

Irrigation—Its Infancy and Potentiality in the Natal Sugar Belt

By E. ROYCE.

The CHAIRMAN stated that owing to the illness of Mr. Wallace Jex, the Committee on Irrigation had been unable to complete its paper. Mr. Royce, however, had stepped into the breach and had prepared a paper on Irrigation.

The following paper was then read by Mr. E. Royce:—

It is necessary to explain that only three days time was available for the preparation of this paper which is intended to deal with the efforts extended by your Committee on Irrigation and Drainage.

Irrigation is somewhat of a nebulous thing in Natal and can at best be referred to in terms of Hawaiian and Javan practice in relation to the Sugar Industry. It is a matter of special research to apply Irrigation judiciously to local conditions after having carefully determined the available source of water supply and its chemical content for harmful saline and other impurities. We have the experience of years in costly experiment upon which to build which has been vouchsafed to us by the more advanced cane growing countries and we shall be wise to recognise our good fortune in being well placed on the ladder of progress.

The main objective is to cheapen the cost of production of Sugar and show the importance of proper knowledge of the real generative element—water, the one and only one element we can supplement is as yet practically unknown to us and so long as we are prepared to sit back and abide by the present climatic conditions and admire the wonderful virtues under adversity of the Uba variety then so surely shall we cease to progress; nothing stands still, so that we shall continue to feel the ever growing world competition, virtually competition in the art of cane growing.

Natal on the 30th parallel with a mean temperature of 71° Far. is one of the most remote and temperate sugar growing countries out of the tropics and, with rainfall at 35 to 50 inches, the driest. With these conditions it will be readily conceived that even with the valuable references we have in other countries there is still much to be done to find out what is required to remedy our own position and to overcome our local problems.

Perhaps we can assume that cane soils may be standardised in chemical composition by fertilizer treatment, but the remaining variable factors sunshine and rain are out of our control; we cannot induce more heat but we can supplement the rainfall and are in a position to do so—practically all Zululand and Natal Planters are potential Irrigators. Notwithstanding this position we have done little to examine the details of this important matter: Natal produces the lowest sugar tons per acre of seven sugar growing countries.

Without going into the subject of the present depression and its causes, those conditions might serve some good purpose in being surveyed in respect of other times and to build up hope and faith by reference. Since some 80 years ago when Natal sugar milling started there has been no lack of experience in the vagaries of the fortunes of Natal sugar; its cradle days, the competition from Mauritius, diseases, lack of transport, restricted markets and sugar dumping as far back as 26 years ago. But in every phase it will be found that a fresh impulse has been stimulated to progress by exercising greater efficiency and in assisting our fairly constant and best friend—the Climatic Condition—and that assistance has come mainly through applied science; and it seems that much is being done to further research and improve the scientific status in the Natal Sugar Industry—expecting in Irrigation.

To-day is in an important stage of evolution in the sugar world and the question of stabilizing and restriction of output is on the air, a process that can only be successfully indulged in with pre-determined conditions with any success; in our case we sadly lack the means of eliminating the uncertain factor of Drought. Cane growing in Natal is largely a matter of Faith, Hope and the Charity dependent on rain clouds and the memory of the loss of thousands of tons of cane through drought is very fresh in our minds. Irrigation is a premium of Insurance, more than that water is the one element required to awaken highly fertile soils now dormant under the present rainfall conditions. I refer especially to the valuable shale lands.

There are several courageous pioneers in irrigation who will be the first to admit its possibilities even under great difficulties, and to admit the vastness of the unknown problems in which they are groping unaided and at much expense relying almost entirely on such service as an overworked Irrigation Department willingly spares them, and that almost purely on the Engineering side.

In order to define more clearly the objectives of the Irrigation and Drainage Committee I shall endeavour to conduct you through the early stages of our deliberations.

The hope of establishing a special experimental block under irrigation is very strong and thereon it is expected to be able to experiment on varieties of cane and vary applications of water in frequency and depth up to two hundred different conditions for experiment; to make rapid propagation of seed cane; to determine the response made by cane varieties in different seasons of the year under varying waterings and from that to form a nucleus of the training ground for better scientific planting in observing the new conditions: the study of the most economical methods of water distribution and the variable types of distributions necessitated by the topographical conditions much of which, in Natal, is exceptionally difficult on the hills whence the best sucrose content obtains. The propagation of new varieties will be expedited and the release of soft canes will become a nearer possibility since suitability and adaptability can be more speedily determined.

To experiment on the dry basis is the only condition possible at present and research is restricted. There is no intention to advocate irrigation since it is so obviously desirable but the study of it is almost imperative and may become an absolute necessity in defence of our Industry and to save it from extinction by competition. It is felt that those countries which have overproduced will not seek so much to restrict as to cheapen production and with their powerful scientific equipment they will stride ahead and it behoves us one and all to keep up with the times and thoroughly discover the potentialities of such revolutionary conditions as Irrigation is bound to bring about.

The value of a proper knowledge of the Cusec is greater than our experience is able to conceive or estimate and its economic value is such that a special study and teaching is a fundamental necessity; and it is suggested that it can be most efficiently imparted through such an organisation as the Sugar Industry already has in the present Experimental Station. The sooner such a school can be organised and established the earlier shall we have the known of standing fast in the ranks of competition.

There is, from the small experience gained in

Natal, a reasonable certainty of realising observed probabilities in the field work in securing the germination of every stick of cane planted; the increase of tonnage per acre and resulting decreased cost of supervision and transport. Experience in tonnage production per acre, even under crude conditions with guess-work as the gauge for applications of irrigation, no water balance being kept and rough and ready control of flow shows anything from 25% to 300% increase, the poorest dry conditions showing the greatest response.

Cultivation whilst being more intensive is of far shorter duration under irrigation.

In cutting and trashing the increased bulk of the cane reduces the cost of that operation compared with dry conditions.

The growth more than doubles in rapidity and hence a greater frequency in cutting.

The elimination of the present extraordinarily long periods of ratooning must tend towards securing a better sucrose content in having more frequent planting, and the effort and cost of ploughing becomes a matter of less cost and more at the convenience of the Planter. Shorter cutting seasons will conserve the labour for more thorough soil preparation and cultivation. The refractory nature of Natal canes is due to severe climatic conditions as compared with other sugar countries and the most severe condition is drought—hence the possibilities of easier and cheaper milling operations are likely to be realised.

The sum of these conditions under present experience balanced one with the other dry and wet greatly favour the latter type of cultivation without taking into consideration the more valuable possibility of being able to grow a variety with such high sucrose content and purity as, say, P.O.J. 2878 which would enhance the advantages already outlined.

But these conditions must have an intelligent and concentrated study made of them without allowing any indulgence in the ruinous method of trial and error at the expense of the general Planter.

The Engineering side demands supervision over field work and the big question of organisation will be revealed to the observer in the development of the Experimental block.

The standardising of units of construction in distributary factors, measuring units, and the many details needed to economise in production might well be brought within the scope of investigation. The proper collection and tabulation of data in all the existing detail under dry conditions will require to be supplemented for irrigation conditions.

Further survey of the irrigation conditions in this sugar belt is desirable, and also that data be

made available on existing practice. Valuable data was revealed by Mr. Hudson Spence in his paper, read at the last Congress and it goes to show the great scope of investigation which must be embraced in dealing properly with this problem.

The number of side issues in economics is too varied and numerous to entertain at this time, and somewhat speculative in view of the conditions and can only be noted in progress. But we may mention the possibility of important consequences such as the denaturing of Uba under irrigation by a softening of the fibre which may cause some alteration in the calorific value of the bagasse.

The matter of Drainage has not been touched upon by the Committee and when the individual effort as apart from Government exercise will lead in this matter is no part of this present discussion but it is certain that in the local requirements Drainage is of first importance as affecting first the health of the personnel of the Industry and then the eradication of saline, marshy and waterlogged conditions so inimical to cane growth.

It is hoped that this hurried and cursory survey of the duties developing on those responsible for this section of our organization will have brought before you a sense of duty to yourselves to forward and assist the Irrigation and Drainage Committee by supplying the means to carry on the investigations through experimentation and to enable them to secure a technical equipment which will establish Irrigation without having to experience the qualms of doubt as to whether their expectations will be realised or not.

It must be borne in mind that the extraordinary conditions of sugar cane growing in Natal will suffer a revolution in practice and production and that an intensive study is a possibility now with existing means available in several Irrigated lands, and that this study will undoubtedly mean the firmer establishment of the Industry.

May I, in conclusion, refer you to the enormous expansion and application of capital for Irrigation in Hawaii brought about in a few years and still in course of expansion as an encouragement to further your interests in like manner by establishing the process of Irrigation on a sound foundation by scientific means now readily available.

Mr. POUCKET: Can you give us an idea of what would be the increase of tonnage per acre equivalent to an inch of rainfall per month? Supposing we were to give three inches of water per month in the four months of the growth of the cane, what would be the cost and what would be the increase of yield?

CHAIRMAN: Mr. Hudson Spence gave us some

data on that last year; I don't know whether Mr. Royce can amplify that.

Mr. ROYCE: I am afraid I cannot give any figures since it has not been tried in this country. We depend largely on the sunshine in this country. With the water we apply it will have to be experimented on. There has been no effort yet to do anything in that nature; we can't tell yet. We only anticipate from experiments made that we will get considerable increase. Increases from 25 per cent. to 300 per cent. under very crude conditions have been obtained in Natal already. What the actual results under proper irrigation would be I can't tell you.

Mr. POUCKET: Have any records been kept of the amount of rainfall?

Mr. ROYCE: You would know yourself what the rainfall has been.

CHAIRMAN: I think Mr. Hudson Spence could give us some figures.

Mr. HUDSON SPENCE: You really want to know what is the relation between the application of water and consequent yield. You will increase it very much indeed.

Mr. POUCKET: Supposing you are trying at the rate of one inch per week, if you were to apply it for three months what would be the excess tonnage?

Mr. SPENCE: The position is approximately this: The ordinary season of cane growth is about two years in Natal, and during that period the equivalent of water which it receives is rather more than 50 inches, but it receives about that. We found that the average yield throughout Natal is about two tons of sugar per acre, not sugar cane. Under those conditions it appears that about 24 to 25 inches produced about a ton of sugar in Natal. Now turning to experiments that have been conducted in Mauritius, Hawaii, and other countries, I have drawn an average curve to see the result, and it works out very fairly to about five tons of sugar per acre. For every 24 inches of rainfall applied to the soil you get an increase of about a ton of sugar per acre in yield. Of course you would have to allow a little bit more for leakages and so on.

Mr. POUCKET: Do you reckon this water could be applied during each month of the year? You could not spread it over the twelve months, could you?

Mr. SPENCE: So far as one can judge you would have to apply most of the water in the summer months when the cane is in a position to take full advantage of the water applied. You will simply apply enough to keep the cane moving in the winter

and as soon as the summer months come in you will put on the water as fast as the soil will stand it.

Mr. FELTHAM: I would like to ask if the application of fertiliser by means of irrigation is more economical than by the usual method?

Mr. ROYCE: That I am afraid I can't answer from lack of experience. It is practicable, but there are many objections. One is that the water concentrates at the outflow; there is often a great volume of water left so that proper distribution of fertiliser does not take place. I should imagine it would be better applied dry.

Mr. FELTHAM: Don't you think that would outweigh the economy in the handling of fertiliser?

Mr. ROYCE: It would if it could be equally distributed. If the water could be applied precisely in the same quantity to every cane root.

Mr. POUCKET: That is the experience in Mauritius; we found it was only certain chemical manures with which could it be done, but it could only be applied for very short distances. Irrigation had to be applied in small sections of not more than 100 feet. It did not pay us to do it; it was far better to apply it direct to the field. There were great chances of the water breaking away from the canal line and a lot of chemical manure going to waste.

Mr. PALAIRET: The first thing one has to study is the grading of the main furrow; that depends on two things, the gauging of the number of crossways and on your limits of velocity; and it seems this is one point on which we lack data. We have to look at our flows and guess our limiting velocity. I rather gather that the coastal soils here are divided into four or five different classes, and I wonder if Mr. Hudson Spence can give us any indication as to the washing on those various classes of soil, the minimum velocity and maximum velocity?

Mr. HUDSON SPENCE: I can't give it offhand, but there have been a number of experiments carried out in India. It is obvious that a fine sandy soil will scour much more easily than a clay soil. You have Canada's experience and various experiments in India and so on. I think we know that to a certain extent for the classes of soils.

Mr. WICKES: Might I ask in the case of plant cane how soon after planting is the first watering applied?

Mr. ROYCE: In general practice the cane is planted practically in the water; it is applied immediately the plant cane is put in.

CHAIRMAN: How frequent are the irrigations?

Mr. ROYCE: It depends on the conditions, but

the water applied should not be less than once a week. It depends on the state of the soil. There are so many things to be considered. But I think the general rule to be laid down is about once a week and about two inches application. It would have to be closely watched for the special conditions.

Mr. WICKES: The reason I asked the question is that I visited an irrigation scheme in Queensland and was speaking to a farmer there. They have a rainfall of about 35 to 40 inches, and with twelve months' growth they applied five to six waterings—monthly waterings, I understood—and he told me the first watering for plant cane was three months after planting. He said they found in that district that the ground got too cold and retarded the growth. In other words they depended on the rainfall for the first three months and gave the waterings after that. Where they resorted to earlier waterings they found it somewhat retarded the early growth of the cane.

Mr. ROYCE: I think it is the experience of one of the planters in Zululand that it is wise not to water the plant cane for about a month. He explained it was a very sandy soil and possibly it is a question of wash with him. It all depends on the local conditions which have to be observed.

Mr. WICKES: I also understand that there is a direct bearing on the growth of the cane in the temperature of the soil.

Mr. BECHARD: I saw a summary of some work done in this regard in Egypt. A moisture content of 35 was found to be favourable; over 50 it did not progress, and under 20 it wilted.

Mr. SIMPSON: I think the climatic conditions must have a great bearing on this subject. In tropical conditions where they use irrigation it is the practice to flood the land as soon as they put the plant in, but there of course you get very rapid aeration of the soil. With the effect of the water on the soil you get aeration and you don't get the cold effects there. You don't depend on the rainfall then for planting.

Mr. POUCKET: In Mauritius they plant the cane in the winter time as they generally grow their plant cane for 18 months. Immediately it is planted it is irrigated, and after that it is irrigated regularly every fortnight. Of course if there is rain in the meantime irrigation is controlled.

Mr. B. J. W. PEARCE: What are the prospects of the Experiment Station carrying out irrigation? What is the use of planting all these canes here if you can't irrigate?

CHAIRMAN: That is a question that has to be decided on. No solution has been forthcoming as yet. As you can see from Mr. Royce's paper a

scheme is being put forward by the Committee of which he is a member, which will have to be decided upon in the near future regarding the general future of irrigation experiments in this country. As I mentioned last year, we have not as yet even made a beginning with systematic experiments under irrigation conditions in spite of its great potential importance to this country. As you can see questions have kept on cropping up all this afternoon regarding information which is desired under local conditions which at present does not exist, simply because the work has not yet been done; such matters as, for example, the best time of the year to apply water, the best means of applying fertilizer to irrigation plants, and so on.

Mr. FELTHAM: Before irrigation can take place we need a water supply. Has it been considered whether the rivers we have in Natal are suitable for irrigation? As you know, when the rainy seasons are on here most of the rivers are in flood, but in dry weather most are almost empty.

CHAIRMAN: That was dealt with very fully by Mr. Hudson Spence in a paper to this Conference last year, in which he showed that taking the minimum flow of the coastal rivers and using the water that at present goes to waste, the output of the Sugar Industry could easily be more than doubled, using the minimum of the present coastal rivers.

Mr. HUDSON SPENCE: That is so. I would like to add that I think with sugar we are particularly fortunate in one respect in the use of our rivers. In most cases crops require the water during the winter season, and at that time, unfortunately, most of our rivers are at their minimum, but with sugar, apparently the maximum demand will come during the summer season when, fortunately, the rivers have quite a quantity of water, and we will be able to make more use of the rivers for irrigation than we would with most crops.

Mr. FELTHAM: Why I asked that is that I know there are several planters in Zululand who are anticipating irrigation, but it is the question of water supply which is stopping them doing so.

Mr. MURRAY: During the visit of the British Association the Principal of the Rothamstead Experiment Station showed a lot of photographs where irrigation had been a total failure on account of the soil. Is there any particular section of the Natal Coast to which similar conditions might apply? If planters start to irrigate they might get worse conditions than with rainfall.

CHAIRMAN: That question was also raised last year and dealt with by Mr. Hudson Spence. I don't know whether he cares to amplify his remarks further.

Mr. HUDSON SPENCE: I don't think we have

so much to fear from brack on the Natal coast as one might have in say parts of the Karroo. In the Karroo we know that brackness is a particular problem. You have there large quantities of salt, and directly you start irrigation it is brought up to the surface, but in Natal the rainfall is a very good one, and the soil in most instances is porous and the brack is washed away. There may be areas of course in Tongaland and on the Pongola where we might meet with those conditions.

Mr. BOOTH: I think these questions are very fully answered by Mr. Hudson Spence on pages 127/128 of last year's Report of the Congress.

Mr. MURRAY: I understand they are going to try to irrigate very steep lands in Natal. Irrigation is a very intricate job; water will never go to the root of every stick of cane. I don't know whether it is possible to do it in these steep lands without fear of erosion of soil. I saw irrigation in Hawaii. I was two years in charge of an irrigation job, and it is a very difficult problem. I understand Natal Estates are doing it, but what the result of their experiments will be I don't know. I should think on steep lands it won't be a success. They may get the water on but it will wash away the soil and do more harm than they think. However, good luck to them in their trial. I would like to hear from Mr. Pearce or somebody who knows what Mr. Jex has done. I understand he has been very successful.

CHAIRMAN: Mr. Jex, I believe, is irrigating on alluvial flats so that the question of the gradient of the irrigation furrows probably does not arise. However, Natal Estates, I believe, are irrigating in hillsides, and perhaps Mr. Royce will be willing to tell you what precautions they are going to take against erosion.

Mr. ROYCE: You are asking what the effect will be of irrigating on hillsides. That is another point I can't tell you as it has not been done. This irrigation is in its infancy. We are attempting to overcome difficulties and we have many factors to face which I don't think are known in any other part of the world. Everything is a novelty here and new conditions have to be met. We are going to a considerable amount of trouble to avoid anything in the way of scour and washaways, and many things have to be introduced to overcome these difficulties; different forms of furrows have to be made and different forms of planting. There are many factors which have to come into consideration which I don't think have had to be met with elsewhere. Therefore I am not in a position to tell you whether it is feasible or not, but it is anticipated from the way we see it now that it will be quite feasible to irrigate on steep hillsides with success.

Mr. PEARCE: With regard to Mr. Jex's experiments all I can say is that he has had very good

results; in fact the best thing I can say is, "Go and have a look and see what he has done." We carried out experiments at Gledhow; we irrigated 60 and 80 acres. With the block of 80 acres we showed a profit of £8 per acre against the unirrigated, and with the block of 60 acres we showed a profit of £5 as against the unirrigated. I might add to that, that irrigation will pay. We are irrigating on hillsides and getting very good results.

CHAIRMAN: What is the average amount of water you applied?

Mr. PEARCE: I could not give the actual details, but we applied about 1½ inches a week. It varied considerably. We found the most suitable grade of furrow for our conditions to be, that is, one in 150, for the quantity of water we deal with.

Mr. POUCKET: What means have you for gauging the amount of water applied?

Mr. PEARCE: We have a practical irrigation man and he measures the water. He is a man who has had experience in the Cape and Transvaal, and we leave everything to him.

CHAIRMAN: Mr. Jex, I understand, has been experimenting with overhead flow. If he had been here I would very much have liked to have had his

opinion on the matter. Can you tell us anything about that, Mr. Pearce?

Mr. PEARCE: The only thing I can say is that it is rather expensive in the initial cost. How it would work out on a big scale I could not tell you. The only thing is the variation in the direction of the wind; it causes a considerable amount of trouble. You may irrigate the same place two days running owing to the variation of the wind. On a large scale I don't think it would work out too expensive.

CHAIRMAN: Apparently it has been used on a large scale in Hawaii, but not with sugar cane elsewhere so far as I know.

Mr. HUDSON SPENCE: Apart from it being applied to sugar cane we made an estimate for a farm to apply overhead spray for about 26 acres, to have a series of pipe lines. All the farmer had to do was to walk along, start the pump, and open up a number of pipes and irrigation would carry on. Unfortunately we found by the time we got the pipes in and everything else right—estimated, of course—that the cost was so enormous that it was an unpayable proposition. It would want a large number of pipes, which are not too cheap in this country, and we found that that particular system anyway was not very workable from an economic point of view.