SOME RECENT DEVELOPMENTS IN CANE TRANSPORTATION AND HANDLING IN NATAL

By J. P. N. BENTLEY

The necessity to investigate the possibility of transporting cane by means other than the conventional methods used in the Natal sugar industry was brought about by the increasing inability of the South African Railways to handle the volume of cane required to maintain steady crushing conditions at our factory.

At the outset it was appreciated that the economic movement of cane depended on the transportation of heavy loads with minimum delay during loading and unloading.

With this in mind the methods used in various parts of the world were carefully studied and it was found that the islands of Hawaii had made great strides in this direction and had developed extremely efficient methods of moving large tonnages of cane and sugar by road. Rail haulage on these islands has been almost completely superseded by heavy diesel-engined road vehicles and transportation costs are quoted as low as 8 cents ($6\frac{3}{4}$d.) per ton mile. Approximately two-fifths of this is the cost of getting the cane from the fields to the main road. The heaviest of these vehicles can carry as much as forty tons of cane. Those of the Tournahauler type are mounted on only four rubber-tyred wheels, are fitted with engines front and rear, and travel through the fields over irrigation ditches and via estate roads to the factory. Severe soil compaction in the fields used by these vehicles is taking place and some observers are of the opinion that the use of heavy vehicles in the fields will have a deleterious effect on productivity.

However, the key to Hawaii's success with road transportation lies in the rapidity and simplicity with which the vehicles are unloaded. Details of this unloader will be discussed later on in this paper.

The problem that had to be faced originally at Tongaat was to make up a daily shortfall of one thousand tons of cane and it was decided to copy the Hawaiian methods, but design the vehicles to meet the requirements of our Road Ordinance, so as to ensure use of the vehicles on public roads, as well as estate roads.

Drawings were prepared by Ed. Watt, of Hilo Equipment and Manufacturing Co., to our specification and two units were built to these drawings in Durban. These semi-trailers (see Fig. 1) may be drawn by any suitable Diesel-engined unit of at least 150 b.h.p. Carrying capacity of twenty-five tons of cane is obtained by using the maximum dimensions permitted by the Road Ordinance. Notable features of the trailer are the complete absence of any chassis (the structural members of the body being used to carry the load), and the low

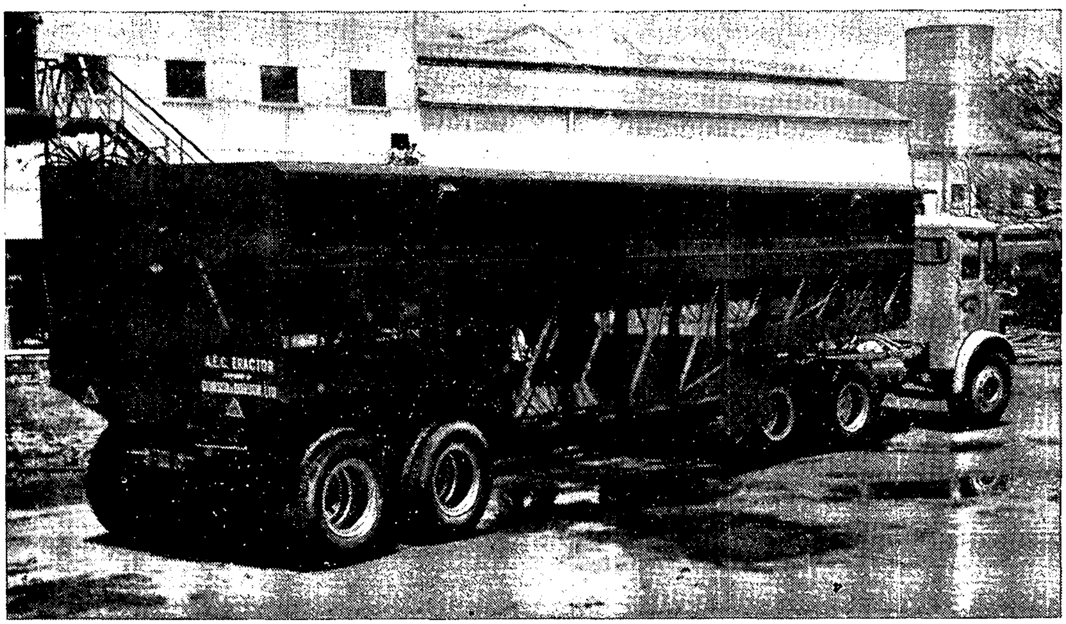

Fig. 1

Fig. 2

centre of gravity brought about by keeping the floor of the trailer as low as possible.

These two units operated from a siding two miles from the factory, were loaded by four-ton gantry crane in ten minutes, took fifteen minutes to travel the two miles under load, required three minutes to offload and twelve minutes to return to the loading point. As drivers and loaders became more accustomed to the work, these times were reduced. Operating for two shifts each per day these two units handled the cane at an average rate of sixty tons per hour—completing the one thousand ton task in seventeen hours. Running costs, including maintenance, fuel, wages and depreciation, amounted to 5¾d. per ton mile.

The same short haul by S.A.R. was costing 2s. 9d. per ton of cane, i.e. 1s. 4½d. per ton mile.

As stated earlier in this paper, the secret of successful operation of any road haulage scheme is the rapidity with which the load can be placed in the vehicle at the receiving end and removed at the factory end of the run.

Dealing with the factory end first. These trailers use what is known as the net unloading system. In this system a series of chains are fixed to the top of one side of the trailer, hang freely down that side across the floor and up the other side, where they are attached to a removable beam (A) (Fig. 2). These chains are spaced at 12 inch centres along the whole length of the trailer and are more satisfactory than steel wire rope for this purpose. By lifting the chains the load is spilled over the side of the trailer.

At the unloading site a wall is required and should be eight feet high, extending at least the full length of the trailer. This wall serves two purposes: the trailer leans against it when the load comes on to the one side, thus preventing severe overloading of the springs on that side; and it prevents the cane falling under the wheels of the trailer after discharging of the load.

The unloading rig is a most ingenious piece of equipment and is the brain child of Ed. Watt, of Hilo. It consists basically of two parallel jibs to which are splice-welded two rolled steel joists hinged near the centre (Fig. 2). Running between the flanges of these two rolled steel joists are two trollies (C) and fixed to the trollies is a horizontal boom (B) thirty-two feet long. Two winches driven by a single motor raise and lower the boom at a speed of twenty feet per minute. The boom is fitted with a series of fingers that engage with the removable beam along the top of one side of the trailer.

In operation the boom hangs well clear until the driver of the trailer has brought his vehicle to rest.

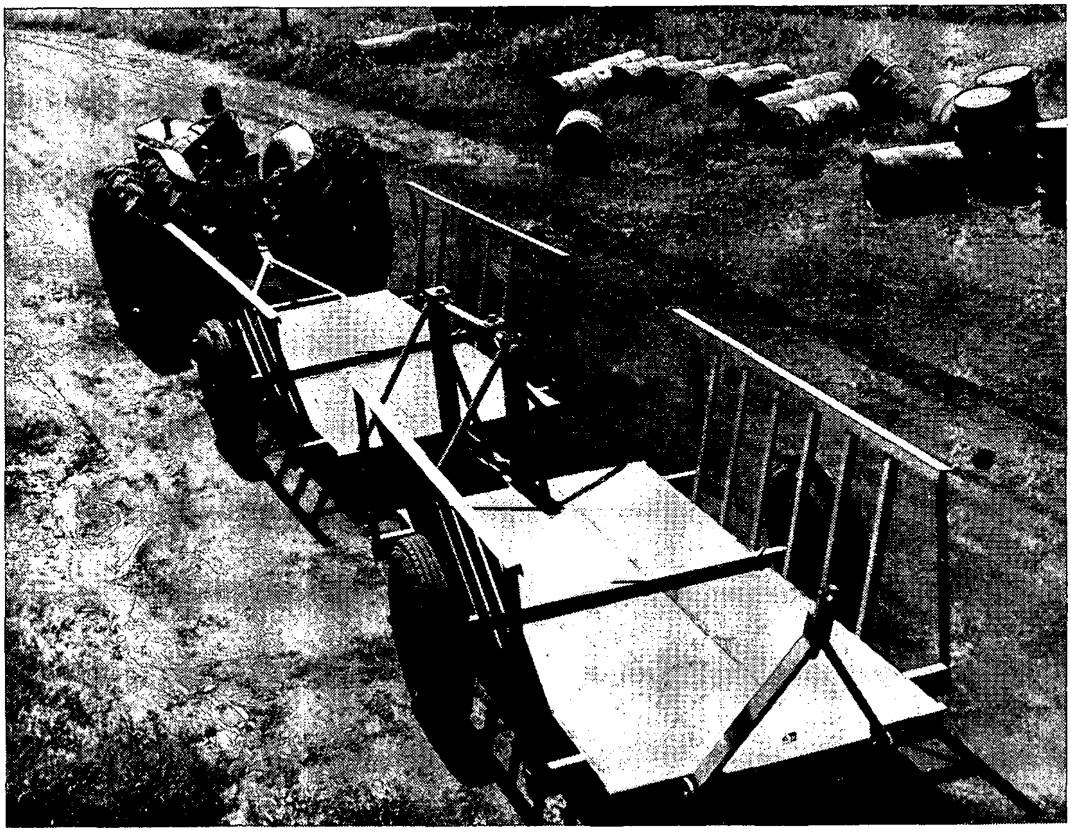

Fig. 3

As he operates the controller of the hoist motor, the boom rises and at the same time a follow-up block (E) (Fig. 2) releases the tension on a steel wire rope (F) and allows the hinged sections of the rolled steel joists to move towards the trailer, bringing the boom with them. When two locating arms (D) engage with the side of the trailer the fingers of the lifting boom will be in line with the removable beam on the side of the trailer. Further hoisting lifts this beam, together with the chains attached to it, and the cane spills over the fixed side of the trailer on to an auxiliary carrier, or on to a loading table. By arranging a trip at the top of the hoist just before the chains become taut, and another at the bottom of the hoist with the boom in its "at rest" position, the whole operation can be carried out by press-button control.

At the loading end of the run rapidity of loading is again of prime importance. This is achieved by the use of light in-field trailers, which are drawn out of the field by a rubber-tyred tractor to a suitable loading point, where the cane is either stored or transferred directly to the larger trailer unit by means of gantry crane, a motorised Scotch derrick type crane or a mobile crane.

The in-field trailer chosen for this work is also of a new design (see Fig. 3) and has been adapted from a trailer first used by certain estates in Trinidad. It is made up of two two-wheeled units coupled together by a special universal joint which gives the stability of a four-wheeled vehicle with the mobility of a two-wheeled trailer. A tow-bar attachment at each end facilitates coupling up, and underslinging the chassis beneath the axle lowers the centre of gravity and makes hand loading extremely simple. The floor of the trailer is plated with 16-gauge steel and is only eleven inches off the ground. It is a simple matter for the cane cutter to step into and place his load, or alternatively deposit his cane over the side of the trailer, which is not more than shoulder high. Each half trailer, two halves to one unit, can carry a three-ton load and this is considered a safe maximum to avoid compaction, and is a suitable load for any standard 35 h.p. tractor, fitted with dual rear-wheels. This addition to a wheel tractor is a definite improvement from the traction point of view, and in the case of the Fordson tractor the performance is vastly improved. Wherever possible, advantage should be taken of terrain and loading planned so that full trailers are hauled down hill and empty trailers hauled uphill. The body design of the light in-field trailer is of importance as the dimensions of the load it carries must be evenly divisible into the overall length of the large trailer, so as to avoid the necessity of splitting a bundle in order to obtain the full payload.

With this new type of trailer experiments have been carried out and it has been established that not only can a greater productivity be obtained per boy as opposed to the older method of small tram trucks, but also there is a lowering of transportation costs. (See comparative field costs.)

Experience so far gained with the methods of transportation briefly outlined in this paper has established that within a radius of some ten miles, depending on terrain, the movement of cane by road compares favourably with movement by standard gauge rail trucks, the shorter the radius the greater the economic advantage accruing to road haulage. Haulage by narrow gauge tramline, in common use on the Natal coast, offers no serious competition to the modern road vehicle and it is possible that the picturesque "Puffing Billy" will soon have to give way to the fast, versatile semi-trailer unit. It has been argued that during wet weather the road vehicles would be brought to a standstill. This can be overcome by the construction of strategic all-weather roads, macadamised if necessary, and motorised transport has proved itself in places such as Trinidad and Hawaii, where the rainfall on certain estates is up to one hundred inches per year—with heavy rains often falling in the harvesting season.

ROAD TRANSPORT COSTS 1955-56

2 A.E.C. UNITS AND 2 HILO TRACTORS

	£ s. d.	£ s. d	Cost per Ton (Pence)
Wages and Rations		76 3 0	.88
Garage Service Charges		93 19 0	1.08
Labour	16 3 5		
Spares	24 8 8		
Diesel Fuel	47 10 8		
Oil and Grease	5 16 3		
Depreciation		750 11 6	8.65
Insurance		30 14 0	.35
Licences		8 16 8	.10
		£960 4 2	11.06
Tons Cane Hauled	20,818		
Mileage (Siding 299 to Siding 450)	2		
Cost per Ton Mile			5.53

So successful have these first two vehicles proved that a further five units are now on order and it is anticipated that in the thirty-two weeks of the coming crop these seven units will transport between them a total of 350,000 to 400,000 tons of cane.

COMPARATIVE FIELD COSTS — UMHLOTI VALLEY SECTION

1st SEPTEMBER TO 31st OCTOBER, 1955

2 FORDSON TRACTORS AND 2 TRAILERS

53 Working Days

4,590 TONS CANE CUT AND HAULED TO SIDING 533

	Cost £	s.	d.	Cost per Ton Pence	
Cutting and Loading					
Cutters and Loaders					
Wages: 1,845 Units @ 2/6¾d.	236	14	5	12.38	
Rations: 1,845 Units @ 1/4d....	123	0	0	6.43	
Bonus: 1,822 Tons @ 1/8d....	151	16	0	7.94	
	£510	10	5	26.75	
Non-Cutters					
Wages: 406 Units @ 2/11¼d.	59	12	8	3.12	
Rations: 406 Units @ 1/4d....	27	1	4	1.41	
Bonus: 20% of Cutters ...	30	7	2	1.59	
	£117	1	2	6.12	
Livestock					
Field Operation	—			—	32.87
Transport					
Main Tramline Transport					
Based on 1954-55 Season's Costs					
Tractors and Trailers					
Fuel Oil: 855 galls. @ 1/7d.	69	9	5	3.63	
Engine Oil: 19 pints. @ 1/2¾d.	1	3	0	0.06	
Grase: 12 lb. @ 1/4d. ...		16	0	0.04	
Maintenance:					
2 sets, Tyres and Tubes... 452 5 0					
8 Tyres and Tubes (Trailers) ... 170 7 8					
Spares ... 80 0 0					
Labour (68 hrs. @ 2/1d.) ... 7 1 8					
53/365ths of ... £709 14 4 =	103	1	1	5.39	
Depreciation (53/365ths of £2,511 0s. 0d.) ... =	72	18	4	3.81	12.93
	£247	7	10		
Total	£874	19	5		45.80

Average Tons per Unit = 2.487

CANE TRUCKS

53 Working Days

3,693 TONS CANE CUT AND HAULED TO SIDING 533

	Cost £	s.	d.	Cost per Ton Pence	
Cutting and Loading					
Cutters and Loaders					
1,704 Units	218	6	6	14.19	
1,704 Units	113	12	0	7.38	
1,137 Units	94	15	0	6.16	
	£426	13	6	27.73	
Non-Cutters					
814 Units	119	11	2	7.77	
814 Units	54	5	4	3.42	
20% of Cutters	18	19	0	1.23	
	£192	15	6	12.42	
Livestock					
616 Units @ 1/9d.	£53	18	0	3.50	43.65
Transport					
Main Tramline Transport					
3,693 Tons @ 1/2¾d.	£226	19	4		14.75
Total	£900	6	4		58.40

Average Tons per Unit = 2.168

SUMMARY

	Cost per Ton
Per Cane Trucks	58.40
Per Tractors/Trailers	45.80
Total Saving	12.60

Maidstone,
March, 1956

Mr. J. B. Grant thanked Mr. Bentley for his paper and said that there could be no doubt that motor transport was bound to come. He was also grateful to see that Mr. Bentley had given cost figures. He was indeed interested to see that the costs shown at Maidstone were so much in favour of road transport.

Mr. W. A. Campbell enquired of Mr. Bentley if the system would be easily applicable to very steep cane lands.

Mr. J. P. N. Bentley pointed out that the big 25 ton hilo trailers did not go into the cane fields. They were loaded either from tram trucks or from the smaller infield trailers.

Dr. G. S. H. Rossouw said that he noticed that Mr. Bentley claimed that the tramline could not compete with road transport, but he wished to know who was going to pay for the roads.

Mr. Bentley pointed out that the roads used were very largely established estate roads.

Dr. Rossouw stated that quite a lot of the transport was carried out on public roads where the cost was not borne by the company. This meant that the motor transport was not debited with a certain amount of maintenance of the roadways such as had to be borne by the tramline system.

Mr. G. H. Walsh said that the saving shown was largely on the transportation side but took no count of any cutting and loading savings. He also pointed out that whereas the road transport was used to its fullest capacity that was not the case with the tramlines. He agreed also that while the costs of maintaining the tramline were charged against the tramline, no such charge was made against motor transport. He though that 16 units a day to handle only 17 trucks was very high. He said also that other estates which had taken to diesel locomotives had been able to save tremendously on their operating costs as against steam tramline charges. He thought that where large quantities or tonnages were handled by tramline there was a very strong case for the diesel locomotives. He considered that quite a big saving would be involved if infield trailers were used to the central loading depot which would then be transferred by tramline.

Mr. Bentley replied that the comparative figures given by him were obtained under two different methods of transport operated under identical conditions. He said that the Company did have other loading sites where the tramline costs were lower. The infield trailers were put into one of the high costing sections. He was not attempting to compare the system shown in the costing figures with other estate railways.

Mr. Campbell said that some companies were dependent upon tramline transport for haulage up to 20 miles. He thought that it would be difficult to discard such a system.

Mr. Bentley replied that in Hawaii they had no hesitation in discarding tramline transport for road transport.

Mr. Saunders stated that the infield trailer illustrated in the paper could virtually be used in almost any terrain. He said that in hilly country this type of trailer was the best one that had been developed. It was very hard to beat for economic costs and economic operation. As far as the heavy hilo trailer was concerned the licence costs took care of public road maintenance. He pointed out that most of the roads being used for infield trailers and the heavy hilo had already been constructed and properly graded for steam locomotives. There would however be some that would have to be specially constructed. He pointed out that there would be a big saving in labour because leader boys, mule boys, track-laying boys, etc. would not be required for motor transport. Actually as far as loading from tramlines to heavy trailer instead of to S.A.R. trucks was concerned, they had been able to reduce from 170 to 60 boys a day. As far as the comparative costs shown between tramline and road transport were concerned, no costs were charged for locomotive haulage as this was done by tractor and mule, so that ordinary tramline costs would be higher than those shown, for this section at least. He considered that up to five miles motor transport was much more economic than steam tramline.

Mr. Campbell pointed out that a large storage space would be required in the mill yard.

Mr. Saunders replied that the place to store cane was not in the mill yards but rather at the loading sites.

Mr. N. C. King enquired if it would not be possible to carry the tramline from the old Tongaat loading siding to Maidstone Mill. He had heard that there were various difficulties in the way, but if it could be done he thought it might be cheaper than using heavy motor transport.

Mr. Bentley said that this matter had been considered for many years but there were many difficulties such as ownership of land as well as the necessity of building a bridge across the river which made this an impractical proposition.

He said that as he previously remarked had the land been in the possession of the Company they probably would have put in a tramline years ago and would now be busily engaged in tearing it up again.

Mr. Campbell stated that one of the big troubles at the moment was the factory's inability to get S.A.R. trucks to bring the cane in.

Mr. J. W. Main inquired if Mr. Bentley could draw up comparative costs of this motor transport as compared with those put up last year by Mr. E. Steward.

Mr. E. Steward said that in preparing his paper on transport, read last year, he found that the cost of transport per ton mile with diesel lorries was just under 4d. This he considered was a conservative figure as he had taken the life of a lorry as six years, while, in fact, it was longer than that.

Although road transport was undoubtedly becoming more popular he considered that in continuous wet weather there was no method, other than tramline, which would ensure the cane being delivered to the mill. He said that although it was expensive to pick up and relay portable line the cost of making macadamised roads, as had been advocated by Mr. Bentley, was tremendous.

Comparing the tractor and trailer system with the existing light railway system, the increased tonnage per unit of labour with the former system was interesting and from the summary of field costs this increase seemed to be due to the reduction in the number of non-cutting units rather than to any labour saving in the cutting and loading.

It should be noted that the cane hauled per day with the tractors and trailers was only 86 tons and that hauled on the light railway only 70 tons. For the light railway this represented something less than one train load which would naturally make the railway figures appear high, when obviously the number of tractors and trailers which would be used would be just sufficient to keep them all continuously occupied.

The figure of 1/2$\frac{3}{4}$d. per ton for the cost of rail transport no doubt included a substantial figure for track maintenance whereas there appeared to be no allowance made for either the initial cost or for the maintenance of the roads used by the tractors and trailers.

There was a saving in non-cutter costs of 6.3d. per ton and he assumed that these non-cutters were the train crew, including brake boys, etc. In the case of the light railway, 814 units for 53 days gave 16 units per day to handle a single train of 70 tons pay-load. This appeared to be rather on the high side and he felt that these 16 units ought to be capable of dealing with a considerably greater tonnage daily with a consequent reduction in the cost per ton.

Experience on other sugar estates using Diesel locomotives shewed that the total railway operating costs could be greatly reduced below those costs, when using steam locomotives. It might well be possible, therefore, to effect a considerable reduction in the costs shown in the comparison table, where on the actual transportation of the cane there was little difference in the cost between tractors and trailers and the railway costs.

Whilst he agreed with Mr. Bentley that the "Puffing Billy" was on the way out, he felt that the road vehicles show up to best advantage only on the shorter hauls and particularly where public roads can be used. On longer hauls and where large tonnages are to be handled there was little to compete with the modern Diesel locomotive, particularly where hauling was done round the clock and where the larger type of cane cars could be used.

There was, however, a very strong case for a combination of both systems, particularly where it was possible to use tractors and trailers which are loaded directly in the fields and can run over poor roads to transfer points where the cane can be handled into cane trucks mechanically and thence transported by locomotives to the Mill.

Mr. Bentley said that the figures he had quoted for Hawaii were greatly influenced by the distance and terrain over which their cane was hauled. On long distances up to 40 miles he thought that the costs could be much lower than those he quoted. As far as depreciation was concerned he said that the depreciation of 20 per cent was on a reducing value and did not mean that the vehicle would last only five years. Some of the roads over which this transport would be conveyed were already macadamised and some they had intended macadamising in any case. The cost of macadamising roads by the company was much less than those of public bodies.

Mr. Steward asked if it were possible to write-off the cost of a vehicle if an annual deduction of 20 per cent of the reduced were made, and, if so, how long would this take?

Mr. Bentley replied that it was necessary of course to fix the residual value, when a formula of the form $K=1-\sqrt[N]{\frac{R}{P}}$ would give the required information.

Mr. Saunders stated that when comparing the Hawaiian costs with those of Natal enormous difference in wages had to be taken into consideration, and if one allowed for this difference one would find that costs in both countries would become more comparative.