,588 tons in the previous season. Shoa factory, the second in Ethiopia, was opened in November. It has a capacity of about 25,000 tons of sugar per season which, although it is not likely that this will be reached in its first season, can be increased to 40,000 tons with moderate capital expenditure. The total output of the two mills in 1962/63 is estimated at 56,000 tons of sugar which should amply cover the further increase in consumption expected.

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Record Jamaica sugar crop[2].—The final output for the 1963 sugar crop in Jamaica was 477,765·5 tons. This is the highest figure ever achieved in the history of the island's sugar industry and was approximately 40,000 tons greater than the previous record output of about 438,000 tons achieved in 1962. With the expansion in cultivation which has taken place in some areas this year, as well as the increasing efficiency of the farm operations throughout the industry, the output next year, subject to any unforeseen eventualities, is expected to reach at least 500,000 tons. Recent statistics published show that there are 18 sugar estates in Jamaica and 20,000 cane farmers, and that 80,000 persons or 30% of Jamaica's labour force are employed in the sugar industry. Sugar provides 25–30% of Jamaica's total exports and sugar, rum and molasses combined realise an annual revenue of £20,500,000.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 17th September* 1963)	
Anglo-Ceylon (5s)	16/7½
Antigua Sugar Factory (£1)	9/–
Booker Bros. (10s)	21/–
British Sugar Corp. Ltd. (£1)	35/3
Caroni Ord. (2s)	4/6
Caroni 6% Cum. Pref. (£1)	15/3
Demerara Co. (Holdings) Ltd.	7/3
Distillers Co. Ltd. (10s units)*	38/–
Gledhow Chaka's Kraal (R1)	20/6
Hulett & Sons (R1)	49/6
Jamaica Sugar Estates Ltd. (5s units)	4/6
Leach's Argentine (10s units)	17/6
Manbré & Garton Ltd. (10s)	48/6
Reynolds Bros. (R1)	21/–
St. Kitts (London) Ltd. (£1)	15/–
Sena Sugar Estates Ltd. (10s)	8/3
Tate & Lyle Ltd. (£1)	52/–
Trinidad Sugar (5s stock units)	2/10½
United Molasses (10s stock units)	37/6
West Indies Sugar Co. Ltd. (£1)	18/7½

CLOSING MIDDLE

New York Stocks (*at 16th September* 1963)	$
American Crystal ($10)	72
Amer. Sugar Ref. Co. ($12.50)	25⅝
Central Aguirre ($5)	31
North American Ind. ($10)	20
Great Western Sugar Co.	46⅞
South P.R. Sugar Co.	36¾
United Fruit Co.	24⅝

* Ex-dividend and 2 for 5 capitalization.

New sugar factories for India[3].—The Technical Advisor on co-operative sugar factories to the Andhra Pradesh Government disclosed in June that it was proposed to erect three co-operative sugar factories in Andhra Pradesh, one at Zaheerabad in Medak district, one at Korukunda in Vishakhapatnam district and the third at Mandasa in Srikakulam district.

* * *

New sugar factories for Pakistan[4].—The Chairman of the East Pakistan Industrial Corporation announced recently that two new sugar mills in East Pakistan would start production in 1964, one at Rajshahi and the other at Kushtia, each having a capacity of 10,000 tons of sugar per year. The West Pakistan Industrial Development Corporation has also announced the contemplated erection of two sugar mills at Badin and Bannu; when both mills are in production there will be an annual increase of 36,000 tons of sugar.

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Refinery plans for Malaya[5].—Three new sugar refineries with a capacity (totalling about 260,000 tons) to supply Malaysia's entire needs are to be built in Central and North Malaya. The refineries will initially import all their raw sugar as there is no large-scale cultivation of sugar cane or beet in Malaya.

* * *

New beet area experiments in the U.S.[6].—The Great Western Sugar Co. of Colorado, has started experimental sugar beet cultivation in pilot plots located in Tennessee, Missouri and Arkansas. A flourishing sugar beet industry could well develop in these areas since acreage allotments can be assigned to new sugar growing areas under the 1962 Sugar Act.

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Sugar expansion in Kenya[7].—The Kenya Government has announced its intention to invest upwards of £6 million in developing the sugar industry in the Muhuroni district of Nyanza Region and there are proposals for building two addftional sugar factories in this area.

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Tanganyika sugar production[8].—The Tanganyika Planting Co. Ltd. closed down for their annual overhaul before restarting at the end of July. The 1962/63 season produced a record crop of 27,252 tons of white sugar.

* * *

Sugar factory for Ghana[9].—An agreement has been signed between the Ghana Government and CEKOP of Poland for the construction of another sugar factory. This will be assembled and installed at Asutsare in the Volta Region and CEKOP have offered credit up to more than £G1½ million for the civil engineering works connected with the project.

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Sugar production in Spain[10].—Sugar production from beet and cane during the year July 1962/June 1963 in Spain amounted to 399,882 metric tons and 22,816 tons respectively, according to Reuter. This is considerably lower than in the previous season when total output was 543,620 of which 513,167 tons were manufactured from beet. Latest figures show that domestic offtake has been rapidly increasing in Spain and requirements are now put at some 550,000 tons.

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Sugar refinery planned for Saudi Arabia[11].—It is planned to erect a sugar refinery in Jidda, Saudi Arabia, with a capacity of 5000 tons per month.

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[1] C. Czarnikow Ltd., *Sugar Review*, 1963, (610), 92.
[2] *Overseas Review* (Barclays D.C.O.), September 1963, p. 67.
[3] *Indian Sugar*, 1963, **13**, 199.
[4] *Sugar J.* (La.), 1963, **26**, (2), 39.
[5] *S. African Sugar J.*, 1963, **47**, 477.
[6] *Sugar J.* (La.), 1963, **26**, (3), 35.
[7] *Overseas Review* (Barclays D.C.O.), August 1963, p. 41.
[8] *Overseas Review* (Barclays D.C.O.), August 1963, p. 43.
[9] *Overseas Review* (Barclays D.C.O.), August 1963, p. 61.
[10] C. Czarnikow Ltd., *Sugar Review*, 1963, (623), 145.
[11] *Zeitsch. Zuckerind.*, 1963, **88**, 471.