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Notes and Comments.

The Sugar Supply Situation in the U.S.

Recently Messrs. B. W. Dyer & Co., Lamborn & Co., and Lowry and Co., prepared for the Food Industry War Committee a review for 1944 of the sugar situation in the U.S., together with an outlook of the likely position during 1945. A summary of this important report together with relative statistics, here follows :—

In 1944 increasing sugar requirements outstripped increasing supplies from offshore areas. Government figures indicate that stocks of sugar in the United States on December 31st, 1943, were 1,760 thousand short-tons raw value, but had dropped to approximately 1,280 thousand tons by the end of 1944. Deliveries to all types of consumers in the Atlantic and Gulf areas served by the cane refineries were many weeks behind orders. Shortages existed in many retail stores, and orders for industrial food processors for civilian production were greatly delayed. Receipts of raw sugar by refiners were about 5.1 million tons during 1944 as compared with 4.8 in the same period of 1943. However, requirements expanded far more rapidly than supplies. Military requirements took up part of the increase, and the balance was made up principally by a more liberal policy with regard to the allocation of sugar for home-canning.

The Office of Price Administration (the government agency which controls sugar rationing and price ceilings) has stated publicly that the amount of sugar obtained by householders for home-canning was probably about 1,150 thousand short-tons raw value as compared with about 850 thousand tons in 1943. Because of the shortage of sugar in the retail stores and the great delay in making deliveries to all classes of consumers, the O.P.A. cancelled most of the outstanding household ration stamps and home-canning certificates and temporarily suspended excess industrial sugar inventories and industrial sugar rationing evidences, effective the day after Christmas.

The above steps have not been effective in easing the delay in deliveries or enabling grocery stores to

obtain all of the sugar for which their customers have ration coupons. The present action has merely tried to limit demand. While the Government has stated that they will try to limit the issuances of household and home-canning sugar to 700 thousand short-tons in 1945, it is still too early to know whether they will succeed in this changed policy. On the other hand, very little real progress has been made in increasing supplies to meet demand. Current shipping conditions are tight, because of military requirements, and thus a limited amount of sugar is being received from off-shore areas.

It appears that the present delay in shipments of sugar from primary distributors in the United States to consumers will continue in the first quarter. At the end of that period, U.S. stocks of sugar will probably be only about 900 thousand tons as compared with 1.23 million tons on March 31st, 1944. Normally, the summer is the period of high sugar consumption in the United States. With refining capacity limited by such factors as labour shortages, and with delays in deliveries still continuing at the end of the first quarter, and no reserve stock-pile of sugar on which to draw, the outlook this Summer for sugar supplies for civilians in the United States is for continued difficulties and shortages.

There may be some relief in the fourth quarter, if the home-canning allotments are carefully supervised and limited, and if there is a good sugar-beet crop. This Autumn, however, if administrative controls are not strict, if the 1946 sugar supply appears black, and the beet crop does not meet the goal which has been established (it already appears that it may fall short by 15 per cent. or more), then there may not necessarily be any improvement.

While the end of the war in Europe will bring some improvement in ocean shipping and an easier supply of labour for cane refineries in the United States, then we shall be facing limitation on the amount of sugar that is available in off-shore areas. European requirements are expected to be larger when the war has ended there, and shipping is available to move

sugar to the countries that need it. On the other hand, the recapture of the Philippines may make some additional sugar supplies available. In the first year after liberation of the P.I. there is not likely to be any significant supply of sugar available for shipment. Her resumption of sugar exports will depend upon what condition their mills and cane fields are in after the Japanese are driven out.

Figures for estimated requirements for distribution and stock replenishment in the U.S. for 1945 may be summarized as follows: Civilian household use (in ration coupons), 1,370,000 short tons, raw value; civilian home canning, 700,000; institutions, restaurants, etc., 440,000; industrial for civilian consumption, 2,300,000; armed forces for direct and indirect uses, 1,200,000; lend-lease and other Government exports, 350,000; population shifts, hardship allowances, etc., 240,000; and possible home-canning bonuses, and unaccounted for distribution, 350,000, this giving total delivery requirements to be 6,950,000; to which is added 210,000 for the replenishment of refiners' raw and refined stocks, making a grand total of delivery and replenishment requirements, 7,160,000 tons.

To provide the U.S. requirements of 7,160,000 short tons the following sources of supply would probably contribute: Domestic beets, 1,160,000 short tons raw value; mainland cane, 100,000; importers of direct consumption sugars (Cuba, 300,000 and P.R. 200,000), 500,000; receipts of raw sugars by refiners from Continental cane raws, 400,000; from Hawaiian raws, 750,000; from P.R. raws, 750,000; from Cuban raws, 3,400,000; and from miscellaneous offshore raws, 100,000, a total of 5,400,000. These several quantities give a grand total of 7,160,000 short tons.

If the sources of supply are drawn upon as just scheduled, then the indicated stock position on December 31st, 1945, will be as follows: Domestic beet processors, 887,000; mainland cane, 135,200; importers, 8,600; cane refiners' raw and refined, 599,200, giving a total in Continental U.S. of 1,630,000. In Hawaii, 20,000; and in Puerto Rico, 36,000, a total in off-shore areas, of 56,000. Then stock in Cuba, after deducting U.S. shipment already scheduled above, 2,000,000; and after deducting shipments to the U.K., Canada, South and Central America, etc. during the period in question, 1,250,000, leaving as balance, 750,000. This gives a grand total for the indicated stocks in U.S. and off-shore areas on December 31st, 1945, of 2,436,000.

Cuban Crop Sale.

In a recent report enumerating some of the difficulties encountered by the negotiators in concluding the sale of the 1945 Cuban sugar crop, Lowry and Co., Inc., of New York, make the following remarks:

There are, it seems, two main divisions of disagreement; first, the basic price, and second, the special

clauses and proposed changes that modify the contract used in 1944. It is reported from Havana that the U.S. Government will not discuss the special clauses until Cuba has agreed upon a basic price of 3c. per pound f.o.b. while the Cubans refuse not only to accept this price but refuse to discuss any price until the special clauses have been worked out more to their satisfaction. If a satisfactory deal can be arranged on such terms as the quantity to be delivered in 1945 and 1946; escalator clause; additional expenses incurred in shipping sugar through ports other than those customarily used by the mill; expenses incurred after the sugar is placed alongside vessel; etc., it is indicated that a price of 3-15c. f.o.b. might be found acceptable. Our government, so our Washington friends tell us, is adamant for a price at not above 3c. per pound.

On the Cuban side the situation is further complicated by internal dissension. The mill-owners, anticipating a higher wage scale in 1945, have held out for a price of 3-25c. or higher; and have been in no hurry to concede anything until the wage controversy is completely settled by presidential decree and their 1945 costs fully established. The colonos, or cane growers, have also advocated a higher price because they foresee higher wages for their cane-cutters and field hands, and their income—that is the price obtained for their cane—is based upon the price of sugar. In addition to their advocacy of a higher sugar price, the Colonos have made claim for some participation in the proceeds received by the mills for the blackstrap by-products. Heretofore the colono cane payments have been based upon what is called the "promedio" price of sugar. This promedio is in effect nothing more or less than the f.o.b. price of sugar less various adjustments such as internal railroad freight, taxes, and other expenses borne by the millowner. Proceeds from blackstrap molasses have always been considered a legitimate incidental recovery for the mill. When blackstrap was virtually unsaleable, and in some cases had to be ditched or pumped into the sea, the colonos were quite willing that they be for millowners' account. But when this blackstrap began to fetch about 13-6c. per gallon the incidental income assumed sizeable proportions, and the colonos thought that participation therein would be a rather nice thing. Some ugly hints have been dropped that producers have consistently been willing to accept lower prices for their sugar because of the high cash offset from blackstrap, and were, in effect, trading against the best interests of the colonos because the latter do not obtain any benefit from the by-product but, nevertheless, have to stand all higher costs resulting from war or inflation. The mill-owners deny any such assertions and point out that if the colonos participate in the blackstrap they should then share proportionately in the higher cost of bags, the advance in cane freight rates and other charges which have been adsorbed by the mill-owners.

Relative Sweetness of Sugars.

During the war attempts have been made to supplement the ration of sugar with other carbohydrates, and naturally the question as to the relative sweetness of sucrose, dextrose, levulose, and mixtures of the latter two, has arisen. Work done on this subject during recent years has been recorded, but in spite of it there exists a good deal of uncertainty. Thus PAUL¹ found dextrose to have 52 per cent. of the sweetness of sucrose, and SALE and SKINNER² gave almost the same figure, viz., 50 per cent. On the other hand AYRES³ assumed 80 per cent., and BIESTER *et al*⁴ 74 per cent. It will be realized that the matter is a difficult one on which to pronounce a definite opinion, seeing that the majority of people lack a delicate taste sensation for sweetness, and that in any case sensations of sweetness are difficult to decide. One has to compare one sensation with the memory of another. It is not surprising therefore that statements especially the earlier ones show marked disagreement.

Probably of all the work done to date that of DAHLBERG and PENCZEK is the most important and reliable. These investigators of the New York State Agricultural Experiment Station⁵ used five experienced tasters, and employed the dairy-tasters procedure of tasting three or more solutions backwards and forwards until these could be arranged in a definite order of sweetness, thus arriving at the following conclusions: The relative sweetness of different sugars varies with the concentration of the solution tasted. Thus sucrose and dextrose both in 40 per cent. solution appear identical, but levulose is always sweeter than sucrose of the same concentration. It was also observed that the sweetness of one sugar is enhanced by the presence of the solution of a second sugar.

Prof. A. T. CAMERON⁶ of the University of Manitoba, employing much the same technique, and still tasting the solutions backwards and forwards until satisfied as to the order of sweetness, has confirmed the findings of DAHLBERG and PENCZEK, just mentioned, also finding the following solutions to be equally sweet: 2.0 per cent. sucrose and 3.8 per cent. dextrose; 10 per cent. sucrose and 14.7 per cent. dextrose; 20 per cent. sucrose and 25.0 per cent. dextrose; 40 per cent. sucrose and 40 per cent. dextrose. They also found that a 25 per cent. solution of sucrose was as sweet as that of a mixture of 5.8 sucrose and 20.4 dextrose. Lastly a 15 per cent. solution of sucrose equalled that of a mixture of 10 per cent. sucrose and 5.4 per cent. dextrose, the energy value of the solutions being almost the same. These results are interesting and mark an advance in our knowledge of the subject. It is clear, however, that something yet remains to be done on the subject of conclusively establishing the relative sweetness of the sugars.

What's in a Name.

In the absence of a *lingua franca*, science demands that at least the material substances and objects with which it deals, shall be designated by names which will leave no doubt as to the identity of the material to which reference is made. Generally, too, in that designation is incorporated an indication of the nature of that material. Chemistry, especially organic chemistry, is a good example of this and, in the realm of living matter, the Linnean binomial nomenclature defines the organism with even greater certainty. Those well-known, homely and descriptive names, pheasant's eye, cock's-spur, colts-foot—and each language has such onomatopoeic names—pass from technical description. *Sic transit gloria mundi*.

Linnean definition, however, has its limitations. It determines the genus and the species. But there are wider groups which are incapable of such accuracy, and words used in common parlance still find the place in technical literature and introduce a certain lack of clarity. Of such a kind is the word, "weed." The word "weed" as applied to any particular group of plants cannot have any defined meaning in the technical sense, for it depends on its environment whether a plant is a weed or not. The best definition of the word is, in fact, "a plant growing in the wrong place." In the sugar cane field any plant not sugar cane is a weed and, in fact, many weeds in one locality are plants of great economic value. The sugar cane industry itself offers a notable example, for *Saccharum spontaneum* is the "kans" of northern India and one of the worst curses the cultivator has to fight there, yet it is the parent of many of the most valuable canes bred in recent years.

Every country has its own group of plants which appear in the cultivated crop and come under the designation of weeds. Such the farmer, from age-long experience, has generally learned to control sufficiently. But man has developed a habit of carrying plants round the world, perhaps for their economic value but often for aesthetic reasons. In that there is danger for, in their new environment, such plants may escape from captivity and become a serious menace in their new home. Instances are numerous; the American water weed, *Elodea canadensis* was introduced into Europe about 1842 and has spread over almost all inland waters; *Lantana* has become a menace in Ceylon and the sub-montane Himalayas; *Eichhornia*, the water hyacinth, has seized on and even blocked the water-ways of Bengal and Assam; the prickly pear, *Opuntia*, has become wide-spread in Australia.

These are not, however, always an unmixed evil; a valuable use for *Eichhornia* has been found as a source of manure, especially rich in potash, for the tea gardens in Assam. But the prickly pear offers a more complex problem in Hawaii. Here it is a

¹ *I.S.J.*, 1922, p. 158.

² *I.S.J.*, 1922, p. 493.

³ *Creamery and Milk Plant Monthly*, 7, p. 48.

⁴ *I.S.J.*, 1925, p. 559.

⁵ *Tech. Bull. of the Station*, 258.

⁶ *Trans. Royal Soc. Canada*, 1943, V, pp. 11-27.

Canadian J. of Research, 1944, 22, pp. 45-63.

detested weed in the more fertile sections of the islands, but in the more arid areas, it is of extreme value. So much is it a source of food and, particularly, water that cattle are stated to reach maturity without learning to drink. Recently a destructive disease of the prickly pear has appeared in Kauai which has been traced to a *Fusarium*. To be, or not to be, is a question which others beside Hamlet have sometimes to face, and it will be of interest to see how the question is answered in Hawaii; whether man or the fungus will take control.

Training Technologists.

The Imperial College of Science and Technology, South Kensington, is this year planning a centenary of the formation of its early predecessor the Royal College of Chemistry, but naturally the form of the celebrations to take place must largely depend on the course of the war. The Royal College of Chemistry became the Davy College of Practical Chemistry, of which the celebrated von HOFFMANN was the first professor. Later other such institutions amalgamated until finally came the fusions of the three large colleges, The Royal College of Science, the Royal School of Mines and the City and Guilds of London Institute, making up the great Imperial College, which indeed in size and in achievement is unique in our educational system.

It is an institution which according to its Charter is expressly charged with the provision of "the highest specialized instruction . . . and the most advanced training and research in various branches of science, especially in its application to industry." Technology is its main concern. It is (quoting *The Times*) "a peak institution" comparable with the Massachusetts Institute of Technology, and the alliance concluded with that institution in 1944 was a recognition of community of aims and interests. Its Charter establishes it as "a School of the University of London."

A centenary is not a common occurrence, and justifies an appeal for funds which the College makes in the following words: "We are not seeking merely to increase our income, for increased income in so far as it is required for work essential to the national economy should be and has been sought from national sources . . . But apart from our need of funds for normal activities allocated on estimates which must be framed a year or more in advance, experience shows that needs may arise too suddenly to be met by a like procedure. Research especially may develop in directions that were not expected and not infrequently it is these developments that yield the most valuable results. They entail, however, periods in which success cannot be guaranteed, and it is imperative to "hold on" . . . Meanwhile if the research is to continue expenditure is necessary so money must be forthcoming." In general terms there is "a need for free money for our College, funds which can be applied by its Governors to special

purposes, and in particular to the development of its corporate life. We plead a need of benefactions such as are enjoyed by colleges in our older universities and by comparable institutions in America; money that is the more valuable for not being given without conditions, since it can meet demands that could not have been foreseen."

Mr. Churchill's Speech.

In his speech to the Conservative Party Conference in London recently, the Prime Minister struck a note prophetic of the post-war era, and it would seem well worth while recording here at least a few of his remarkable words. Thus, he administered a well-merited rebuke to those who claim that it will be possible to create a prosperous new world out of all the waste that has been brought about by the war:

"Blood, sweat, toil and tears! There may be less blood and fewer tears; we thank God for that hope. But mental toil and physical sweat, the conscious, united resolve of every man and woman to give all that is in them, will be required of us long after the last bomb or cannon has ceased to thunder. Let there be no mistake about it; it is no easy, cheap-jack Utopia of airy phrases that lies before us. This is no time for windy platitudes and glittering advertisements."

A specially loud cheer greeted Mr. CHURCHILL's declaration regarding "control for control's sake," which was expressed in the following words:—

"If we are to recover from the measureless exertions of the war, it can only be by a large release from the necessary bonds and controls which war conditions have imposed upon us. Control for control's sake is senseless. Controls under the pretext of war or its aftermath which are in fact designed to favour the accomplishment of wayside totalitarian systems, however innocently designed, whatever guise they assume, whatever liveries they wear, whatever slogans they mouth, are a fraud which should be mercilessly exposed to the British public. At the head of our mainmast we, like the United States, fly the flag of free enterprise."

But he made it certain that at least some control would be necessary for "if we look to the future nothing is more clear than that when the war is over the world will face an acute shortage of food for several years."

USES OF SUGAR.—In one of their recently issued leaflets, the Sugar Research Foundation stated the "thousand and one" ways in which sugar is used in the arts and manufactures, among which may be mentioned the following less-known applications: Stabilizing agent in cloth manufacture; meat, fish and poultry curing; boiler cleaning fluxes; grain mill products; mortars and cements; also electrodes, explosives, Glassine, book-binding glue, hectographs (transfers), insecticides, insulating agents, oxalic acid, penicillin, plaster-removing agent, polishes, synthetic resins and water-proofing materials.

Sugar Cane Research in the West Indies.

In 1942 there was formed the British West Indies Sugar Association (Incorporated), representative of all the British West Indies sugar exporting colonies and presidencies, the object of which is the promotion of research and other scientific work in connexion with the industry and the collection and dissemination of information concerning it. Under its auspices has been published a series of Reports on Research Work for 1943. It forms a further link in co-ordinating the scientific work now being conducted in the West Indies on sugar cane and its culture. In 1932 a preliminary step in this co-ordination was taken in the founding of the British West Indies Central Sugar Cane Breeding Station in Barbados, a station designed to meet the requirement of the various West Indian Islands, Barbados, Trinidad, Jamaica, St. Kitts, Antigua, St. Lucia, Grenada and St. Vincent. The present Association embraces also British Guiana. Some indication of the magnitude of the field covered is given by the fact that the production of sugar from these islands is some half a million tons per annum, to which must be added the production of British Guiana of between 180 and 190 thousand tons.

Two of the reports deal with the sugar cane in its agricultural aspect. Respectively they are by P. E. TURNER, who gives a summary of the investigations into the agricultural aspects of sugar cane culture, and by A. E. S. McINTOSH, who gives an account of the breeding work carried on by him in Barbados¹. The former covers the ground of the Report recently reviewed in this Journal² but is in the nature more of a summary of the results achieved to date than a review of the latest year's work. It gives, in consequence, a clearer picture of the stage reached in these investigations. These fall under three main heads, Varieties, Cultural Operations, and Manures.

SUGAR CANE CULTURE.

Varieties.—The varietal work is mainly an extension of the plant breeding work carried out at the Central Station in Barbados, the testing of promising varieties under the very varied conditions, ecologic and climatic, found within the area covered; for not only the whole area as a unit, but each component, whether island or continental tract, shows a marked range of conditions. It is this fact that renders the varietal problem in the West Indies so complex. In Barbados, St. Kitts and Grenada it is possible to allocate varieties primarily on the basis of rainfall; in Antigua, owing to the small variation in the rainfall, soil type becomes the dominant consideration; in Trinidad, St. Lucia and Jamaica both must be considered.

Of the four varieties which formed the commercial crop of Barbados in 1936, Ba 11569 had totally disappeared by 1943. In the former year B 726, with B 2935, was the standard for areas of intermediate

rainfall and occupied 29.6 per cent. of the total area but, in 1943, occupied only 9.6 per cent. Then BH 10(12) was the standard for high rainfall areas and occupied 29.1 per cent., whereas in 1943 its area had dropped to 12.7 per cent.; B 2935, the standard for low (and intermediate) rainfall areas, in 1936 also occupied 29.1 per cent. but had fallen to second place with 20.9 per cent. of the total cane area. Of the newer varieties B 37161, which only appeared as a commercial variety in 1942, occupied no less than 26.8 per cent. of the area in 1943 and is particularly adapted to the low and low to intermediate rainfall areas. No really suitable variety has been found for the areas of high rainfall; B 35187 occupied 10.2 per cent. of the total area in 1943 and gave the highest yield of plant cane but its bagasse has a low fuel value. There are other promising varieties in prospect, notably B 34104 which is recommended for extended cultivation. B 38155 and B 38212 promise to do well in the wetter areas, as also B 37193 for late reaping. B 4098 has given exceptional promise over a wide range of conditions.

In St. Kitts only two varieties occupied extensive areas in 1930, BH 10(12) at 69.5 per cent. of the area and SC 12/4 at 17.4 per cent. By 1940 the latter had disappeared and the former limited to the wetter areas, with 46.0 per cent. of the area. They had largely been replaced by B 2935 at an area of 47.8 per cent. By 1943 this variety occupied 54.7 per cent. while BH 10(12) had fallen to 17.0 per cent. and B 3439, which occupied only 2.5 per cent. in 1940, had risen to occupy 25.8 per cent. in 1943, mainly by ousting BH 10(12) from the areas of lower rainfall. Trials of the newer varieties are not so forward as in Barbados but several, particularly B 37161 for the wetter areas, show much promise.

Conditions in Grenada resemble those of Barbados but progress is not so advanced, the main varieties now harvested being B 3013, B 2935, BH 10(12) and B 726. But experimental work has proceeded far enough for B 3439 to be recommended for early reaping in the drier, and B 34104 for early reaping in the wetter areas, with B 37161 for mid-season and late crops in all areas.

The conclusions so far drawn for Trinidad have been given in some detail in the review noted above and need not be repeated here. The present position of commercial varieties is the result of a great diminution in the area under Uba which has fallen from 39.9 per cent. of the total area in 1935 to 4 per cent. in 1943. Coincidentally, the area under Co 213 has risen from 4.8 per cent. to 24.4 per cent. B 34104 and B 3439 with 8.2 and 4.0 per cent. respectively in 1943 are just coming into the commercial picture.

Characteristic of Antigua has been the practical elimination of the two varieties which were dominant in 1934. The area under BH 10(12) has fallen from

¹ Reprinted from *The Empire J. of Exp. Agric.*, 10 (1942) No. 37.

² *I.S.J.*, 1944, p. 313.

37.2 per cent. of the total cane area to 4.3 per cent. and that under B 4507 from 26 per cent. to 0.1 per cent. in 1943. The area under Ba 11569 rose in the same period from 14.0 per cent. to 24.8 per cent. This variety, however, is already on the decline, having occupied 38.3 per cent. in 1939 when B 2935 formed 24.8 per cent. of the crop area. But varietal change is proceeding apace, for B 3439, not appearing among the commercial crops in 1939, had assumed a dominating position by 1943 with 43.4 per cent. of the area under it, while B 34104 at 2.4 per cent. had just reached the stage of commercial planting. The soil type is here the dominant varietal consideration, for the most part being either calcareous clays with marl subsoil and free drainage, or calcareous or alkaline soils with poor natural drainage. These two varieties have in general proved superior so far to the newer varieties, though B 35187 and B 37161 appear suited to certain areas.

St. Lucia is noteworthy for the dominant position still held by BH 10(12), the area under which rose from 67.3 per cent. of the total in 1940 to 82.7 per cent. in 1943, a gain mainly at the expense of B 2935 which fell from 22.8 per cent. to 3.2 per cent. in the same period. Recommendations only have been made for the trial of certain of the newer varieties.

The problem in Jamaica is rendered more difficult not only by the variations of both soil and climate but by the presence of mosaic in endemic, and even epidemic form, and many of the newer varieties are susceptible to this disease. It would, perhaps, be fair to say that, on the whole, mosaic has dominated the varietal position. About 1925 it led to a rapid extension of the resistant Uba and other resistant varieties of the POJ series. The control secured partly by these means and by roguing rendered possible the later extension of the more susceptible varieties. The varietal position, thus, has been very complicated with no less than 62 per cent. of the total area under a large number of varieties each occupying a relatively small percentage and BH 10(12) alone occupying any considerable area (27.9 per cent.). Characteristic also was the large area under mixed canes, some 10 per cent. being mixed though mainly BH 10(12). Those were the figures for 1930. By 1940 the area under BH 10(12) had risen to 40.8 per cent. with 14.1 per cent. mixed, mainly BH 10(12). Miscellaneous varieties had dropped from 62 per cent. to 14.2 per cent. with POJ 2878 19.4 per cent. and other POJ varieties, mainly POJ 2727, 11.5 per cent. Newer varieties are still under trial but B 34104 appears to be a good general purpose cane capable of outyielding the established varieties in spite of its susceptibility to mosaic. B 3439 appears to have an opening as an early maturing cane on the more productive soils of light texture.

British Guiana is noteworthy as having for long issued a number of valuable canes, forming members of the well known D series. In later years there has

been a succession of such varieties grown commercially only recently to be supplanted. In 1920 D 625 was the standard cane occupying 53.5 per cent. of the total area with 33.8 per cent. of this area under other varieties and the high percentage of 12.7 of mixed canes. In 1927 D 625 reached its zenith at 73.7 per cent. of the area. Latterly it has fallen into disrepute and is now no longer grown commercially. By 1934 Diamond 10 was forging ahead with 16.8 per cent. of the area, which figure rose to 43.5 per cent. in 1939, only to fall in its turn to 26.5 per cent. in 1943. POJ 2878, occupying only 1.4 per cent. of the total area in 1943, has increased its area to 68.0 per cent. in 1943 in which year D 166/34 and Co 419 first appear among the list of commercial canes. D 200/36 and B 34104 are among the newer varieties which have promised well under trial and are recommended for extended cultivation.

Cultural Operations.—The cultural operations depend to so large an extent on the character of the particular soil, that any general summary is difficult. The general trend of these is to secure a good preliminary tilth for planting and its subsequent maintenance and, on heavy, ill-drained soils, the improvement of drainage. In Trinidad mechanical tillage in the dry weather leads to a better tilth than hand forking but the gain is largely lost by the subsequent operations during the wet season. Cambering is of major importance in the preservation of tilth while drains cut to six inches below the ploughing depth gave gains both in plant crops and ratoons. Furrows should be made in the dry season and their depth depends on the character of the soil; mechanically the furrows can be made along the beds in the dry or early wet season. No satisfactory method for ratoon cultivation which does not destroy the tilth has been evolved, though rotary hoes show promise. In Antigua the conditions resemble those of Trinidad. Deepening alternate drains beyond the six inches below the plough depth has been found beneficial.

The number of new sets planted varies widely from 2000 in Barbados to between 8000 to 10,000 in Jamaica. In the latter island the large number is attributed to the need for roguing for mosaic. Data indicate that there is little difference in yield between 8000 and 12,000; 4000 sets led to a definite drop in yield. In Trinidad between 4000 and 5000 pairs of sets are normally planted, pairing being a precaution against poor germination. This pairing has been proved beneficial on the more intractable soils. In Antigua differences between 6 rows and 7 rows in a 30 ft. bed (2436 and 2842 sets per acre) gave little difference in yield.

Manures.—The manurial requirements vary so widely according to the soil that no general summary is possible for so diverse an area as the West Indies. An indication of their trend is given in the earlier reference noted above.

BREEDING WORK.

The second article covers the work of the Central Breeding Station since its inception. As already explained, the extension of the work to cover all the British West Indies raised problems of varietal adaptation to different ecological conditions of no mean order. Barbados had been the centre of breeding work since 1887, but this earlier work was confined to raising varieties adapted to the rather narrow range of conditions found in Barbados; the new problem approximated to that which faced India, the production and selection of varieties at one Station for commercial development under the very different conditions prevalent in distant areas. The first step was to obtain a broad definition of the range of these conditions and, as noted above, a series of categories based on climate and soil was prepared. The list of desirable characters in a variety of cane is large and it is inconceivable that, even if all were combined in a single seedling, they would find expression under all conditions. It was clearly a question of developing a range of varieties each with its peculiar adaptation.

The preliminary step was to determine the range of parent material available. Earlier work had been confined to the noble canes and, for over 40 years, the two varieties hitherto grown commercially in Barbados, Bourbon and White Transparent, were alone employed. There were evident signs that the potentialities of this material were being exhausted. Of the ten commercial seedlings produced between 1890 and 1913, seven appeared before 1906. Since that date only one has been produced. But these seedlings were particularly well adapted to the relatively long growing period characteristic of the West Indies generally. In this they differed from the varieties raised in the East which were adapted to the relatively short but intense growing period of those parts. The problem, generally stated, was therefore to superimpose the desirable characters of the latter on those which had rendered the Barbadian seedlings so valuable. The initial steps to widen the basis of the parental material available for crossing were taken in 1928, and between that date and 1935 a large number of canes were imported. They included several forms of *S. spontaneum*, *S. barberi* and *S. sinense*; representatives of the cross *S. officinarum* × *S. spontaneum* in Kassoer, synthetic Kassoer, members of the POJ and M series and Toledo (a presumed natural cross between a noble cane and the Celebes form of *S. spontaneum*, Tabongo), of the cross *S. officinarum* × *S. barberi* in members of the POJ and Co series, and of the cross *S. officinarum* × *S. barberi* × *S. spontaneum* in members of the Co and CP series. In the same period a number of pure noble canes of the D and Queensland series was imported. Later, from 1938 onwards the range of available parental material was extended by importing further forms of *S. spontaneum*, *S.*

robustum and *Erianthus arundinaceus*, together with members of the cross *S. officinarum* × *S. robustum* in members of the CP and MQ series, while Co 419 (*S. officinarum* × *S. barberi* × *S. spontaneum*) and Co 421 (*S. officinarum* × *S. spontaneum*) were imported from Trinidad where they had given promising results.

The basis of the breeding work was the idea that, in the Barbadian seedlings already evolved, there existed types particularly suited to the local conditions. These, therefore, served as the basic matrix into which it was attempted to incorporate desirable characters from other varieties and species. In view of the highly heterozygous constitution of the sugar cane, breeding for individual characters is a practical impossibility and the only test of parental value lies in the calibre of the progeny. Attention was directed, therefore, to determining those varieties which gave the highest proportion of valuable seedlings. On this basis, the breeding programme fell into two main divisions: experimental crosses with the object of testing the parental value of particular varieties, and proven crosses between parents of proved value, with the object of producing seedlings of commercial value. Originally emphasis was laid on crosses between varieties of purely noble origin with repeated back-crossing on to varieties of Barbadian origin, and a number of valuable seedlings have been isolated by this method; but the range of variation appears to be nearing exhaustion and later work has been confined to interspecific crossing or nobilizing.

For the purpose of carrying out the programme, a very detailed technique has been evolved. As far as possible, to avoid the labour of selfing, only varieties characterized by male sterility are used as female parents. Originally the seedlings were first selected after 12 months in the field but the method proved unsatisfactory for the selection for a normal 15 to 18 months' crop season. Subsequently, therefore, the seedlings were planted out as before in April but, in October or November, cuttings were taken and the crop harvested in March at some 18 months. The method causes a year's delay but has proved very advantageous, and offered an additional opportunity for elimination. Normally the programme involves some 60 experimental and 10 proven crosses annually, from which 100,000 seedlings are raised, 22,000 potted, 12,000 planted out in April and 10,000 carried to the first trial as cuttings. At harvest, elimination by general appearance, weight and Brix leaves some 2 per cent. of the proven crosses. Multiplication with further elimination follows, leading to varietal trials under the recognized ecological conditions of Barbados, and material is ultimately dispatched to the Plant Quarantine Station in Trinidad whence the varieties surviving are sent for trial in the various areas.

The paper summarizes the results obtained to date. As noted, the earlier work concentrated on pure

noble crosses. Among the many varieties used only three, Ba 11569, B 3013 and B 3439, proved to be male-sterile and usable as female parents. All the imported canes were male-fertile. From progeny testing, the best crosses were Ba 11569 by BH 10(12), Ba 6032, B 603, B 417 and Q 813, and B 3439 by BH 10(12). B 3013 failed as a parent in purely noble crosses but has yielded excellent progeny when used for nobilization. Of the 40,000 seedlings raised between 1928 and 1937, only four have reached the commercial stage, B 2935, B 3013, B 3127 and B 3439, all from Ba 11569 as female parent. The first has become the predominant variety in Barbados and St. Kitts on good soil with low rainfall; its susceptibility to mosaic rules it out for Jamaica. The two next have a limited value in Barbados, occupying some 10 per cent. of the area under cane, but are not suited to the other islands. B 3439 is proving exceptionally suited to some Trinidad and Jamaica conditions (being highly resistant to mosaic) as well as to those of Antigua and St. Kitts. It is the best general purpose noble cane so far raised at the Station. This small number, four only, the result of so much labour, is suggestive and the reason for turning to the more profitable field of inter-specific crosses.

For nobilization work the same Barbadian canes were used to provide the noble parental material. Elimination reduced the imported parental material to the following; *S. spontaneum*, the Local Coimbatore form; *S. sinense*, the Hawaiian form of Uba; *S. officinarum* $\times$ *S. spontaneum*, both forms of Kassoe, POJs 2364, 2725 and 2878, Ms 28 and 42, and Toledo; *S. officinarum* $\times$ *S. barberi*, POJs 213, 234 and 2379 and Co 213; *S. officinarum* $\times$ *S. barberi* $\times$ *S. spontaneum*, Co's 281 and 290.

The original cross between Ba 11569 and the Local Coimbatore has so far yielded no commercial canes but its derivatives back-crossed with B 3013, B 3439 and nobilized Java *S. spontaneum* (Glagah) promise to be of value. *Saccharum sinense*, again, has yielded no commercial canes with BH 10(12) and POJ 2878 as the second parent. But the derivatives have been further crossed with nobilized glagah, chunnee (*S. barberi*) and Toledo, and of these further derivatives many have been planted out in the nurseries.

The Java form of *S. spontaneum* has been extensively crossed with Barbados seedlings and the derivatives back-crossed to like seedlings, as well as to other nobilization derivatives, the primary object being to obtain seedlings suited to the growing conditions of Jamaica and at the same time resistant to mosaic. Among many seedlings showing promise of commercial value, the best so far obtained is B 35187 derived from POJ 2725 $\times$ BH 10(12), which is B 3172 and which, in its turn, was crossed with B 391. It is highly resistant to mosaic and superior to the standards in districts of high rainfall but has yet to be tested outside Barbados. Nobilization of the Java *S. spontaneum* has been carried to

the fifth degree and direct nobilization is now being replaced by crossing with derivatives of other nobilizations to reduce the risk of losing resistance to mosaic.

Toledo from Celebes, accepted as being a first nobilization of the Celebes *S. spontaneum*, Tabongo, has been nobilized to the third degree and both second and third nobilizations have been crossed with nobilizations of glagah, chunnee, Uba and of mixed derivation. Second degree nobilizations of this origin have appreciable commercial promise, particularly for areas with poor soils. The best, B 35197, B 35200, B 35204, B 35247, B 37227, are under large scale trial in Trinidad and Antigua.

Nobilizations of *S. barberi* crossed with Barbados seedlings have yielded several very promising seedlings. B 35245 is derived from POJ 234 and Ba 11569 and is a thick, heavily ratooning variety with high juice quality. Though its susceptibility to mosaic renders it unsuitable for Jamaica, it is expected to figure prominently in other areas. B 3365 is a derivative of the cross between POJ 2379 and BH 10(12) and is one of the best female parents raised at the station. B 37161 and B 37193 are derivatives of the cross between it and B 603. The former is outstanding, having out-yielded the standards by 20 to 70 per cent. under all the ecological conditions in Barbados, where it is expected ultimately to occupy 50 per cent. of the total area. Trials in other areas necessarily lag behind Barbados owing to the quarantine system, but reference to its behaviour in these has been made earlier. Co 213 has been found to be rather infertile when crossed with Barbados seedlings but has yielded B 35207 and B 35214 with these and, with POJ 2878, B 37174, B 37175 and B 37176, all of which are promising.

The *S. officinarum* $\times$ *S. barberi* $\times$ *S. spontaneum* derivatives, represented by Co 281 and Co 290, have proved to be excellent parents. Particularly noteworthy is the cross B 3439 $\times$ Co 290, which has yielded the highest field and final selection figures so far obtained at the Station. The cross Co 281 $\times$ BH 10(12) has yielded the seedling B 34104, a heavy stooling, very vigorous, seedling with high sucrose content which has done well in Trinidad though, being susceptible to mosaic, it is not suited for Jamaica.

Thus early, therefore, in the nobilization work there have been obtained five seedlings not only greatly superior to the standards but to the four seedlings raised from pure noble stock. Moreover, these five represent a recovery of 1 in 1800 as against 1 in 10,000 among the pure noble derivatives. The potentialities of the material so far considered are not yet exhausted and the new parental material recently imported is only now entering into the programme.

H.M.L.

The Cult of the Plough.

In the course of generations customs become established so firmly that they are taken as axiomatic, accepted without question. From time to time doubts are raised by some mind less bound by tradition and the effect is similar to that of throwing a brick into some intricate mechanism. Such is the case with "Plowman's Folly" by E. H. FAULKNER¹ to which brief reference was made in our "Notes and Comments" of our March issue. In it he contends that the plough "is the least satisfactory implement for the preparation of the land for the production of crops." His argument, is forcefully put, and is backed by a wealth of practical experience which cannot but carry much weight even if the exposition does not follow the accepted scientific procedure which demands a wealth of statistical data. Stated briefly, his contention is that the plough, by inverting the soil and so burying the superficial organic matter, creates a pad at plough depth which absorbs moisture and insulates the surface layer of the soil. It is primarily a question of soil moisture, but other factors are recognized as playing their part. There is the question of the conditions necessary for the processes of decomposition and whether these are optimum at the depth at which organic material, so ploughed in, lies; there is the question of leaching of the products of decomposition at that depth. The pad formed will naturally be greater, and the effect more marked in the case of green manuring when a bulky crop is ploughed in.

To one who has been brought up in the conventional attitude to soil management, the ideas expounded in the book are certainly revolutionary and, at first sight, invite incredulity. It is, however, only fair to the author to state that, in spite of the forcefulness of his exposition, he repeatedly invites investigation and concentrates on the results obtained in his own experience and offers his explanation without undue dogmatism. And, on second thoughts, reviewing his argument in the light of personal experience of agriculture in many countries both tropical and temperate, there is more than a substratum of truth in that argument, though it is difficult to accept unreservedly his total condemnation of the plough. The soil is a complex substance, differing widely in constitution and with chemical, physical and biological aspects. It is, moreover, subjected to a wide range of climatic conditions. It is hardly to be expected that any system of handling it will be universally applicable. It may be of interest therefore to attempt to adjust the book's argument in the light of personal experience.

The plough, as commonly used, disturbs the surface soil to a certain, approximately uniform depth year after year. There is thus formed a sharp break between the disturbed surface soil and undisturbed subsoil. In the process of surface reconsolidation after ploughing there occurs a silting out of the heavier

particles, and it is possible to pick out the dividing line by the higher specific gravity of the immediately superposed layer. This breach of continuity is further emphasized by the compression of the plough sole and, depending on the climatic conditions and nature of the particular soil, there is a tendency to form an inorganic pan which may form an interruption to the movement of soil moisture as effective as the organic pan of the author's experience. It is a pan which, under certain conditions, is formed in Nature, particularly in the semi-arid tropical areas, and is well illustrated in the *usar* tracts and the *kankar* beds of upper India. It is the writer's impression that too little attention had been paid to pan formation; it can occur without the intervention of the plough and a garden worked on a four year rotation with double trenching every fourth year will often disclose a pan sufficiently hard to be perceptible through the spade. Where such a tendency exists, and it is probably more common than is generally recognized, the remedy is subsoiling at intervals, but of interest here is the application to the author's thesis. No superficial treatment is likely to be effective where such a pan has been allowed to develop, Caution is necessary in the interpretation especially of negative results.

In acceptance of the argument that the organic pan formed by the deep burial of surface vegetation caution is again necessary. Optimum conditions for correct fermentation of organic matter are primarily a question of aeration, humidity and temperature; the last uncontrollable, and the second only partially controllable. It is these facts which make green manuring so "chancy" a proceeding in a humid climate. But organic matter has also a physical aspect in that it assists in the formation of aggregate particles. There can be little doubt that the author is right in advocating its incorporation throughout the surface soil, especially in the case of the preparation of a seed bed.

The "capillary" rise of water in soil depends so largely not only on the permeability of the soil but on local conditions that it would be dangerous to generalize on the effect of ploughing on it. Loss of water can be very great—under the conditions of Bihar, India, the writer's determinations placed it at the equivalent of some 0.25 in. rain per diem—and the limit may be the available reserve of water as conditioned by the height of the water-table. There it was possible to secure germination after 5 months' drought and a crop capable of living through a further 3 months' dry and intensely hot period merely by repeated compacting of the soil. It is probably safe to say that too little attention is, in general, given to adequate consolidation of the soil between ploughing and planting.

[Though it may not be possible to accept all the conclusions drawn, the book is one which all should read with attention. H.M.L.]

¹ *Plowman's Folly*, E. H. FAULKNER. (Univ. Press, Oklahoma, U.S.A.).

Varietal Differences.

It is a matter of common experience with all crops that there is a differential reaction of varieties to particular environments which makes one variety better adapted for cultivation under the conditions of a particular area. That is best seen in a short season crop grown from seed, such as a cereal. If a mixture of varieties is sown, after a short interval of years it is probable that one variety will be found to dominate the others. The question arises as to what particular varietal characters this greater adaptability is due. The point has recently been studied in the case of the sugar cane by A. H. CORNELISON¹ in a lengthy paper which describes work carried out in continuation of earlier work² on nitrogen nutrition in which the single variety H 109 was employed. In the present work three commercial varieties, H 109, POJ 2878 and 31-1389, all genetically related, were planted under conditions as uniform as possible, in plots consisting of seven 20 ft. rows with 5 ft. between rows. Bi-monthly harvests were taken, one line being cut at each harvest. The individual canes were grouped according to age of emergence and the primary stalks were divided into sections, each section being the seasonal 4-monthly growth. The normal field procedure was adopted, with irrigation at 2 in. per week throughout adjusted to all rainfall over 0.5 in. and application at 1.5 months of 50 lb. nitrogen and 200 lb. each of potash and phosphate, of a fall application of 125 lb. nitrogen and a further 75 lb. nitrogen the following March. Failures in germination were made good by replanting and uniformity of stand obtained by cutting out shoots to arrive at 2.75 shoots per running foot of line. The classification of the cane was as follows: primaries from the base, 4 month and 8 month sections, dry leaf, green leaf and non-millable cane while the secondaries were classified into only the last three. Stalks yielding no millable cane at harvest were classed as suckers.

Certain differential varietal characteristics were clearly visible by observation alone. The growth of H 109 was much slower to commence with than that of the other two and it closed in about 2 months later. In the first four months POJ 2878 made much more millable cane than the others. The thick, sturdy and well leafed top of H 109 was in sharp contrast to that of the others in the fall and it consequently suffered less from winter winds. Tasseling, too, at this season was light, but greatest in POJ 2878. With rising temperatures H 109 gave an immediate response in the primaries, the others initiated considerable sucker growth and, in POJ 2878, marked senescence of primaries occurred. By December "going down" was common, but least in 31-1389. To sum up: POJ 2878 does not carry over well, producing as it does a crop of secondaries in each

12 month period; 31-1389 could be harvested at 12 to 16 months or left till the secondaries become millable; H 109 yields a crop largely composed of primaries even at 24 months. Such differences necessarily have a marked effect on composite juice samples. These general distinctions are elaborated in a large number of diagrams designed to bring out the more subtle differences and their effect on juice quality.

Growth measurements of primaries commenced in November (5 months). A general slowing down of growth was noticeable in all, but was somewhat less in H 109 during the fall. Rapid elongation, particularly in H 109 took place as temperatures rose with a peak in May, attributed to the nitrogen dressing in March, since temperature and length of day continued to increase for a further 6 weeks. The later drop after December of the second year is attributed to physiological maturity.

The analysis of weight of cane is carried to the various sections noted above and illustrates the complexity of field sampling. These analyses indicate that POJ 2878 is the lowest producer of millable cane (4 months' section). The 8 month section indicates that H 109 had begun to produce more primary weight than the others, a possible interpretation of which fact is that this variety can continue growth at a lower temperature level than the others, in which case the generally accepted 70°F. used for calculating "day-degrees" may require varietal adaptation. The complexity is well indicated by the figures for secondaries which form from 30 to 60 per cent. of the final crop and this fact throws doubt on the soundness of determining fertilizer control by index figures. The weights of the green leaf section show a close parallelism with the growth curves in H 109 and 31-1389 but not in the case of POJ 2878 owing to the death of primaries. The factors influencing the production of secondaries were not studied sufficiently to predict differences in varietal response.

Mortality, which set in before spring in the second year was greatest in POJ 2878 partly from arrowing or damage, but partly from unascertainable causes. In secondary stalks, dying out occurred from overcrowding, especially in POJ 2878 in which variety arrowing was a contributing cause.

The comparisons of the juice covered a wide range of determinations: *pH* of Cuba mill expressed juice, conductivity, reducing sugars and sucrose. Determinations of the moisture and nitrogen contents of the cane were also made. There are here introduced a whole series of complexities which it is impossible to review adequately and only the major outline can be given. The *pH* of the expressed juice of all three varieties were similar and exhibited the same seasonal and age trends. The non-millable tops had a higher

¹ *Hawaiian Planters' Record*, 1944, 48, p. 125.

² *I.S.J.*, 1942, p. 287.

acidity than the rest of the stalk, probably due to increased concentration of organic acids. In the green leaf section acidity is lower, a fact attributable to the excess of the anabolic over the catabolic processes and inhibition of the accumulation of organic acids. Identification of the acids was not made. The expressed juice figures, however, are means; micro-chemical studies have shown that interfaces in the protoplasm of some parenchymatous cells have a pH of 3.2 when that of the expressed juice is 4.8 to 4.9. The figure will also be affected by changes in water content without quantitative change in acid content. A comparison of the pH and conductivity curves suggests that the latter measures the acidic radicals in the sap rather than the ash constituents, the two curves being inverse to each other. In the case of POJ 2878 and 31-1389, however, this parallelism does not hold for the later life of the older sections and these older tissues may have small variable salt concentrations.

The main fact disclosed by the moisture concentration (grm. H_2O per grm. dry matter) curves is the rather consistently lower content of POJ 2878 at all ages; but the curves show great variability, those of H 109 and 31-1389 repeatedly crossing each other. There is obviously a considerable error due to various causes, such as colloid content, variations in the relative amounts of nodal and inter-nodal tissues, and water content of the vascular tissues not immediately involved in the life processes of the cells. This latter was, as far as possible, eliminated by thorough irrigation.

Reducing sugars, determined both on dry weight basis and on Cuba mill expressed juice, showed similar seasonal and age trends in all varieties, but some varietal nonconformity at the various harvests. Taken in conjunction with the sucrose figures, it would appear that these variations are due to changes in absolute amounts of dry matter in consequence of variation in the amount of sucrose, the absolute amount of reducing sugars remaining constant. There is here proof of the ebb and flow in sugar content of the older tissues; once laid down, they remain dynamic, responding to seasonal influences.

Sucrose is recorded either as percentage of dry weight or in the Cuba mill expressed juice. In all varieties the two curves show considerable dissimilarity in the general seasonal trends, and, as between varieties, in their relative position. Thus, in the two mature-age sections of POJ 2878 the two percentages are highest in canes at one year but, in the younger sections on the dry weight basis, the reverse holds. In H 109 the opposite is the case on the dry weight basis. These varietal differences are attributed to the differential growth rates. There is, further, evidence of the accumulation of sucrose with age in all parts of the plant, attributed to a complex series of factors among which are discussed loss of nitro-

genous colloids, reduction of water-holding capacity through loss of colloids, increase in vacuolar volume and reduction of osmotic pressure in the cell. Another phenomenon noted is that changes in sucrose content, expressed either as percentages or absolute amounts, never balanced the reverse changes in reducing sugars. Comparing the changes through the growth of an individual section, a steady increase in the sucrose content is found; in the green leaf stage from 5 to 11 per cent. in the juice, in the dry leaf stage from 11 to 15 per cent. and thence on to the eighth month stage from 15 to 19 per cent. the trend in the section attaining 4 months is similar but less marked.

The nitrogen determinations included total nitrogen and α -amino nitrogen in the expressed juices. Variations in total nitrogen for all seasons were similar in all varieties with slight indications only of a varietal influence in that POJ 2878 had a higher nitrogen content than the other two in the cane formed in the first season while the reverse was the case in second season cane. One explanation offered is the translocation of nitrogen in POJ 2878 to the young secondary stalks. The main difficulty in interpretation lies in the present inability to separate total nitrogen into fractions according to their physiological activity. From the practical aspect interest centres on the peak growth period in May already mentioned and attributed to nitrogen deficiency in mild form. This is confirmed by the downward trend in total nitrogen of the top and green leaf section up to November and an earlier experiment is quoted in which nitrogen was applied every second month and in which growth continued at a steady rate from May to September. These nitrogen figures are used as a basis for a detailed discussion of the possibilities in methods for determining or predicting the fertilizer requirements of the crop, that is, for the problem of sampling. The conclusion drawn is that a far greater knowledge of the factors controlling cane growth is required.

In summary, it is pointed out that the largest varietal differences lie in the timing and vegetative responses exhibited with chronologic age. In fact, many of the results given are interpretable only in terms of factors not measured. Thus sugars on dry matter depend largely on the relative amounts of nodal and internodal tissues. Diagrams are given of refractometer readings showing the accumulation of sugar in the internode at a point somewhat above the centre, particularly marked in the green leaf section. The main practical conclusion from this wealth of material is that varietal behaviour is a question of physiological maturity rather than of age. This fact determines the adaptability of a variety to climate and cropping seasons and, in Hawaii, points to the need for varieties having long physiological life cycles.

H.M.L.

Malaria Control in Mauritius.

As in most tropical and sub-tropical countries, malaria is now a well-established disease in Mauritius. But this was not always so; Mauritius shares with Barbados the peculiarity that malaria is a relatively recent introduction. In the former island it made its appearance in 1885, in the latter—subject to correction—about 1926. It is noteworthy that, in Mauritius, it appeared with the introduction of irrigation, the first laws to control which were passed in 1863. At that time its cause was unknown and medical opinion attributed the outbreak to germs brought in the rain clouds from Madagascar during a particularly heavy gale in February 1865. Modern ideas would attribute it to the presence of an infected immigrant population incapable of spreading the disease so long as the mosquito could not establish itself. Those conditions the introduction of irrigation upset. In the event, malaria has become endemic and Mauritius is faced with the same problem as other countries in which this is the case, the question of control. At a recent meeting of l'Association des Anciens Etudiants du College d'Agriculture¹. C. R. HARRISON discussed the problem. He spoke from a wide experience, having had responsibility for control measures on plantations in Malaya, on mines in Northern Rhodesia and in connexion with the building of the bridge over the lower Zambezi.

His review of the history of the discovery of the cause of malaria contains some points of interest not generally known. The writing of both the Greeks and the Buddhists in Ceylon associated the mosquito with malaria, facts which elicited the comment that, 2,000 years ago, someone was bound to guess right! It is, perhaps, an unfair comment, for it neglects the wonderful capacity of observation shown by the ancients which, without knowing the reason, led to such practical action as the Jewish interdiction of the pig and, probably, to the burning of grass from one end of Africa to the other. The discovery of the parasite of malaria in 1880 by the French doctor, LAVERAN, and the proof of the mosquito association by ROSS in 1898, following up the suggestion of PATRICK MANSON, are noted. He then gave some figures of the results achieved within his experience. On the estate he managed in Malaya the death rate in 1911, when he commenced operations, was 232 per 1,000; by 1923 it had fallen to 3 and, in 1932, to 1.1. In Northern Rhodesia the death rates on the mine in 1929 was, for Europeans 22.4 and, for Africans, 32.3; in one year the rates fell to 13.2 and 15.8 respectively.

Mauritius was visited in 1907 by Ross when in Vacoas and Phoenix malaria and black-water were rife and spleen rates ran up to 100 per cent. The visit led to the draining of the Clairfond marshes and the district has since remained healthy. Recently another notoriously unhealthy area, Tombeau Bay, has been

successfully dealt with by an Army Anti-Malarial Unit.

The species of mosquito number 1,700 of which only 170 are *Anopheles*, and, of these, only 17 are vectors of malaria, the female alone being active. Of the *Anopheles*, only four are found in Mauritius of which one, *A. Mauritians*, is not a vector. A second, *A. maculipalpis*, is rare and alone, though a vector, is incapable of maintaining malaria. The remaining two, *A. Gambiae* and *A. funestus*, are deadly carriers. The former breeds in sun-lit water, pools and puddles even when slightly saline; the latter, a strong flyer, breeds in gentle moving and lightly shaded water. The type of breeding ground in Mauritius is, thus, wide and it becomes desirable to control the breeding grounds of all mosquitos and not only of the two main vectors, for other mosquito species carry other diseases; *Culex* and *Aedes* carry dengue, filariasis and yellow fever.

Of importance second only to a knowledge of the breeding habits is a knowledge of the normal extent of the flight of the female. Flight is normally limited by the accessibility of the source of blood for a meal and is a few hundred yards only. But, generally, half a mile will give adequate protection except in the case of *A. funestus*, unfortunately introduced from Africa where one mile is considered adequate. Within the area of protection the greatest care is required to see that there is no man-made breeding ground. The female lays her eggs every 2 or 3 days, and four moults and pupation occupy 10 days. A further 10 days must elapse between infection of the mosquito by biting an infected person, and its ability to pass on the infection. Ten days also elapses between the date of infection of a bitten person and of his capacity to reinfect the mosquito, giving a total minimum cycle of 30 days.

The above facts dictate the methods of control which are directed, first to clearance of all breeding grounds within the area and, second, to maintaining that clearance, involving control every ten days. The methods are as various as the conditions met with. Oil as a thin film only 1/1430 in. thick, the equivalent of iridescence on the surface, is adequate to kill the larvae and prevent deposition of eggs. Grading of the surface to prevent the formation of pools, filling in rock pools with concrete and removal of all old receptacles capable of holding rain water will do much. Springs may be led into drains, streams canalized, tanks have their banks sharp and free from weed and supplied with fish such as those termed "millions." Small streams may be kept clear by dense shade from such plants as *Lantana*, trimmed to cover them in completely. The best method is that which meets the particular conditions most simply.

H.M.L.

¹ Rev. Agric. l'Île Maurice, 1944, 23, p. 138.

The Sugar Industry in India

A Survey of Forty Years' Development.¹

By NOËL DEERR.

The genesis of the modern sugar industry in India dates back to the beginning of the present century. About 1900, a Mr. DAVID WILKIE, a retired Demerara planter, visited India on behalf of Mr. L. W. McDONALD, his son of the same name, and of his nephew Mr. T. McDONALD. The object of his visit was to report on the possibility of sugar replacing indigo in Bihar. The first result of his Mission was the formation of the Indian Development Company which erected a factory at Ottur in the district of Dharbhanga, Bihar. This project ended in failure. Nevertheless, before 1906, seven factories, small, but equipped with modern plant, had been erected in Bihar and the United Provinces.

These factories had been designed on the unwarranted assumption that Indian cane was so poor that expensive machinery would not be economic, and that the industry could only exist by the combination of cheap cane and cheap labour. In this policy, there was an error of fact and an economic fallacy. The cane was of reasonable quality and the labour, while paid a low rate, was not cheap. Consequent on the design of the factories, efficiency was low and, during the first 25 years of their history, not more than 65 per cent. of the sugar in the cane was marketed. Nevertheless, all these factories survived and blazed the way to the modern industry.

After recognition of this condition, the pioneer firm of Messrs. Begg, Sutherland & Co. was quick to correct it, and, by 1928, had so remodelled the factories in which they were interested that 80 per cent. of the sugar in cane found its way to market in the form of a high-grade direct consumption sugar. This step forward influenced the development of the whole industry, as when the great extension of the industry took place in 1934, after the imposition of a protective duty, the design of factories adapted to Indian conditions was understood and was accepted. Although, in the earlier years, the efficiency of operation of many of the new factories was far from satisfactory, this condition has now been corrected, for the season 1942-43 the reduced overall efficiency being for all India 82.36 per cent., a figure which, while capable of improvement, may be looked on as reasonably economic.

At the time of the inception of the modern industry, there was but one cane available in quantity in Upper India where the pioneer factories were located. This cane was that known under the names of *Hemja*, *Bhurli*, *Reora* and *Mungo*. The Government of India had early recognized the necessity for improved varieties and, in 1912, Dr. C. A. BARBER started work at Coimbatore. About 1920, he offered to the industry

two canes, Co 210 and Co 213, which in a few years, had almost entirely displaced the *Hemja* canes. For this rapid extension the industry is indebted to Mr. WYNNE SAYER of the Imperial Department of Agriculture and to Mr. A. B. SHAKESPEAR, C.I.E., of Messrs. Begg, Sutherland & Co. After BARBER's retirement work continued at Coimbatore under Mr. T. S. (now Sir TIRUVEDI) VENKATRAMAN who has produced canes, notably Co 299, Co 313 and Co 513, suited to the conditions prevailing in Upper India and of high sugar content. From these canes, in the season 1942-43, the Bihar factories recorded an average yield of 10.93 per cent., the average over all India being 10.28 per cent. This compares not discredibly with Java, where, for the years 1920 to 1938, the average yield was 11.40 per cent. with extremes of 10.38 per cent. and 13.21 per cent.

A recommendation of the India Sugar Committee in 1921 was for the establishment of a Sugar School to provide the necessary trained technicians for the satisfactory operation of the factories. There is now, at the Harcourt Butler Technical Institute at Cawnpore, one of the best, if not the best, equipped model sugar factories in the world, whence have come most of the operating and executive staff now in charge of India's sugar factories. As an index of what this Institute has done under the administration of Mr. R. C. SRIVASTAVA, O.B.E., it is only necessary to refer to the technical papers published by the Indian Sugar Technologists' Association, which, while of uneven merit, contain much of real technical value. The lines above indicate that three of the desiderata, efficient factories, sugar-rich canes, and efficient operating staffs, for a stable sugar industry are available.

Zoning System—The India Sugar Committee's report of 1921 discussed the zoning system, by which is meant the allocation of an area to a factory which would have the sole right to purchase cane in that area. This scheme, while it received support from the late Mr. B. J. PADSHAH and Mr. WYNNE SAYER, was rejected by the Committee. The zoning system had, however, many supporters, among whom was Sir J. P. SRIVASTAVA, but the official view was uncompromisingly antagonistic, Mr. H. C. PRIOR saying at a Congress held at Simla in 1933 :—"The view of my Government (Bihar and Orissa) is that any legislation for zoning, licensing of factories, or fixation of cane prices is impracticable and will go against the interests of both the cane growers and of the development of the industry." With the extension of the industry, what had been foreseen by those in the best position to judge came to pass. A state of chaos

¹ *Commerce*, December 23rd, 1944.

resulted. In some areas, there was an excess of factories competing against each other for cane; in others, there was excess cane with none but a long-distance market. So confused became the position that, in 1938, the Tariff Board reported:—"The only practical solution seems to be in the organisation of zones of operation in factory areas." By this time, Government had recognized the magnitude of their error and had already put into operation a limited zoning system. With this was associated a control of the price to be paid for cane variable with the market price of sugar, but not including the sugar content of the cane. This complete reversal of policy had the effect of introducing some degree of stability into the economics of the industry, but not till great harm had been done.

"Associated Production" Wanted.—The most important factor in the production of sugar in Upper India has not yet been touched on. The system of agriculture followed by the peasant producer remains as it was in its main phases. Efficient factories, high sugar content canes, and skilled operation are, to a large extent, stultified if the ultimate basis of production does not move forward. It is the considered opinion of the writer that a solution of this difficulty will be found in the zoning system combined with a profit-sharing plan. In any such scheme, it must be understood that the interests of the miller and the grower are equal and that either cannot economically exist without the assistance of the other. For such a scheme I propose the term "associated production." In this scheme, with the miller established in his zone and with the profits of his enterprise secure against the piracy of competitors, it would be to his advantage to help the grower with advances in cash and in kind, and in the demonstration of improved methods of agriculture.

There is a limit, however, under the present social conditions of Indian village life to what the miller can do. I refer to the fragmentation of holdings, whereof, in one village, there may be found as many as one hundred half-acre plots of cane. If it were possible to persuade the village community to co-operate among themselves and to pool these fragments into one fifty-acre field, the problem of the application of rational agricultural methods to the production of sugar cane would be nearly solved, and associated production would be approaching an actuality. Chief among the developments which it would be to the advantage of the capitalist miller to introduce would be mechanical cultivation and the provision of water from tube-wells or the utilization of localised sources of supply not large enough to be brought into any general scheme. There is yet another advantage that this proposed method of associated sugar cane production would afford, and that a major one. Unless I have misunderstood

the problems connected with pests and diseases, their control would appear much simpler with one isolated large block than with an equal acreage split into many small holdings.

It is not pretended that these benefits should be afforded the grower without cost to himself. The necessary charges, fair to him and to the miller, would be debited against the grower, who would find an increased net profit from the higher yield of cane. Equally, the miller would benefit by an assured supply of cane with a concentration nearer to the factory and with reduction in the collection charges. The problem of associated production of sugar cane, as I have stated it here, is merely indicative; its solution is admittedly difficult but is, I submit, not insoluble.

[Price Fixation and Profit-sharing.—Connected with associated production is that of price fixation and of profit-sharing. Already the price of cane is fixed by Government, but the schemes in force introduce only one element, the market rate of sugar, and leave the intrinsic value of the cane untouched. Under this system, the miller pays the same rate for cane with 10 per cent. of sugar as he does for one with 14 per cent., a quality that has been recorded in Bihar. The system of price fixation and profit-sharing proposed by the writer is broadly:—

1. The first charge on the income of a factory to be a payment to the grower of an agreed price per maund of cane, this price as nearly as possible to be representative of the cost of production.
2. The second charge to be a payment to the miller clearing his cost of operation.
3. The balance to be divided equally between miller and grower. In this scheme both selling price of sugar and sugar content of cane are automatically introduced.

Finally, I wish to express the view that it is the grower of cane who remains and will remain the keystone of the complex system of sugar production that has developed in India and without whom there would be no industry. This position was taken one hundred years ago by no less a statesman than BENJAMIN DISRAELI¹ with an extract from one of whose speeches in the House of Commons, I conclude:—

"In the cultivation of indigo, cotton, lac and the other products of the soil, the native can only be a labourer. I repeat that the only privilege of the poor in that country, where the wages are the lowest and the interest on money are the highest, is the cultivation of sugar. This is the class who will give you your sugar from India. It is not the English speculator who furnishes you with 20,000 tons, it is the peasant of India; not the owner of the vacuum pan and the steam engine who will send you the sugar to purchase these quantities of Manchester goods, who if supported in their intention will take more of your manufactures than any slave population in the world."

¹ *Hansard*, 1846, lxxxiii, p. 151.

Bonechar Research

at the National Bureau of Standards, Washington, D.C.

By VICTOR R. DEITZ.

Our project was started at the National Bureau of Standards about five years ago in order to explore the possibility of fundamental research on the problems arising in the refining of sugar. Bonechar often been described as "the blackest mystery of sugar refining" was chosen as the number one problem because of its wide use and variable behaviour.

There was available at the time that this research was started a method to determine the surface area of finely divided and porous materials (as carbon black paint pigment, etc.) which was based on the determination of the adsorption of nitrogen gas at the temperature of boiling nitrogen (77°K) or of boiling oxygen (90°K). We undertook to measure the surface of a number of our samples and with these results were able to assign a definite area to a bonechar with an accuracy better than 20 per cent.

SURFACE AREA OF SOME BONECHARS.

Sample	Surface Available to Nitrogen Gas		
	Sq. metres per gram.	Sq. miles per 100 lbs.	
New bonechar— 2.....	130		2.28
Service „ — 9.....	88		1.54
Gray „ — 8.....	59		1.03
Service „ — 3.....	40		0.71
Service „ —12.....	38		0.67
Spent „ —15.....	17		0.30
New „ —16.....	104		1.82
Laboratory preparation from bones	139		2.44

These data give quantitative proof for what had always been thought to be true regarding the difference in the surfaces of a new and a spent bonechar, and also mean that those refinery operations and procedures which keep the char clean and the pores open will lead to a more efficient operation of the bonechar filters.

The next experimental observation to be considered is the fact that the various nitrogen adsorption isotherms for an assortment of bonechars were found to form a single graph by referring the adsorption to unit surface. In the previous curves there was plotted the volume of gas adsorbed per grm. of char against the pressure of the gas. We now plotted the volume of gas adsorbed *per unit surface* against the pressure, and then found that an average curve could be drawn which, up to a relative pressure of 0.6 did not deviate more than ± 3 per cent. from the curves for the individual chars. This result was proof that for this type of experiment the extent of surface is one of the main variables in determining the amount of gas adsorbed; in other words the greater the surface, the more the adsorption.

But this experiment also indicated something about the porosity of bonechars. Other experiments on gas mask charcoals and the vegetable carbons have

given isotherms which have different shapes than those for the bonechars. In general, the adsorbents with a fine structure have flatter isotherms than those with a coarser structure. Hence a possible interpretation of our results for the bonechars may be found in attributing the same porosity or pore-size distribution to all of the bonechars investigated. The larger pores of a bonechar which are of dominant importance in solution work are not the controlling factors in these considerations.

What has been said so far applies to data obtained from gas adsorption experiments. We soon wanted to find out how these findings applied to the behaviour of bonechar in solutions. For example, having found that two have surface areas in the ratio of 4 to 1, it was natural to see if the decolorizing powers under comparable conditions were in the same ratio. We did not expect that the same surface available to a gas would be available to a solution, but perhaps it might be proportional. The answer was found to be that sometimes they were and sometimes they were not. The discrepancy is to be found in the oversimplification of the true problem which always arises when an attempt is made to draw general conclusions of so complex phenomena as occurs in bonechar filtration from a single type of experiment.

In order to analyse the difficulties to be encountered in a study of the decolorizing power of a bonechar, let us consider in detail what happens to a sugar liquor which has been brought into contact with some char. The first result is a strong depletion in the concentration of the impurities in the layers of the solution directly adjoining the surface layer of the bonechar, and diffusion into this layer from more distant parts of the solution must follow. This diffusion of the impurities into the available surface constitutes a very important variable. Anything that will modify this diffusion will influence the extent of decolorization.

For example, the flow of the sugar liquor through the char creates a variation in the concentration of impurities down the column. As the wave-front of varying adsorption passes through the column, the diffusion of the impurities of the solution into the pores of the char changes. In a static system such as used in some testing methods, or as used in treating liquors with vegetable carbons, the diffusion alone occurs under the concentration gradient existing around each particle. However, in this procedure, a reduction in particle size is used to aid the diffusion processes, although there is a limit to the increase in efficiency due to the particle-size reduction being determined by filtration technic.

¹ A talk before the Sugar Industry Engineers, 1943, Meeting (here abridged).

It is the slow diffusion of the liquor into the pore system of a carbon adsorbent, therefore, which prevents the complete coverage of the available area in the char. This lack of equilibrium prevents any correlation of the total area with the extent of decolorization. (We have recently used a new procedure which seems to give more reproducible and steady results.) In addition there are several other complications:

(1) All the constituents of the solution compete for the surface and in sugar liquors the large part of the surface will be occupied by the water and sucrose molecules, which will not necessarily be replaced by the impurities in the same proportion for the different chars; (2) The oxygen adsorbed on bonechar plays an essential role, for it can be shown that when the oxygen is rigorously excluded, the rate of decolorization may be decreased to a marked extent.

Additional complications are to be found in the pH effect of different chars; also in the different behaviour of the constituents of the impurities, some components with colour and some without; the mechanical interference due to the action of colloidal or suspended matter is an added complication. Thus, the different chars will not necessarily behave the same with respect to these variables and, therefore, a correlation with the total surface cannot be expected to be a simple one.

Despite these many variables, it is now possible with the fundamental information now available to begin to correlate the results already obtained with some of the details of the effects present in bone char filtration. With some additional experiments dictated by the results so far obtained, we hope to present a complete picture whereby it is possible to specify what makes a good char good and a poor char poor.

The Return of Beet Factory Waste Waters.

By J. CAMPBELL MACDONALD, A.R.T.C., M.I.Chem.E.

Lately some prominence has been given in the technical literature to the methods for returning process waters worked out for Swedish factories by WINTZELL and LAURITZSON¹. A commentator expresses the opinion that this process "appears to be a definitive solution of the waste-water problem." With respect we must disagree with this opinion.

The factory with which we are associated has been re-using its process waters with a large measure of success for the last seventeen campaigns. Nevertheless, despite the enormous amount of work done both in the laboratory and in the factory during this period on the subject we are chary of "definitive solutions" of the problem for, owing to the complexity of the organic chemistry and biology of the constituents of sugar beet, we freely acknowledge that the more we know about the subject, the more we realize we have still to understand.

Be that as it may, we claim to be the first to recognise at a very early stage in our experiments that difficulties in diffusion when re-using process waters were biological, being caused for the most part by fermentations. This was opposed to the view held by our Continental colleagues that slow diffusion was the result of "ponding" of the filter-bed of cossettes at the top of each cell by the particles of fine pulp and colloidal matter present in the returned waters.

Consequently, it was logical that about twelve years ago we experimented with an acid system, almost similar to that now put forward by WINTZELL and LAURITZSON, whereby the returned waters were

treated with an inorganic acid to a pH below 4.5 as it was clear that the fermentations, optimum at 4.9, could not exist at or below pH 4.5. This had the desired result of sterilizing all waters and pulps in process, so that gas formation ceased in the diffusion battery with consequent increase in its speed and capacity. Unfortunately, other undesirable phenomena appeared and we were soon forced to abandon the process for the following reasons:

(1) *Corrosion*. When re-using process waters between 3 and 4 pH , corrosion of plant is positive. The Swedish Technologists do not report corrosion of any consequence, but they have only been experimenting with the complete re-use of process waters for the last two or three years, and we maintain, as old campaigners, that positive corrosion which does not appear to be of consequence in three years, can mean scrapping valuable plant in ten years. Again in our experiments we found that a mixture of an inorganic acid like sulphuric with an organic acid like acetic, is much more intensely corrosive than each of these acids separately at the same pH . Consequently, any breakdown of the sulphuric acid dosing plant can mean the production of acetic acid in the process by fermentation and when the inorganic acid addition is restarted a mixture is created which will not only corrode mild steel but will attack bronze and even stainless steel.

(2) *Inversion*. When re-using process waters containing up to 1.5 per cent. sucrose at 3.2 pH for over 90 minutes at 70°C. inversion of the sucrose is positive. Our Swedish colleagues do not find any increase of

invert sugar of any consequence, but surely this is no proof that sucrose has not been destroyed. With the complexity of other organic matter present we suggest the reaction goes in that time beyond simple inversion by secondary hydrolysis. We certainly found that the ratio, sucrose to impurity, fundamentally changed after the addition of acid and there can be no question that sucrose is too valuable to destroy, even to get the diffusion battery working faster, especially when other safer methods are available. It may be of interest to note that the waters are out of battery circulation in the Swedish technique for over two hours whilst with our method they are only out of battery circulation for less than 15 minutes.

(3) *Economic.* When re-using process waters at low pH and 70°C. a decrease in the amount of dry pulp produced is positive. We found this to be the most serious objection to the acid process for, as opposed to working with the returned waters at pH 6.5, we produced at least 0.5 per cent. on beets less dry pulp. In a campaign of 250,000 tons beet this means a loss of 1250 tons dry pulp, a condition which no efficient factory would tolerate. The likely cause of this decreased dry pulp production is the action of the acid on the "furfurogenic substances" mostly hemicelluloses or pentosans and pectin which are found in the middle lamella of the cell walls of the beet. These substances, according to SMOLENSKI, constitute 78 per cent., as against 22 per cent. cellulose, of beet marc. In both acid and alkaline solutions these pentosans and pectic substances are more or less extracted in changing condition, for example, as pectic acid which is then precipitated from the raw juice as calcium pectate in the carbonatation so that this valuable feeding stuff is discarded to waste with the filter press cake instead of being bagged as dried pulp where it belongs.

This action of the acid on these substances also tends to explain in part, at least, why the pulp extracts better and presses better in acid medium, for any change that increases the cellulose ratio to pectin in the beet cell wall constituents would have this effect, bearing in mind the non-colloidal and colloidal properties of cellulose and pectin respectively. This acid hydrolysis of the furfurogenic substances in plant tissue is well-known and widely used in industry for the production of cellulose and its derivatives, nitro cellulose, textiles, rayon, plastics, lacquers, adhesives, cellophane and other foils, etc. from wood, cotton, straw, esparto grass, etc. Other examples are the retting of flax for linen manufacture, the production of pectates from apples or citrus fruits, the preparation of pulp from wood, straw, etc. for paper manufacture, the production of wood sugar, manufacture of the pentose sugar xylans from peanut hulls, the production of ethanol, acetic acid, furfural, etc. from maize or other vegetable wastes, etc., etc.

All these examples have as their definite object the separation of the pentosans and pectins from the cellulose of plant cells, but surely this is detrimental and can pay no dividends in the beet sugar factory, which is only interested at present in producing the maximum amount of sugar, molasses and dry pulp. Any additional product of value which could interest us in the future can always use the dry pulp as raw material, provided it has its full quota of hemicelluloses and pectin, a condition that can only exist with controlled neutral extraction in the diffusion process. Acid extraction will certainly dissipate these valuable substances in the filter press cake, or the molasses, where the hydrolyzates will hold valuable sucrose in solution.

It should be mentioned that we found that chloring or bleaching powder had much the same effect on the beet pulp as acids and that is what we meant when we said elsewhere that they have been used "with only partial success."

Another economic objection to the Swedish process is the expense of plant and labour required to work it, as well as the continuous cost of the acid.

In conclusion, we are convinced that the method of sterilization with heat, neutralization with lime, and minimum time in circulation, outlined in our recent article¹ is, on balance, still the best method of re-using process waters in the beet sugar factory. It has the advantage over the Swedish process of minimizing corrosion, minimizing inversion, producing a maximum of dry pulp, increasing the amount and feeding value of the pulp by calcium mineralization, and minimizing plant expense and cost of labour and materials necessary to work it, without having any significant disadvantages. However, this will certainly not be our last word on the subject as we continue to work on this very interesting problem.

U. S. BEET CROP.—A table was recently published by Willett and Gray² giving (a) sugar produced in the U.S. beet industry in long tons and (b) factories operated, some of the figures being: 1888-89 (a) 1,861 (b) 2. 1910-11 (a) 455,220 (b) 63. 1930-31 (a) 1,075,688 (b) 78. 1943-44 (a) 837,500. (b) 72.

A CORRECTION AND EXPLANATION.—In our October issue, 1944, p. 261, it was stated that the requirements for the production of 1000 tons compost per annum were 250 labourers, 45 animals and the necessary organic matter; emphasis was laid on this apparently large demand by adding that a better unit would be man-hours. That statement was an unfortunate mis-reading of the original article. The requirements are for the waste products, excreta and so on, of that number of natives and animals. Additional labour is insignificant and, in the example quoted, is nil, the two boys always employed merely having a little more to do. The fact is that the process fits so well into the standard estate practice that costing is practically impossible. On any estimate the cost would be less than 1s. 6d. a ton. The "necessary organic matter" refers to vegetable wastes, bagasse, cane tops, trash and so on. More recently, abattoir refuse has been used as additional animal waste.

Experiments on De-Liming Clarified Juice.

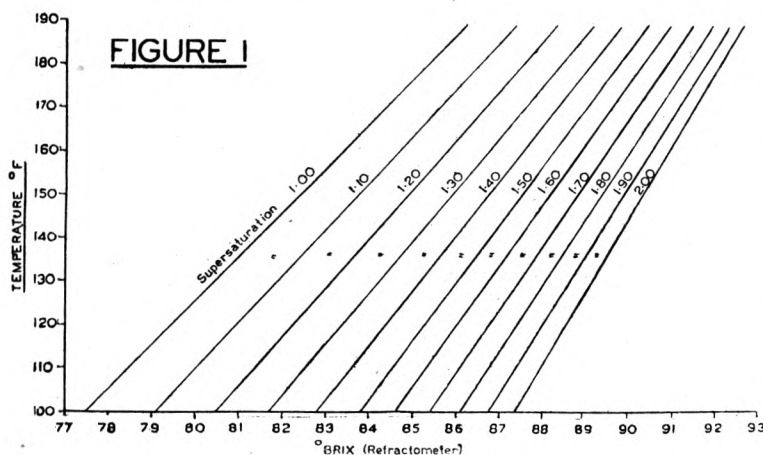
By R. D. E. YEARWOOD,

Department of Sugar Technology, Imperial College of Tropical Agriculture, Trinidad.

Trisodium phosphate has been shown by the Department to be the cheapest and most efficient liming agent of the chemicals tried. Under certain conditions, especially when the calcium content of the clarified juice was high or when the addition of trisodium phosphate was followed by evaporation to syrup, the amount of calcium eliminated from the juice greatly exceeded that which was theoretically possible. For purposes of comparison the weight of calcium actually precipitated was expressed as a percentage of the amount which should theoretically have been precipitated by the added phosphate. The figure thus obtained was called the "efficiency of de-liming." It follows therefore that in all cases

C. MERCEDITA. MOLASSES (JUNE 1944).

68.48 Suc./Refr. PURITY



where the actual precipitation of calcium exceeds that which is theoretically possible a de-liming efficiency of over 100 is recorded. The present work may be described as an examination of such high de-liming efficiencies.

Experimental.—The procedure was generally similar to that formerly used. In the previous work, however, the amount of calcium precipitated was estimated by difference (calcium in clarified juice—calcium in de-limed juice). Further, the calcium in both the clarified juice and the de-limed juice was estimated by analysing a 50 ml. sample of each, the results being expressed as CaO per cent. juice. This gave the CaO removed per cent. clarified juice which, on being multiplied by the weight of juice, gave the weight of calcium removed. This expressed as a percentage of that which should theoretically have been precipitated gave the efficiency. The method is open to the criticism of being an indirect one as

compared to an analysis of the total precipitate. It also suffers from the drawback that any error due to sampling or analysis is multiplied by over 500 because the amount of clarified juice used was 500 ml. and its weight was therefore $500 \times \text{sp. gr.}$

It was accordingly decided to check the weight of calcium in clarified juice against that in de-limed juice + precipitate. At first many difficulties were encountered until various improvements were included in the method. The modified procedure was as follows: Raw juice from B 3013 cane variety was clarified by the simple lime—heat method usually employed in B.W.I. sugar factories and settled. The clear juice was drawn off and filtered. The muds were discarded, since only the filtered clarified juice was required for the experiments. Part of the clarified juice was then de-limed by adding trisodium phosphate at the rate of 1.0 ml. of a 2.0 per cent. solution per 500 ml. of juice, followed by boiling for one minute.

The precipitate formed was then separated from the juice by filtration through a Buchner funnel using a Whatman No. 40 filter-paper (containing no calcium). The details of filtration were found to be very important. The method eventually adopted comprised first washing the precipitate with hot water until the filtrate showed no sign of colour. These washings went into the de-limed juice. This was followed by removing the filter-paper from the Buchner funnel which was subsequently washed first with hot water and then with dilute hydrochloric acid (10 per cent. strength). This procedure was found to be necessary in order to remove all particles etc. clinging to the funnel. The washings, after the removal of the filter-paper, were collected and analysed separately for CaO. The CaO found was added to that present in the precipitate.

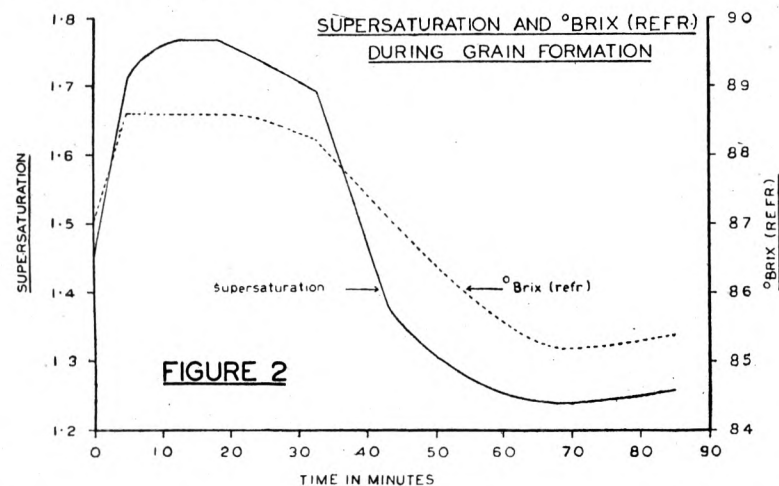
In all experiments blank tests were run by simply heating the clarified juice without adding any chemical. This secondary heating in all cases caused precipitation to occur. The subsequent filtration and analysis were the same as for the de-limed juice.

One of the factors previously shown to have a great influence on the efficiency of de-liming was the calcium content of the clarified juice. It was therefore decided to carry out a series of experiments in which clarified juice of different calcium contents were de-limed and analyses of both de-limed juice and precipitate were conducted. In order to do this, the calcium content of the classified juice in certain runs was boosted either by the addition of a neutral

EXPERIMENTS ON DE-LIMING CLARIFIED JUICE

solution of calcium chloride or by over-liming the raw juice.

Several tests were run on comparatively small quantities of juice, but the amount of precipitate obtained for analysis was rather too small. It was therefore decided to increase the amount of clarified juice used in each experiment. Finally it was found that batches of 2 litres were satisfactory.



From the analytical results the weight of calcium removed and the efficiencies of de-liming have been calculated and are presented in Table I.

TABLE I.

Run No.	Date	By Difference (grm.)	By Ppt. (grm.)	Theoretical cal (grm.)	Efficiency (By Diff.)	Efficiency (By Ppt.)
1..	27/4/44..	0.0088..	0.0091..	0.018 ..	48.9 ..	50.6
2..	5/5/44..	0.0144..	0.0153..	0.0135..	106.7 ..	113.3
3..	12/5/44..	0.0064..	0.0062..	(0.018 ..	(35.6) ..	(34.4)
4..	19/5/44..	0.0087..	0.0083..	(0.018)..	(48.3) ..	(46.1)
5..	2/6/44..	0.0080..	0.0078..	0.018 ..	44.4 ..	43.3
6..	6/6/44..	0.0214..	0.0216..	0.018 ..	118.9 ..	120.0
7..	7/6/44..	0.0091..	0.0087..	(0.018)..	(50.6) ..	(48.3)
8..	15/6/44..	0.0118..	0.0113..	0.018 ..	65.6 ..	62.8
9..	16/6/44..	0.0048..	0.0040..	(1.018)..	(26.7) ..	(22.2)
10..	18/7/44..	0.0049..	0.0051..	0.018 ..	27.2 ..	28.3
11..	19/7/44..	0.0124..	0.0086..	0.018 ..	6.89 ..	47.8

In Runs 6 and 7 the calcium content of the clarified juice was boosted by the addition of calcium chloride. Before discussing the results there are one or two things which require further elucidation. Runs 3, 4, 7 and 9 were blanks, that is the clarified juice in these runs was only subjected to a secondary heating without the addition of trisodium phosphate. It is therefore evident that under these circumstances there could be no "theoretical" precipitation, and therefore no efficiency figure for calcium removal. There was, however, an actual precipitation and in order to compare it on equal terms of efficiency with those runs in which 1.0 ml. of 2 per cent. trisodium phosphate solution was added per 500 ml. of clarified juice, it was assumed that a similar amount had been

added to the blanks. The figures concerned are shown above in brackets.

From Table I it can be seen that in only two out of eleven runs were efficiencies of over 100 obtained, which is very different from the results previously obtained. No reason for this has been found, but it is thought that the different quality of the juice may have been partly responsible, because in the early

part of the crop season some three months were taken in preliminary experiments and in developing a reliable analytical procedure. Thus, the juices on which the trials herein reported were made from over-ripe cane which had begun a new cycle of growth following the start of the rainy season.

In order to examine the results further, Table I has been sub-divided into Tables II and III. Table II contains the figures of the blank runs (those in which the clarified juice was submitted to a secondary heating only without the addition of trisodium phosphate) whereas in Table III are shown those of the de-limed runs. In both tables the runs are in order of ascending CaO contents of the clarified juices.

Further, it should be noted that in the last five experiments (Runs 7 to 11 inclusive) the juice was considered to be particularly poor (judged on the way it clarified). These runs have been labelled "poor".

TABLE II.

Run No.	CaO % Cl. Juice	Efficiency (By Diff.)	Efficiency (By Ppt.)	Juice Quality
3.....	0.04781 ..	35.6 ..	34.4 ..	Fair
4.....	0.07400 ..	48.3 ..	46.1 ..	Fair
9.....	0.10359 ..	26.7 ..	22.2 ..	Poor
7.....	0.11169 ..	50.6 ..	48.3 ..	Poor
Total	0.33709 ..	161.2 ..	151.0 ..	—
Mean	0.08427 ..	40.3 ..	37.8 ..	—

TABLE III

Run No.	CaO % Cl. Juice	Efficiency (By Diff.)	Efficiency (By Ppt.)	Juice Quality
10	0.04900 ..	27.2 ..	28.3 ..	Poor
5	0.05676 ..	44.4 ..	43.3 ..	Fair
2	0.06793 ..	106.7 ..	113.3 ..	Fair
1	0.07281 ..	48.9 ..	50.6 ..	Fair
11	0.08195 ..	68.9 ..	47.8 ..	Poor
8	0.11487 ..	65.6 ..	62.8 ..	Poor
6	0.13603 ..	118.9 ..	120.0 ..	Fair
Total	0.57915 ..	480.6 ..	466.1 ..	—
Mean	0.08274 ..	68.6 ..	66.6 ..	—

The first observations to be made is that the average "efficiency" recorded in the blank runs (Table II) is equal to about two-thirds of that in

which trisodium phosphate was added (Table III). If allowance is made for this, it becomes apparent that the net efficiency of the trisodium phosphate is reduced to about 30 and on no run could there be a net efficiency of over 100.

Another point which should be noticed is that in both the blank and de-limed runs there is a tendency for the efficiencies to increase with an increase in the CaO content of the clarified juice. In order to see the trend, however, it is necessary to consider the results of the two classes "fair" and "poor" separately. If this is done, the only run which does not fit into the trend is Run No. 2.

It is also evident that juice quality affects the results appreciably. The efficiencies in the runs labelled "poor" being much lower than those in the runs marked "fair."

CONCLUSIONS.

The most accurate estimate of the quantity of calcium removed from the juice is thought to be obtained by analysis of the whole of the precipitate produced by de-liming two litres of clarified juice. It has been found that a secondary heating without the addition of trisodium phosphate causes precipitation to occur. In only two out of eleven runs have de-liming efficiencies of over 100 been recorded. It is thought that the over-ripe condition of the juice in the present trials may have been partly responsible for the low de-liming efficiencies observed. When the average precipitation brought about by the secondary heating only is deducted from the precipitation occurring in the de-liming juices, it is clear that on no occasion is there a net efficiency of over 100. There is an indication that the higher the calcium content of the clarified juice the higher is the efficiency of de-liming.

Chemical Reports and Laboratory Methods.

The Gas Test for Boneblack.¹ A. B. BABCOCK. *Presented before the American Chemical Society, Division of Sugar Chemistry and Technology, Detroit, Mich., 1943, and Sugar Industry Engineers, New York.*

Between each filtration cycle the spent boneblack (animal charcoal) must be revived first by washing in order to remove the ash, and then by heating to about 1000°F. (538°C.) to destroy the organic matter. These organic impurities are driven off in the form of a gas containing CO₂, CO, and a constituent resembling methane, this latter being about 40 per cent. of the total. Normally, the volume of the gas is from 5 to 10 times that of the boneblack, but in extreme cases may be as much as 40 times.

There is a very definite need in the refining industry for a quantitative test to show how well a boneblack has been revived, and how much work the spent material has done. As the work done consists principally in adsorbing organic impurities, and as its revivification by heat means destroying this organic matter, the most positive test one could have for determining the condition of the black would be to measure the volume of gas given off, using 1000°F. (538°C.) as the standard temperature. This volume of gas should be proportional to the amount of organic matter in the sample.

Briefly the apparatus consists of a small chrome steel retort, suspended by a collar in a small electric furnace capable of raising the temperature of the contents to about 1200°F. (650°C.). It is connected to a copper gas receiver, having a volume of about 655 c.c. It is provided with a thermometer, and is connected to a vacuum pump and a U-tube manometer. In order to find the amount of gas evolved

from the boneblack, its actual volume in the apparatus at the start and at the finish must be calculated, the difference being calculated to normal conditions of temperature and pressure. This volume divided by the weight of black used in the retort gives the c.c.

Numerous determinations by this method established the fact that the number of colour units adsorbed by the black is approximately proportional to the gas evolved. In another series of tests, the same quantity of low-grade liquor was filtered over different grades of boneblack, when the gas tests showed gas volumes proportional to the colour removed. In yet another, the different screen sizes of the same boneblack were used, the smaller sizes being shown to remove more colour and consequently to give a higher gas test.

In order to show the maximum work that boneblack can do, large quantities of affination syrup of approximately 80 purity were filtered for a period of several days over No. 1 boneblack, weighing 50 lbs. per cub. ft. and over new boneblack after washing and burning. These gas tests showed that new boneblack is capable of removing enormous quantities of organic matter, and that the boneblack in everyday refinery use is a long way from being completely exhausted. Ordinarily it does much less than half the work it could do. Another point established was that the gas test of a revived black was capable of indicating the temperature at which it had been revived.

Often the statement is made that if the kiln retorts are not properly vented so that the gases may escape they will be re-adsorbed by the char, causing it to do less work during the ensuing filtration cycle. This could not be the case. When boneblack is cooled to 300°F. (150°C.) in contact with the gases given off,

¹ A short abstract of this paper has already appeared, See *I.S.J.*, 1943, p. 211.

only about 1 c.c. per grm. of gas is adsorbed. In any case the ability of the black to adsorb organic matter again could not be affected by this adsorbed gas any more than it would be by some oxygen and nitrogen adsorbed from the atmosphere. The paper concludes by stating that the gas test is simple to make, and should be established as a standard control in refineries.

Sterol Separation from Cane Wax. C. VENKATARAO and M. NARSINGARAO. *Proc. 12th Ann. Conv. Sugar Tech. Assoc. India, I*, pp. 191-194.

In this paper an account is given of a successful attempt to separate cane wax into high and low melting portions by extracting it with methyl-ethylketone (B.pt., 82°C.). It was further found that the soft portion contained almost all the sterol portions of the wax. Following this, the non-saponifiable fraction of this soft wax was subjected to chromatographic separation, and a semi-quantitative concentration of the sterols thus effected.

A fairly large quantity of dried press cake was extracted by carbon tetrachloride, when a yield of 9.2 per cent. of wax was obtained; 100 grm. of it were repeatedly extracted with methylethylketone, when 57 grm. of insoluble and 43 grm. of soluble material were obtained, figures for which portions are to be seen in the following table:—

Fraction	M.Pt.	Saponi- fication Value.	Iodine Value.	Free Acidity	Appear- ance
A, Cane wax from press cake	68°C...	139°C.	53.8...	20.3	Green
B, Soluble in m.e. ketone.	53.5°C...	144.2...	69.6...	46.4	Green soft and sticky
C, Insoluble in m.e. ketone	81.5°C...	136.1...	42.0...	1.7	Hard, brittle and dark.

Next, 40 grm. of the soft wax were saponified with 5-N alcoholic potash, the alcohol distilled off, and the saponified mass mixed with dry pumice stone and repeatedly extracted with ether in a Soxhlet apparatus. The non-saponifiable matter was taken up in ether, and washed well with water to free it from any soap. The ether was distilled off, when 23.6 grm. of dry non-saponifiable matter was obtained, which was subsequently subjected to chromatographic adsorption analysis.

Although this chromatographic technique was developed by TSWETT as far back as 1905¹ for the rapid separation of closely related colouring substances, as the chlorophylls, the carotenoids, and other pigments, it only came to be widely used in 1931. Since that date, this elegant method has come to be used for colourless organic compounds, and even in more recent years for inorganic compounds as well. In the case of pigments, alumina is the usual adsorbent, though silica and magnesia are also sometimes used.

In the experiment under consideration a 2.5 per cent. solution of the non-saponifiable matter in methyl alcohol-acetone was slowly passed through a vertical column of alumina contained in a glass tube (8 in. × 1½ in.), which was finally washed out with the same warm solvent. Finally, the alumina column was pushed out of its tube, and divided into three parts, each of which was separately extracted with boiling 1 : 1 benzene-methyl alcohol mixture. On analysis the following figures were obtained.:

Fraction of the Column	Colour	Weight	Specific Rotation	Melting Point.
1....Colourless.....		0.40	—25	109-111°C.
2....Colourless.....		0.68	—22	108-112
3....Light Yellow.....		1.42	—10.6	101-104
4....Filtrate (brownish-yellow.....)		6.94	—7.2	40-42

The solid obtained from the filtrate was twice crystallized from 3 : 1 methyl alcohol-acetone mixture, when shining plates melting at 129-130°C. were obtained. Myristic alcohol could be identified in the mother-liquor. It was to be seen, therefore, that the sterol portions are selectively adsorbed by the alumina.

High Frequency Heating. L. HARTSHORN. *Jl. Roy. Soc. Arts*, 1944, 93, No. 4681, pp. 38-49.—Industrially it can be used for bonding plywood boards with synthetic resins, and for special drying jobs, in which it is essential to heat the inner layers of the material at least as much as the outer ones. It is particularly useful for generating heat within a substance, and in effecting localized heating. But for technical drying jobs in which much water is to be removed (as of grass) it would put the price up too high.

Temperature Corrections in Juice Polarizations. G. S. MOBERLY. *Proc. 18th Congr. South African Sugar Tech. Assoc.*, 1944, pp. 24.—In this article the author discusses the influence of temperature corrections in calculating the uncorrected Brix of the aliquot portions of mixed juice used for the JACKSON and GILLIS sucrose determination, as specified in the "Recommended Methods of Chemical Control," published by the South African Sugar Technologists' (p. 27). It is concluded that the temperature correction to be applied to the corrected Brix should be that of the solution at the time of polarization, not that at the commencement of the analysis, nor yet that resulting from an average of the original temperature. Nor again is the weighted average uncorrected Brix the correct figure to use. In methods of analysis other than the J. & G. double polarization, every reference to "uncorrected Brix" in the descriptions of methods of polarization should be substituted by "corrected Brix adjusted to the temperature of the solution at the time of polarization," for which the author suggests the simple term "polarization Brix."

¹ *Ber. deut. bot. Gesell.*, 1906, 24, pp. 316, 384; 29, p. 630.

New Books and Bulletins.

Motor Fuel from Molasses. [Dr. WILLIAM L. OWEN. (Sugar, 2 West 45th Street, New York). 1944. Price : \$5-00.

Dr. OWEN, well known specialist of Baton Rouge, Louisiana, here collects recently published articles discussing a variety of topics connected with the production of motor fuel from molasses. "Jeanite" is a motor fuel made from molasses, which has practically the same octane number and other properties as gasoline, pertinent data relating to the production of which are given. Other chapters deal more specifically with alcohol motor fuel, production costs, marketing problems, and the technical management of fermentation and distillation, the following being a summary of the principal contents :

Economic Areas where Production would be most likely to prove Profitable. Initiating a Program for producing Motor Fuel from Surplus Molasses. Comparative Value of the Motor Fuel Program as a Means of absorbing large Surpluses of Molasses or Grain. The Motor Fuel Program as integrated with the Milling of the entire Cane Stalk. Value of a Survey of the Potentialities of a Sugar producing Area for converting its Surplus Molasses or Grain into Motor Fuel or Chemicals. Factors affecting the Cost of producing Ethyl Alcohol for Motor Fuel Alcohol from Molasses in the synthetic Rubber Program. Methods and Processes of converting Alcohol into Butadiene. Adapting Sugar Factories to producing Ethyl Alcohol during the idle Season. Deterioration of Molasses in Storage.

The South African Sugar Yearbook, 1943-44. No. XIV.

Compiled by The Editor, *The South African Sugar Journal*. (Published by the S.A.S. Journal, Smith St., Durban) 1944. Price : 5s.

In spite of the shortage of paper, the publishers have succeeded in producing a Yearbook replete with useful information. It especially includes an important review of the South African Sugar Industry, which discloses the essential facts bearing on the production and disposal of sugar in that country. It is an authoritative survey which will dispel much of the misunderstanding that has given rise to unjustified rumours of its general uneconomic operation. It also reproduces an opinion by Mr. ODY H. LAMBORN on the world sugar position, and a contribution by Dr. O. W. Wilcox on the probable trend of International sugar legislation. Besides this there are the reports for 1943 and 1944 of the S.A. Sugar Association and of the S. A. Cane Growers' Association. For the rest, the Yearbook contains useful information about S. A. sugar estates and their personnel, while a Supplement gives historical records of the principal manufacturers and suppliers associated with the sugar industry.

The Chemistry of Cellulose. By EMIL HEUSER, of the Institute of Paper Chemistry, Wisconsin, U.S.A. (John Wiley and Sons, New York; Chapman and Hall, Ltd., London). 1944. Price : \$7-50.

This volume is firstly a critical digest of the literature of the chemistry of cellulose with due consideration of the microscopic and submicroscopic structure of the cellulose fibre. Emphasis has been laid on the scientific rather than on the practical application of cellulose chemistry. An attempt having been made to present the current knowledge of the subject from this viewpoint, it may be hoped that the book will be useful, not only to the scholar who wishes to inform himself about a field hitherto unfamiliar to him, or in which he intends to specialize, but also to those who practise the chemistry of cellulose in industrial and other research laboratories, and who wish to acquire or renew their knowledge of the fundamental background of their specialized activities. Secondly the book may be regarded as a textbook, inasmuch as it has been written from the point of view of presenting the subject matter in a systematic and simple manner to the student who is looking for guidance in his studies and who expects to find an unbroken and coherent treatise rather than a number of individual and loosely connected chapters. HEUSER's book may be termed the volume *par excellence* for all chemists having to carry out research on cellulose. Those investigating problems concerning cane and bagasse will find it indispensable.

The Diagnosis of Mineral Deficiencies in Plants.

T. WALLACE, D.Sc., A.R.I.C., of the Research Station, Long Ashton, Bristol. (H.M. Stationery Office.) 1944. Price : 5s.

It is explained in the preface that the large and continued demand for the "Co'our Atlas and Guide," and the increasing interest in mineral deficiencies has led the author to extend its scope and value by a supplement, which renders it more complete, and incorporates the results of investigations carried out since the original publication was issued¹. Additional crops in the Atlas include flax, sugar beet, broad bean, pea, red clover, lucerne, lettuce, radish, leek, celery, pear, plum, and sweet cherry, and further deficiencies are depicted for other crops. Nitrogen deficiency, which is not portrayed in the main edition, is shown for a number of crops, including wheat, flax and vegetable and fruit crops.

Eastman Organic Chemicals. List No 34. (Eastman Kodak Co., Rochester, 4, N.Y.)

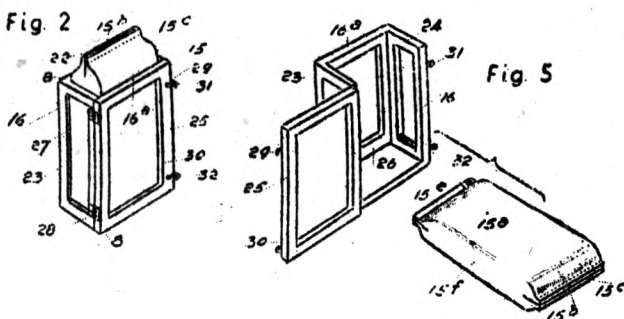
More than 3300 different chemicals (nearly all organic) made in the U.S. are found in this list, which gives the formula, m.p., b.p., and price, as well as a code letter or no. indicating the grade of material offered.

Sugar-House Practice.

Experiment on the Dehydration of Molasses. JULIO C. GONZALEZ MAIZ. *Proc. 17th Meeting Asoc. Tecn. Azuc. Cuba*, pp. 49-52.

Central Hormiguero, Cuba, was requested by the Board of Economic Warfare, Washington, to try out an experiment on the dehydration of cane molasses, so as to make it possible to export it in a dry condition in bags. This test was willingly carried out by the author, carefully following the instructions given. It was considered sufficient to reduce the water content to about 5 per cent. in order to maintain it in a solid state at temperatures up to 150°F. (66°C.). Washington also considered it would be practicable to dehydrate by boiling in open vessels, so as to use equipment such as old oil drums already at hand, thinking that so long as the temperature was not allowed to rise above 350°F. (176°C.) little decomposition would occur. Then having reduced the molasses to the water content named, it was to be filled into paper bags, which were subsequently to be sewn up and placed in a store to cool before shipment.

Accordingly, an open vessel holding about 6000 lb. of the molasses at 87°Brix, and equipped with copper coils, was used, this having plenty of space at the top to allow for the swelling and frothing of the boiling mass. Evaporation was carried out using a ratio of 2 : 1 between surface and volume. Nevertheless, it was found that decomposition of the molasses did occur to no small extent, as was demonstrated by the analytical figures given below. It was solidi-



fied to 94.6 Brix (86.12 per cent. of dry substance), and no less than 23.37 per cent. of reducing sugars were calculated to have been lost in the operation. It was, therefore, concluded that such a method of atmospheric evaporation was impracticable, and that concentration must be carried out in pans *in vacuo*, as is ordinarily done in the sugar factory.

	Before	After
Brix,	86.64	94.56
Dry matter,	54.80	42.76
Sucrose (Clerget)	40.59	18.88
Reducing Sugars	14.21	23.88
Unfermentable sugars,	2.68	8.80

In packing the solidified molasses, moulds of wood or metal on the lines shown in the drawing herewith were used. As is seen, each unit was divided through its centre into two compartments to contain a pair of bags, the outer walls opening out to facilitate the removal of the bags when filled. These units were continuously moved along in front of the weighing mechanism over which the bags were filled, after which the bags were closed by stitching, being finally sealed with paraffin. Next they were placed in racks in a store, where they remained till cool enough for handling, this taking about 24 hours. Molasses dehydrated to about 95 per cent. of water is quite hygroscopic when exposed to the air, but packed in the manner described it remains quite solid during transport. This concluded the Washington experiment, from which it is certain that atmospheric evaporation in the manner described must be abandoned. It is also certain that dehydration, which means a considerable addition to costs, will be interesting only so long as there are no tank steamers to convey the molasses from port to port.

Utilization of Sulphitation Press Mud as Fuel in Sugar Factories. T. N. VERMA and D. G. WALAWALKAR. *Proc. 12th Conv. Sugar Tech. Assoc. India*, I, pp. 37-57.

Where extra fuel is needed in a sugar factory, and is costly to transport, the use of press mud to replace it becomes a matter of some interest, worthy at least of exploration¹. First, analyses were made by the authors (of the Imperial Institute of Sugar Technology, Cawnpore) of four samples of press mud which had been air-dried, and the figures found to be as follows : Moisture, 5.0-6.36; organic matter, 58.78-71.31; ash, 23.69-25.34; total ash, 1.86-3.48 per cent. Wet cake has usually 60-70 per cent. of water, capable of being reduced by air-drying to the figure indicated above. Its ash is high, which is usually considered detrimental in a material to be used as a fuel. GOODRICH² has doubted the value of fuels with more than 25 per cent. of ash; but it is to be noted that in Holland wastes containing much more mineral matter are used for steam-raising purposes. As for the composition of the press mud ash, this was found to be of the following order : SiO₂, 25.54; Fe₂O₃ + Al₂O₃, 31.52; CaO, 25.12; MgO, 0.15; alkalis, absent; SO₃, 12.74; P₂O₅, 2.35; CO₂ and Cl₂, absent; undetermined, 2.58 per cent.

Calcium sulphate and sulphite are the principal sulphur compounds in the press mud, which compounds evolve SO₃ and SO₂ on heating to high temperatures, viz., about 900°C. In the combustion of press mud, however, the authors have observed that this decomposition takes place at comparatively

¹ *I.S.J.*, 1937, p. 321

² "Low Grade Fuels" by W. F. GOODRICH

lower temperatures, owing to the presence, they suggest, of other impurities. In order to avoid corrosion in practice when burning press mud, two precautions must be observed: (1) the fuel must be as dry as possible; and (2) it must not be used when the boiler is cold, only after it had been started on other fuel to acquire a sufficient temperature.

But the important point is the calorific value of press mud. Using a Parr oxygen bomb calorimeter the values for four samples, ash and moisture free, but containing 66.7 per cent. of bagasse, 22.0 per cent. of cane wax, and 11.3 per cent. of sucrose was 10,000 BTU/lb., the figures for bagasse and final molasses being 8400 and 7400 respectively. In carrying out boiler tests with the press mud, at first the existing coal furnace of the boiler was used, when no particular difficulty was experienced in its combustion, but the flame was entirely different from that of coal, being much longer, and the gases smoky, dark and voluminous. Later trials were made using the bagasse furnace, the press mud being in the form of small lumps, and the inclined portion of the step-grate being covered with long lipped bars to prevent the lumps dropping into the ash pit. Openings in the step-grate were blocked up to prevent the entrance of unnecessary air, and the grate was brought to the ignition temperature with an auxiliary fuel. There was no difficulty in this way in burning the press mud alone.

Comparative figures are tabulated when the press mud was burnt in (a) a coal furnace; and (b) a bagasse furnace, the equivalent evaporation per lb. of fuel being 2.09 and 2.32 lb. respectively. In the light of the observations made, and difficulties experienced, an improved type of furnace of this press mud fuel has been designed, its outstanding features being: The horizontal grate has been provided with a ratio of G.A. : H.S. : 1.70, considered sufficient for the combustion of the required quantity of fuel in its natural sun-dried state, i.e., lumps of press cake. A large combustion chamber has been provided for the efficient combustion of volatile constituents, the amount of which is very high in the case of press mud: the ratio of F.V. + C.V./H.S. = 0.3 and F.V./C.V. = 0.50 being recommended. The bridge arch is made inclined to reflect heat on the burning fuel so as to maintain a good temperature for combustion on the grate, and for giving a circuitous path to the ensuing gases. Assuming that in factory practice, dry press mud can be burnt, this would mean a reduction in the coal consumption equal to half the weight of dry mud, which is about 90,000 tons per annum (that is, one-third of the wet mud which amounts to 3 per cent. on cane).

Edible Syrup from Khandsari Molasses. J. G. SHRIKHANDE and S. B. LAL. *Indian Sugar*, 1944, 7, No. 8, pp. 270-271.—Khandsari molasses is a purer product than the molasses from sugar manufacture;

it is sweet, and makes an excellent edible syrup; but it contains a certain amount of suspended matter, which detracts from its quality. It is therefore recommended that the product be diluted with water to one-quarter of its volume mixed with kieselghur or kaolin, and heated to 100°C. for 30 min. After allowing the molasses to settle, it is filtered, and lastly re-concentrated to 78-80°C. Another suggestion is that the molasses similarly diluted be mixed with *bhendi* mucilage extract as used by gur manufacturers, the impurities being thus separated with the scums forming on the surface, which are skimmed off, after which the product is filtered, and re-concentrated. Or if *bhendi* is not available, *ghee-kuar* may be used. Khandsari molasses has the following composition: Brix, 60.2; sucrose, 32.6; reducing sugars, 15.6; ash, 5.72. Use of SO₂ and sodium hexametaphosphate (Calgon) are recommended for the improvement of the colour.

Sugar Losses by Inversion. F. A. LOPEZ FERRER. *Proc. 17th Meeting, Assoc. Cane Sugar Tech., Cuba*, pp. 45-46.—In experiments described in the 1942 Conference the author had estimated the inversion taking place in the juice treated in vertical, continuous multi-tray clarifiers to be 0.30 per cent glucose of the weight of the juice. This result was, however, withdrawn as it was found that the trays had dropped, so that cachaza accumulated on them had become decomposed. In preparation for the 1943 crop, the clarifier had been repaired, and the experiments had been repeated, in some of which formol (formaldehyde) had been injected into the lower zone of the clarifier. These are the results in terms of glucose per cent. of the weight of the juice: Without formol, 0.13; and with formol, 0.10. It is considered advisable to use formol as disinfectant in the cachaza zone of the clarifiers, preferably at the rate of 1:10,000. Or hypochlorite of lime could be used, but its dosage would have to be determined by experiment. This sucrose loss might be reduced further by using scrapers that remove the cachaza entirely, or almost so, whereas at present a deposit is left on the trays from $\frac{3}{8}$ to $\frac{5}{8}$ in. thick.

Hydrolysis of Starch by Sulphurous Acid. MASON HAYEK and R. L. SHRINER¹. *Ind. and Eng. Chem.* 1944, 36, No. 11, pp. 1001-1003.—Using pure starch, nearly complete conversion to glucose was obtained in 15 min. at 165°C. in sealed Pyrex tubes in the presence of 0.2 to 0.4 per cent. of SO₂. Satisfactory conversion were also obtained with corn and wheat mash, the glucose yields being around 95 per cent. Afterwards, the SO₂ is removed, and the sugar fermented to produce good yields of alcohol. It seems probable that the hydrolysis of starch in this way can be adopted as a continuous process, the SO₂ being recovered (if necessary) from the converted mash and re-cycled.

¹ Of Indiana University, Bloomington, Ind., U.S.A.

Review of Recent Patents.

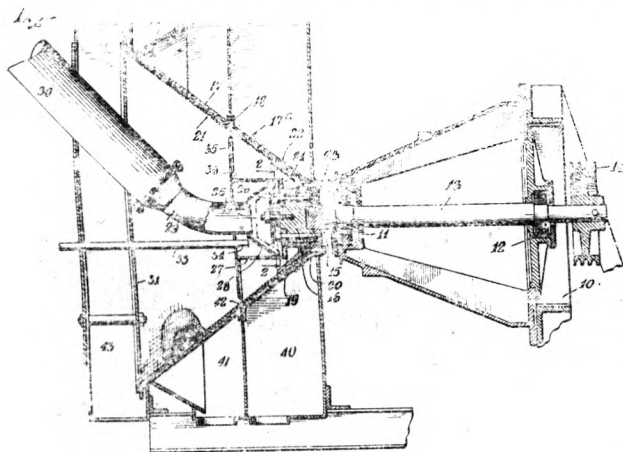
Copies of specifications of patents with their drawings can be obtained on application to the following—United Kingdom: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s. each). United States: Commissioner of Patents, Washington, D.C. (price 10 cents each).

UNITED STATES.

Continuous Action Centrifugal Separator¹. FEDERICO G. SANCHEZ, of Vedado, Habana, Cuba. 2,335,794. November 30th, 1943.

One of the difficulties encountered in the use of continuous separators is that a considerable quantity of crushed crystals are left in the molasses, and also that it is difficult properly to wash the crystals. An improved continuous-action separator comprises a cantilever-supported rotatable basket which at the larger end is spokeless and open. A feed conduit for the massecuite extends into the basket through this large open end, the wash-water supply pipe also extending through the open end. Devices are also provided for accelerating the incoming massecuite and wash-water and delivering the same to the rotating basket in the form of films which move in a rotational direction at about basket speed.

The drawing shows a transverse vertical sectional view of the separator. Parts 15, 16, 19 and 20 afford the cantilever form of support for driving the basket



from the shaft 13. The conical basket 17 is perforated in the usual way, the upper part of the 17a section being likewise perforated, and when in use, the members 27 and 28 rotate in unison with the conical basket. The massecuite descends along the pipe 30, and is delivered within the conical member 28 at the smaller end thereof by the pipe 29. On falling upon the rotating cone, the massecuite stream is gradually accelerated in speed. Centrifugal action advances the massecuite in a thin film along the conical member 28, which is finally delivered over the inner part of the cylinder 27 to the smooth surface of member 22.

Experience has shown that to secure uniformity of washing of the crystals, provision should be made for supplying the wash-water at a definite zone and in close proximity to the layer of crystals on the screen, 33 designating the supply pipe. The rotation of the disc 35 accelerates the water, which is delivered off the periphery over the crystal layer on the screen in such a way that the rotational speed of the water approximates that of the crystals. By delivering the water in this manner, thorough washing of the sugar crystals is secured and all atomizing and splashing effects are avoided. Lastly, in the operation of the apparatus molasses substantially free from wash-water is entrapped in housing 40; while molasses containing the wash-water is entrapped in housing 41. Dry sugar crystals will be delivered over the outer edge of the conical basket and will be caught in a sugar entrapping housing 43.

Claim 1: A continuous action centrifugal separator comprising a screened frusto-conical basket continuously rotatable about a substantially horizontal axis, driving means connected to the smaller end of said basket for supporting and rotating the same, said driving means being located substantially entirely outside said basket, a frusto-conical distributing element rotatable with and received coaxially within said basket, the space between said distributing element and said basket being entirely unobstructed, the larger end of said distributing element being directed towards the smaller end of said basket, the larger end of said distributing element being open around substantially its entire inner edge which constitutes its discharge end, a massecuite supply pipe projecting into the larger end of said basket and delivering into the inside of and through the smaller end of said distributing element, a chamber located around said basket for receiving molasses discharged through the screened portion thereof, a receptacle for receiving sugar delivered beyond the larger end of said basket, and inclined baffle means arranged intermediate said chamber and receptacle and adjacent the larger end of said basket to prevent undesired intermixture of sugar and molasses.

Sugar Granule Manufacture. JOHN W. SCHLEGEL and LOUIS LANG. 2,347,388. (Assignor to THE NATIONAL SUGAR REFINING CO., of Edgewater, N.J. April 25th 1944.

This invention relates particularly to the manufacture of a granular sugar product of the kind in which each granule is composed of compacted crystals and non-crystallizable materials retained from the original raw syrup, so incorporated in the mass of each granule

¹ See U.S. Patent, 2,096,594; *I.S.J.*, 1938, p. 203. Also *I.S.J.*, 1942, pp. 17-18.

as to produce a non-sticky, free-flowing and non-caking product suitable for sprinkling on food¹.

The machine comprises an apparatus for converting hot crystallizable syrup to granule form comprising a trough with a series of trough-borne fingers, means for delivering the syrup to one end of the trough, a rotary shaft with a series of shaft-borne fingers working in the interspaces of the other fingers, said series of trough-borne fingers being co-extensive with the series of shaft-borne fingers, and a second series of trough-borne fingers co-acting with the shaft-borne fingers only at the syrup-receiving end of the trough, the clearance of the shaft-borne fingers from one of the series of trough-borne fingers at said receiving end being not substantially greater than the diameter of the product granules.

Immediately on entering the trough of the granule former, the syrup begins to crystallize, becoming a thick paste which is worked by the blade elements with a cutting and, more especially a rubbing or rolling action, which automatically divides the mass into small pill-like bodies or granules as it is slowly worked along the trough toward the discharge outlet. Each granule is composed of many fine sucrose crystals compacted together by the action of the blades.

The pill-like condition is more or less critical and it is important the rubbing action should cease as soon as it occurs, which is to say, at that point along the trough where such conditions has been attained in a maximum degree and where further working would serve only to increase the production of fines or powder by the attrition effect of the blades on the granules and of the granules on each other. By proper adjustment, by far the larger part of the entering stock, estimated at about 70 per cent is converted by this machine into product-sized granules, in the range above given, thereby putting but a relatively small burden on the classifying part of the system.

Sugar Refining Process (Elimination of Ash in Beet Sugar Manufacture). CHAS. D. and PAUL R. BARBER, of Green Bay, Wis., U.S.A. 2,350,143. May 30th, 1944.—What the inventors claim is: "The process of producing sugar of low ash content which consists in liming and subjecting the raw juice to a first carbonatation treatment and a sulphitation treatment, then adding calcium chloride to the juice, then filtering, evaporating and subjecting the juice to another sulphitation treatment to remove the sulphur, again adding calcium chloride, concentrating the juice to produce a sugar of low ash content and a brown sugar syrup, and then re-entering the brown sugar syrup into the process at the point where the calcium chloride is first added." In the text of the specification, it is mentioned that trisodium phosphate is added after the first carbonatation "to lower the

lime salts present in the juices and facilitate the evaporation and crystallization."

Activated Carbon. ALAN C. STONEMAN, of Los Angeles, Cal., U.S.A. 2,354,713. August 1st, 1944.—Claim 9:—The method of making improved activated carbon from finely divided char comprising relatively low density and high density particles and having an average specific gravity between 0.35 and 0.52 and produced by partial carbonization of carbonaceous shells of the group consisting of peach pits, apricot pits, and walnuts; that includes removing from said char particles thereof having an average specific gravity below about 0.35 by separating the char particles in accordance with their relative densities, and thereby obtaining a higher density residual material, and subjecting said residual material to carbonization to produce an activated carbon product having an average specific gravity between 0.30 and 0.45.

FUNGICIDAL TREATMENT OF CANE CUTTINGS.²—Treatment of sugar cane cuttings with a suitable fungicide prior to planting has been found to result in a more vigorous germination, thus reducing the replanting of "blanks" to a minimum. Among the most promising proprietary preparations under trial are those known as Aretan, Verdasan, Ceresan and Agrosan, all of which contain organically combined mercury. They are used in 0.5 or 1 per cent. solution; About $\frac{1}{4}$ lb. of the preparation is used per acre, making the cost of application of such preparations to work out at 1s. 9d. per acre.

PROF. W. N. HAWORTH, F.R.S.—"M.S.N." recently gave some particulars of this distinguished chemist, who is generally regarded as the leading authority on the chemical constitution of the sugars. He was the first British organic chemist to receive a Nobel prize. It was in 1915 that he began his researches on the different forms of glucose, and on the arrangements of the atoms in sucrose, maltose, starch and cellulose. These researches proved that the normal structure of the simple sugars from which the more complex moleculars of starch, cellulose and glycogen are derived is a six-membered ring. In 1933 he synthesized ascorbic acid, and later identified the product with vitamin C. He has been Professor of Chemistry at Birmingham University since 1925, where a fine new laboratory with an energetic team of workers has been created under his direction. His book "The Constitution of Sugars" is well-known.

FACTORS IN WOOD DECAY.³—The most important physical condition influencing the rate of decay of wood is of course its moisture content, and no decay can occur in wood containing less than 20 per cent. of water (on the dry weight). Decay proceeds very slowly in wood below the fibre saturation point of 27 to 30 per cent. Since wood rotting fungi are essentially aerobic organisms, they cannot grow in wood which contains less than a certain minimum amount of oxygen. Therefore the optimum moisture for the growth of any fungus is related to its density, i.e., to the amount of air space which it contains; on the average it ranges between 35 and 45 per cent. for most fungi in ordinary timbers. Temperature of course has an important influence on the rate of growth of wood rotting fungi, the optimum for most species being about 30°C., and with a few above 35°C.

¹ I.S.J., 1944, p. 82.

² A. McMARTIN in S. A. Sugar Journal, 1944, 28, No. 12, p. 509.

³ Chemistry and Industry, 1945, No. 7, p. 55.

Stock Exchange Quotations.

LONDON STOCKS, at March 27th, 1945.

ANGLO-CYLON	36/6	— 38/0
ANTIGUA SUGAR FACTORY (£1)	16/3	— 18/9
BOOKER BROS. (£1)	3 ³ / ₁₆	— 3 ⁵ / ₁₆
CARONI Ord. (2s.)	1/3	— 1/9
„ 6% Cum. Pref. (£1 shares) ..	19/9	— 20/9
GLEDHROW CHAKA'S KRAAL (£1) ..	1 ¹ / ₂	— 1 ¹ / ₂
HULETT & SONS (£1)	34/0	— 36/0
INCOMATI ESTATES (£1)	16/6	— 18/0
LEACH'S ARGENTINE (10s. units) ..	8/1 ¹ / ₂	— 8/7 ¹ / ₂
REYNOLDS BROS (£1)	42/0	— 44/0
ST. KITTS (LONDON) (£1)	2 ¹ / ₂	— 2 ¹ / ₂
STE. MADELEINE (Ord.)	15/3	— 16/3
SENA SUGAR ESTATES (10s.)	15/7 ¹ / ₂	— 16/1 ¹ / ₂
TATE & LYLE (£1)	73/9	— 74/9
TRINIDAD SUGAR (5s. Ord., 4s. stk. units)	4/7 ¹ / ₂	— 5/1 ¹ / ₂
UNITED MOLASSES (6s. 8d. stock units)	37/9	— 38/1 ¹ / ₂

NEW YORK STOCKS, at Feb. 28th, 1945.

AMERICAN CRYSTAL	\$ 18 ¹ / ₂
AMER. SUGAR REF. Co. (\$100)	50 ³ / ₈
CENTRAL AGUIRRE	22 ¹ / ₂
CUBAN AMERICAN (\$10)	18 ¹ / ₂
GREAT WESTERN SUGAR	29 ¹ / ₂
SOUTH P.R. SUGAR	44

United States, All Ports.

(Willett & Gray)

	1945 Long Tons.	1944 Long Tons.
Total Receipts, Jan. 1 to Feb. 3	432,170	381,309
Meltings by Refiners „ „ „	449,688	411,678
Importers' Stock, Feb. 3	—	—
Refiners' Stock „ „	185,262	266,336
Total Stock „ „	185,262	266,336
	1944	1943
Total Consumption for 12 months	5,725,249	5,263,624

Cuba.

(Willett & Gray)

	1945 Sp. Tons.	1944 Sp. Tons.
Carry-over from previous crops	680,176	559,119
Production to date „ „ „	450,000	800,000
	1,130,176	1,359,119
Exports, Jan. 1st to Feb. 3rd	347,750	307,442
Stock (entire Island) Feb. 3rd	782,426	1,061,677

Grinding started January 15th.

Brevities.

GEORGETOWN'S FIRE.—The most disastrous fire in the history of British Guiana broke out in Georgetown on February 23rd. As nearly every building in the city is constructed of wood, the fire quickly spread from the assembly rooms area, where it started, to the congested parts near the riverside. An important section of the business centre, the city's two banks, the General Post Office and the valuable museum and library of the Royal Agricultural and Commercial Society, as well as the offices of the *Daily Argosy* were destroyed. Only one life was lost and seven persons injured. A considerable quantity of sugar awaiting shipment to Britain was destroyed. It is estimated that the total damage was about two million pounds.

GOVERNMENT-OWNED U.S. PATENTS.—One of the chief recommendations of the recently published U.S. National Patent Planning Commission is that Government agencies should be empowered to issue exclusive licences in respect of Government-owned patents, or to sell or assign them whenever the inventions would not otherwise come into use. At present it seems that Government departments in the U.S.A. have no power to grant exclusive licences, or to dispose of patents, and in fact their general practice has been to grant non-exclusive, revocable licences without royalty or other charge. These proposals reflect a belief in the efficiency and usefulness of exclusive patents at a time when in this country advocacy of non-exclusive patents and of licences of right has become strong.

EDUCATION OF QUEENSLAND TECHNOLOGISTS.—For some years past the Central Technical College at Brisbane has provided a diploma course in Sugar Technology, the advanced sugar technology subjects being taught by members of this Division. Each year it became more apparent that this course was far too ambitious for the type of student taking it. This is no reflection on the mental ability of the students themselves, but simply an indication that their preliminary education was not usually adequate. After such consideration, it was concluded that the only really satisfactory solution was to develop a post graduate course in Sugar Technology at the University, and to let the College course revert to the original Diploma in Sugar Chemistry Course.

COLONIAL DEVELOPMENT AND WELFARE BILL.—In moving in the House of Commons that this Bill be read a second time, the Secretary of State for the Colonies discussed the Amendments made by it to the Act of 1940. He regarded as the most important the abolition of the principle of annual accounting, and the surrender to the Exchequer of any sum which had not been spent in the particular year. That principle has been disastrous in times of shortages, and would be a severe handicap even in more normal times, because permission to spend an equal sum in each of the ten years of a ten-year period does not coincide with the facts of any long term planning. The second amendment (the main change) was that the funds made available were rather more than doubled. Thus, the total financial provision to be made available is to be increased from £5,000,000 per annum for development, and £500,000 per annum for research, to a total of £120,000,000 for all purposes during the ten-year period commencing April 1st, 1946, subject to a maximum issue in any one financial year of £17,500,000. The third change was the extension of the term from 1951 to 1956. A very full discussion followed (running to some forty pages of *Hansard*), Colonel Stanley concluding by thanking the house for the reception to his Bill, and by reiterating the hopes which all speakers had expressed that through its operation real benefit will in future be brought to the Colonial Empire.

Brevities.

SIR J. L. HULETT & SONS, LTD.—The Directors announce in a circular to shareholders that the company's output of sugar for the season just closed reached a record figure of 144,535 tons (2,000 lb. each)—being an increase of 3,585 tons on its previous best. The local market for refined and two grade absorbed 116,011 tons, leaving 28,524 tons, or nearly 20 per cent. of the total production, for export in accordance with the directions of the British Ministry of Food.

FERTILIZERS IN INDIA.—An ammonium sulphate plant with a daily capacity of 150 tons will shortly be built in the State of Travancore at a cost of about two million pounds. Then the Government of Madras is said to be planning a phosphate factory using supplies of raw material which are to be found in the Trichinopoly district. A method which does not require sulphuric acid, but uses materials and equipment similar to those employed in cement manufacture, will be applied.

"FREON."—This is a clear, colourless and volatile liquid, which finds its chief use in aerosol "bombs" for dispersing insecticides, pesticides, as pyrethrum, D.D.T., etc. On releasing the pressure in the bomb, the solution within it is vapourized as a fine fog, which remains suspended in the air six or seven times longer than are droplets from a mechanical spray. In this way, rooms can be disinfected rapidly and effectively, and mosquitoes, flies etc., exterminated in a few minutes. "Freon," which is non-poisonous and non-inflammable, is also largely used as a refrigerant.

POST-WAR USES OF SUGAR.—Dr. Robt. C. Hockett recently told the American Chemical Society that new post-war uses for sugar may result from a discovery made at the Sugar Research Laboratory, of the Massachusetts Institute of Technology. He said that new correlations had been found to explain previously unsolved structural problems in the sugar group. "The way has been opened for exploring the relative re-activities of the various hydroxyl groups of sugar derivatives thus discovering subtle differences which may be utilized for preparation of useful derivatives," Dr. Hockett added.

CALCIUM ACONITATE.—This compound has come into some prominence of late as having a value in the plastics industry.¹ It occurs in cane juices, and sometimes to such an extent that it starts to crystallize out just before the graining point of the sugar. Several tons of it were recently produced at the New Iberia Sugar Cooperative factory, Louisiana, it being demonstrated in the test that 2 lbs. of it per ton of sugar cane could be extracted. Calculation shows that this amount represents a potential gross increase in income to sugar producers of about \$0.40 per ton of cane, based on pre-war value of aconitic acid.

A MOBILE DISTILLING UNIT.²—Jos. E. Seagram & Sons, Inc., of Louisville, Ky., said at a recent conference that they had designed a mobile distillery unit which was intended to bring the alcohol plant to the farm in the U.S. and in other countries, not least those producing molasses. Making up the train were cars in the order named: (1) Boiler equipment; (2) water treatment and maintenance shop; (3) water cooler and re-circulation for water; (4) production unit and still; and (5) fermenter. Such a "Distillery on Wheels" is believed by the firm named to be a practicable idea for bringing alcohol making facilities to the farm with a savings in transportation costs on raw materials for the manufacture of power fuel.

BEET SUGAR IN TURKEY.³—Production of beet sugar in Turkey has developed during recent years to the extent that the country is now practically self-sufficient. During the 1944 season, about 75,000 tons were made, but though this will be less than the 96,000 tons produced in 1934, the carry-over from 1943 will be sufficient to meet domestic demands, which has been reduced by the high cost of sugar to the consumer.

MAFFRA BEET INDUSTRY.—Some uncertainty is being felt as to the future of the Maffra beet sugar factory in Australia. During the season just ended only 745 acres of beet were harvested for 6000 tons of beet, yielding only 700 tons of sugar. For the economical working of the factory about 25,000 tons of beet are needed, varying with sugar content, to yield from 4500 to 5000 tons of sugar. To maintain this about 4000 acres must be planted. In the peak year of 1939-40, 3950 acres yielded 42,898 tons of beet, and sugar produced totalled 6220 tons.

ALCOHOL FROM SWEET POTATOES.—A paper was read recently before the American Chemical Society, New York Meeting, by J. A. Jump, A. J. Zarov and W. H. Stark, pointing out that dehydrated sweet potatoes offers yields of alcohol that are much higher in terms of yields per acre than can be obtained from grain, and are in fact comparable to those from sugar cane. The dehydrated product can be stored for a year-round supply, and can be processed by methods similar to those used with conventional grain alcohol plant equipment.

PUERTO RICO WAGE ORDER.⁴—The Administrator of the Wage and Hour division of the U.S. Department of Labour issued the following wage order which became effective on January 15th, 1945: That wages at a rate of not less than 35 cents an hour shall be paid by every employer to each of his employees in the sugar manufacturing industry in P.R. who is engaged in commerce or in the production of goods for commerce. By the "sugar manufacturing industry" is meant the manufacture of raw sugar, cane juice, molasses and refined sugar, and incidental by-products.

THE COMPLETE ANALYST.⁵—He should be something of a microscopist and spectroscopist, conversant with optics, photography, and modern electrical circuits, all these, in addition to a fundamental knowledge of chemistry. Besides theoretical knowledge and manipulative skill, he should have personal qualities as integrity, scepticism, caution without loss of imagination, and keen powers of observation. He should have the ability and will to record faithfully his observations. These qualities should give the analyst the unquestioned right to equality in the chemical world.

AGRICULTURE AND THE CHEMICAL INDUSTRY.—Dr. E. F. Armstrong, F.R.S., believes that there is in this country a great future for agriculture to supply raw or "chemurgical" materials for use in the chemical industry. "Agriculture badly needs another and more regular outlet for its products . . . with good organization and cheap transport it should be possible to translate far more of what is grown into alcohol, protein or fat, and so lessen the waste." Examples given include the following: The common nettle, as a first-class fibre and source of chlorophyll; crops for the production of alcohol for plastics; cereal straw for cellulose and ligno-cellulose used in the plastics industry; waste wood for conversion to sugars, alcohol and food yeast; and finally soya-bean nuts or seeds for the supply of protein products for making artificial textiles of the nylon type.⁶

¹ *I.S.J.*, 1943, p. 244.

² *Chem. and Eng. News*, 1945, 23, No. 2, pp. 168-170.

³ *Willett and Gray*, 1945, 69, No. 2, p. 21.

⁴ *Willett and Gray*, 1945, 69, No. 1, p. 11.

⁵ R. C. CHIRNSIDE in the *Jl. and Proc. Royal Inst. Chem.*, 1945, p. 36.

⁶ *Jl. Min. Agric.* 1945, pp. 569-571.

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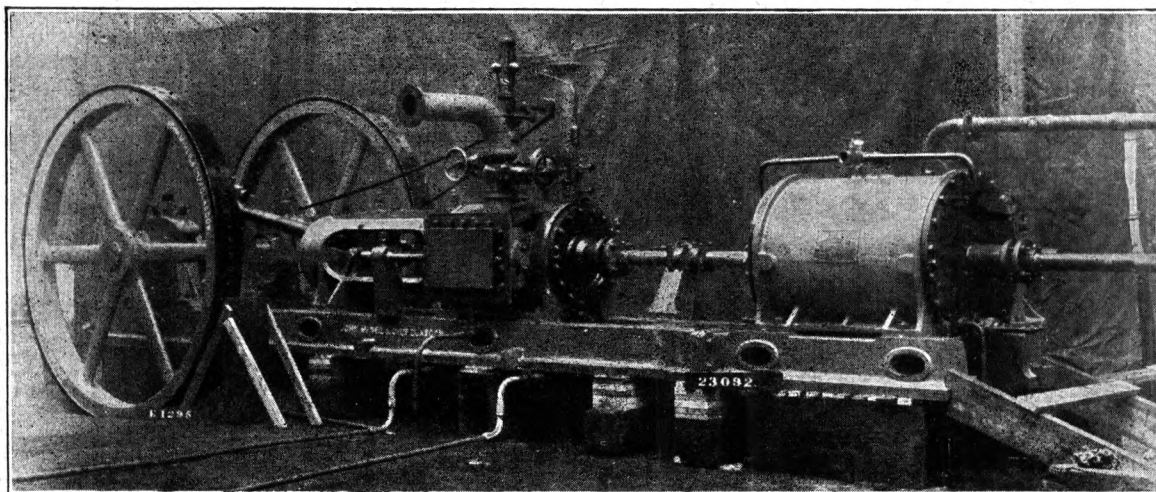
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