SURVEY OF LABOUR-SAVING AND COST-SAVING DEVICES.

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The first step in this preliminary review of labour-saving and cost-saving devices has been to prepare a rough groundwork on which future investigations on specific subjects may conveniently be built.

A survey of all available sugar literature has been made and the subjects indexed.

However sketchy our efforts may appear to be, it is apparent that there are many phases in sugar production where non-essential or surplus labour may be curtailed or eliminated. With this generalisation everyone will agree, but difficulties immediately arise when better methods and procedures are put into practice. Thus, local conditions at our factories vary greatly, changes must be capitalised against existing labour costs, while new machinery is difficult, if not impossible, to obtain.

It is obvious, however, that the upward trend of industrial wages, in field and factory, will force industry to study and apply the experience of other countries in many forms of mechanisation.

In the 1941 Proceedings of the British Association for the Advancement of Science, it is stated that before the cessation of hostilities, and for some years thereafter, every country will be forced to produce foodstuffs to the limit of its capacities and at the cheapest possible rate.

With these points in view, the Committee has prepared a basic index of overseas reports on subjects of specific interest, together with comments and plans on a few salient points applicable to the Natal Sugar Industry.

The survey is divided into thirteen major headings. The first four deal with the agricultural side :—

1. Preparing the land.
2. Irrigation.
3. Haulage.
4. Harvesting, loading and off-loading.

While developments in other countries during the past ten years have been impressive, agricultural methods in Natal have remained comparatively static.

In 1939, Mr. Dodds wrote : "One of our largest plantations in this country has a graveyard of all kinds of elaborate field instruments, that have been tried out and eventually discarded."

This is a highly important statement to make, for any investigation into the possible adoption of agricultural labour-saving devices must first answer the question: Why have they failed in the past ? Secondly, it is likely that failure under one set of conditions may prove successful under another.

The only new factor which has to be faced in the near future is the fact of "scarcer and dearer labour." This is sufficient to warrant a closer scrutiny of that "graveyard of elaborate instruments" with a view to future possibilities and necessities.

1.—Preparing the Land.

Apart from agricultural implements in the preparation of the land, such as ploughs and harrows, cultivators, subsoilers, planting and fertilizing machines, weeding control, etc., there are certain major points in the recent literature which deserve study.

The first is an important article by Dr. B. A. Keen of Rothamsted, entitled "Soil Physics, Theory and Practice" (Proceedings of the Royal Society of Arts, July, 1942).

The following is an extract from his summary : "The results, even on a cautious interpretation, lend no support to the idea that extra cultivations increase crop yields. They show that, provided—

(*a*) A reasonable seed bed is obtained,

(*b*) Weed competition is prevented during the early growth of crop,

(*c*) The worst of the weeds are kept down afterwards;

then any work in excess is wasted and may even be harmful, so far as the crop yield is concerned."

Since the ordinary cultivation of a cane-field is an expensive item, experiments should be conducted to test out Keen's observations, as to the illusionary effects of capillarity with a cane crop.

The second subject, which occupies a prominent position in overseas reports, is trash. There are articles on trash as a weed preventer ; the burning, burying or composting of trash ; the effects of trash in factory operations, together with the mechanical devices which have been evolved to deal with the abnormal trash from drag-harvesting in Hawaii.

All these items are of interest in Natal, where clean cane is rather the exception than the rule.

2.—Irrigation.

This subject is, as yet, of specialised interest to the few. It is therefore passed over by simply refering to the references in the index.

3.—Cane Haulage.

Eighteen articles cover this important subject of individual local interest.

The Committee considers that investigations should be carried out on the principle of centralising transport facilities with a view to minimising haulage costs. There are various systems which have given satisfactory results, such as motor transport, light portable railway track, and the use of diesel engines.

4.—Harvesting, Loading and Off-Loading.

Overseas developments in these three sections have been spectacular in recent years. The following is a summary of mechanical harvesting results in Hawaii from 1938 to 1940.

No accurate estimate has yet been made of the damage to fields and milling plants by the use of mechanical harvesting.

Rake and grab-harvesting are the two principal systems. Neither of these tops or cleans the cane, with the result that costly stripping and washing plants have had to be installed. The resulting effluent is quite a problem.

Rake-harvesting, as practised by the McBryde Sugar Co., affords a good general picture of the results of this system.

Depending on the type of cane, the rake can handle from 500 to 600 tons of cane per day, the cost per ton delivered at main line being 62.75 cents. For comparison, the older method of hand-cutting and grab-loading was 86.25 cents.

Against this saving of 23.50 cents are to be marked the following disadvantages.

There is a large percentage of crushed and bruised sticks, which rapidly deteriorate. The accompanying dirt, trash, stones, etc., vary from 5 per cent. to 30 per cent., according to the type of cane and soil. Replanting is as high as 40 bags of setts per acre, instead of the customary one or two.

The effects in the factory are likewise serious. Cane tonnages decreased from 51.5 to 44.7 tons per hour. The crusher juice dropped 3.5 degrees in purity, with a corresponding drop in the mixed juice polarization and purity.

The milling loss increased from 2.93 to 3.04, and the extraction dropped from 96.47 to 95.99 per cent. The yield of sugar per acre decreased by half a ton.

The costs during the test of mechanical versus hand-harvested cane, were as follows :—

	Hand-harvested.	Mechanical.
Cost per acre...	$51.49	$35.3
Cost per ton	$0.63	$0.43

The saving from mechanical harvesting on a sugar-per-acre basis was $15.72.

None of the companies using mechanical harvesting of this type considers that the ultimate has been obtained, nor do they know what that ultimate may be—either in reduction of costs, extra capital on milling plants, or in damage to the fields.

Mechanical harvesting of this type is a field of experimentation open only to large moneyed interests. Of the true cane harvesting machines, the comparatively simple windrowing machine (now fitted with a topping device) made by the Thomson Machinery Co. of Labadieville, has great possibilities. Its cost in 1939 was about £1,000.

Considering, however, our contours and our hills, together with the probable development of more and more small farms, the possibilities of mechanical harvesting, except on a cooperative basis, or by special harvesting gangs, appears impracticable in Natal.

The methods of field-loading cane, as practised in Louisiana, seem to be of more practical interest to this country at the moment.

Loading Cane at Sidings.—The loading of cane into S.A.R. trucks is usually performed by manual labour, five to six boys being employed per truck.

At various sidings, where mechanical means are used, four or five boys may load seven or eight S.A.R. trucks per day, whereas by the old method 30 to 35 boys would be required.

Here is undoubtedly a field for investigation and co-operation. The cranes required can be operated by electric motor, as at Duffs Road, or by oil, paraffin or petrol, as at Frasers, at a very low economical cost. With the exception of the electric motor or engine, the rest of the equipment can be manufactured in this country.

Failing power engines, simple windlass and derrick devices operated by animal power are simple and successful. The amount of labour and money that can be saved by these methods is impressive. A tentative investigation revealed that the cost per ton of cane loaded into S.A.R. trucks last season ranged from 9.3d. to 0.8d. The first figure refers to a siding, which loaded 42,000 tons of cane by manual labour, and the second figure to a planter loading six S.A.R. trucks with a derrick and chains.

Natal Estates has kindly supplied the following comparative costs at Duffs Road and Frasers:—

	Duffs Road. Electric crane.	Frasers Siding. Oil-driven crane.
Tons of cane per day...	300	156
Labour units	14	15
Cost per day	33/-	29/-
Labour cost per ton cane	1.32d.	1.94d.
Power or fuel cost per ton cane ...	Unknown	0.72d.

The foregoing figures refer to estates with large tonnages. For the average planter loading one S.A.R. truck per day, the number of boys required is five or six, which means a loading cost of between 4d. and 5d. per ton, and sometimes even higher.

Compare, now, one individual planter's costs using a derrick, chains and animal power:—

Cost of outfit (pre-war)	£738.
Cost of loading 1 S.A.R. truck (30 tons)...	3.0d. per ton cane.
Cost of loading 3 S.A.R. trucks (30 tons)...	1.4d. per ton cane.
Cost of loading 6 S.A.R. trucks (30 tons)...	0.8d. per ton cane.

The pecuniary benefits that would accrue to planters by co-operation, along these lines, are obvious.

OFF-LOADING.

The problem of off-loading cane, either from tram trucks or from S.A.R. trucks, is a matter of local conditions and individual concern. There is, however, room for improvement at many of the factories in this country. For example, the methods of off-loading cane from ox-wagons, motor transport, and S.A.R. trucks, and thereafter dumping it onto inclined platforms, from whence it is fed to the carrier by manual labour, leaves much to be desired.

In other countries a mechanical arm, operated by one boy, is employed.

Other mechanical means, such as hydraulic tipping platforms, the ordinary tippers and off-loading rakes, are suitable for meeting the individual requirements of each factory.

MILLING SECTION.

This section is divided under the following headings:—

1. Boilers, steam, bagasse.
2. Milling, milling control, lubrication and maintenance.
3. Weighing and recording.
4. Filtration and clarification.
5. Evaporators.
6. Pan boiling and vacuum pans.
7. Centrifugals.
8. General items not classified.

1.—Boilers, Steam, Bagasse.

These subjects are covered by 23 indexed articles, which deal with fuel economy; boiler control instruments; storage, handling, baling and briquetting bagasse; boiler feed water, automatic bagasse feeders, etc.

2.—Milling, Milling Control, Lubrication and Maintenance.

The application of a central milling control can be applied, either for steam- or electrically-driven tandems. There are many instances in this country, where each of the three or four steam engines is operated by separate drivers. A central platform with extension controls for each steam valve would necessitate only one driver. A simple but effective control for stopping the engines in cases of emergency can be incorporated in this system. This consists of butterfly valves inserted in the steam pipe to each engine. These are controlled by small electrically-operated magnets. When the current is disconnected from the magnets, the butterfly valves automatically close and shut off the steam to the engine.

Speed variation for each engine can be controlled by a small servo-motor and a gearbox arranged for the governor control. Several of these installations have already been fitted in one or two of our factories.

Lastly, automatic control of a mill engine can be arranged according to the thickness of the blanket entering the mill.

3.—Weighing and Recording.

Like many other departments in the sugar business, the installation of automatic devices is only warranted when the increased capital will yield increased accuracy, speed, and a reduction in costs, commensurate with the outlay over a stipulated number of years.

This is obviously the case with weighing and recording machines. Automatic weighing is simply a matter for local calculation.

4.—Filtration and Clarification.

The literature covers the Oliver Campbell filter, automatic liming devices, and the Bach continuous subsiders.

Mr. R. A. Carter, of the Umfolozi Co-operative Company, has recently patented a continuous subsider without moving parts; also a new method of juice clarification.

5.—Evaporators.

The trend of invention is towards the automatic control of this station. The Mobrey control system is in operation at Doornkop. The possibilities of operating the entire evaporator station automatically are given in the literature.

6.—Pan Boiling and Vacuum Pans.

For several years much attention has been devoted to the development of pan-boiling by instruments, and if advantage is to be taken of these modern methods the pan-boiling station will require a personnel of higher education and adaptability.

Unfortunately, the design of our average factories is such that there must always be a certain amount of unskilled labour to attend to pan requirements, discharging massecuites and

other multifarious roundabout jobs. Future developments must lie along lines that will help to eliminate that type of labour, whose greatest capacity lies in "opening and shutting cocks or valves under supervision," and its replacement by the skilled educated operator. It is farcical to boil a good massecuite to cuitometer control, and then have to shovel it into a crystallizer 50 yards away, after steaming the pan for 30 minutes to enable the massecuite to get there. Few factories are incapable of improvement in this regard.

G. S. Moberly, in his 1935 report on Australian conditions, tells us that in a 60-ton factory the pan staff usually consists of one man and one boy. In that year automatic feed and control of pans were undeveloped. Either the type of labour or the layout of the factory must have been advantageous in comparison with our normal Natal conditions.

It is obviously the duty of every responsible party in the factory to visualise how best to reorganise the layout of pan supplies, pipe connections for rapid tank cleaning, re-locating crystallizers where possible, so that improvements in efficiency and labour economy from vacuum pan to sugar elevator may be the result.

7.—Centrifugals.

The latest self-operating centrifugals will no doubt solve the labour problems at this station. Up to the present time full details are not available, but it is obvious that here is a fruitful field for capital expenditure.

8.—General.

The literature is full of articles which might be included under this heading—51 have been selected.

The last item which the Committee has included under this heading is the contentious subject of chemical control. Efforts have been made by the International Society to standardise all chemical terms, formulæ and calculations. This has been fairly successful, but the quantity of work done is largely a matter of individual preferences.

In some overseas factories the laboratory is situated in a convenient place in the factory. This enables a number of sample pipes to be led through the laboratory, with consequent simplicity in sampling.

The trend in this country during the last fifteen years has been towards multiplicity of samples, based on the principle that the larger the number of samples and analyses made, the smaller the possible error. Added to the very large amount of work conducted at some of our factories, is the complicated system of cane testing. In many cases the chemical personnel is very high, and yet comparatively low in others.

The Committee feels that in view of the high wages now in force, it is time that the whole subject of chemical control and cane testing requirements should be reviewed.

That such an enquiry should investigate the pros and cons of more convenient laboratory sites; the limitation of routine sampling and analyses necessary in order to maintain an agreed standard of accuracy; more co-operation with the centralising of cane testing and factory control in one laboratory and, in general, greater simplification of routine with directed opportunities for co-operative research.

Such a system, we feel, would pay dividends.