Road *versus* Rail Transport

The Swedish Experience

G Isaac

THE question, whether the technical evolution of road transport has made rail transport obsolete, is a difficult one, hut it deserves investigation, and a final judgement, because many important consequences flow from the conclusions of such an appraisal. To conclude that railway transport is obsolete, or even that it is likely to become obsolescent in the forseeable future, would imply that the large expenditures on railway expansion in the Second Five Year Plan- which amount to nearly a quarter of the total planned expenditure may have been misdirected, It may be that the country is being saddled with enormous investments in financially unremunerative and technically obsolete machinery. It would also imply that the negligible allocations for road transport, and the innumerable restrictions on its expansion, are holding back technical and economic development in a sector of the greatest national Importance. In brief, the final judgement on the question would decide whether or not there has been a major misdirection of resources involving the sacrifice of many opportunities to create employment and increase national wealth.

In what follows, the Swedish experience is marshalled to throw light on this problem. It is not suggested that this evidence is sufficient to support a definitive conclusion by itself, but it may very well indicate one.

Three measurements are used :

(1) The weight of goods carried, or the number of passengers carried.

(2) The work done, calculated by multiplying the weight of goods, or the number of passengers, by the distance carried,

(3) The monetary worth of these services expressed in Swedish Kroner. (I l l Swedish Kroner 100 Indian Rupees)

The Hallway Age

The first Swedish railway began operation in 1856. The next fifty years may be rightly described as 'The Railway Age in which railways maintained undisputed supremacy, expanded rapidly, and established themselves in the nation's economy. The Railway Age came to an end with the first world war, as competition from the roads began. Expansion still continued, though at a sharply reduced rate. In 1938 the railway mileage reached its maximum length, 16,886 kilometers, and then began a long, stow decline. In 1956 the length of line was 16,117 km. The second world war provided the railways with a powerful impetus which has still not completely been dissipated.

The Swedish Railways are today among the most modern and efficient in the world. Almost half the line is electrified and this accounts for nearly 85 per cent of the traffic, In 1956, steam traction accounted for only 8.6 per cent of the total train kilometers worked. This is of considerable importance. The Indian railway programme is primarily based on coal-fired steam traction, which is comparatively inefficient. Coal fired steam traction has been displaced all over the world by diesel and electric traction.

Competition from Road Transport

Road transport expanded steadily after the first world war interrupted only by the depression of the thirties, and with a major dislocation during the second world war, when its capacity was largely absorbed by military purposes. The distribution of civilian internal passenger traffic among the various forms of transport in 1950 is shown in Table 1.

The powerfully competitive position vis a vis the railways achieved by road transport is obvious. But what is significant for our purposes is the startling rate of change over the next five years which is indicated by Table II.

Table I—Internal Passenger Traffic in Sweden 1950

	Work in billions of Person km	Worth in millions of Kroner	Work percentage	Worth percentage
Railways	6.6	374	39	21
Trams	1.8	92	8	5
Road vehicles of which	8.0	1.160	48	67
Bus & taxi	3.2	460	19	26
Motor cycles	0.6	100	4	6
Boats	0.15	14	1	0.8
Air	0.02	4	0.1	0.2
Total	16.7	1.744	100	100

Source : 'Svenskt Transport Vasende'. Carl Wilhelm Petri Industriens Utredningsinstitut.Stockholm. 1952.

Table II—Changes in Internal Passenger Traffic in Sweden 1950-1955

	Work in billions of Person km		Millions of passengers		Worth in millions of Kroner	
	1950	1955	1950	1955	1950	1955
Railways	6.6	6.2	150	122	339	416
Trams	1.3	1.3	328	297	92	138
Bus	2.6	3.0	450	510	250	390
Personal Cars	5.4	14.0	540	1.400	910	1.600
Motor Cycles	0.6	0.9	150	180	100	180
Boats	0.2	0.1	15	10	14	15
Air	0.02	0.04	0.05	0.1	4	10
Total	16.7	25.5	1,633	2,519	1,709	2,749

Source.: 'Vagplan for Sverige'. Statens Offentliga Utredningar, 1958.

Table III—Internal Goods Traffic in Sweden 1949

Commodity	Railways '000 tons	Railways Mn ton km	Road Trucks '000 tons	Road Trucks Mn ton km	Boats '000 tons	Boats Mn ton km	Total '000 tons	Total Mn ton km	Average haul km
Foodstuffs	1,300	430	18,700	540	500	170	20,500	1,140	10
Agr produce	3,700	450	5,700	170	700	190	10,100	810	80
Building materials, earth & debris	2,700	690	63,600	470	2,600	550	68,900	1,710	25
Forest products	5,100	1,290	22,700	470	400	80	28,200	1,840	65
Ore & metallic products, but excl Lap Ore	7,800	1,710	9,500	140	500	360	17,800	2,210	124
Lappland Ore	10,400	1,750					10,400	1,750	168
Mineral Oil	1,000	200	2,200	70	900	320	4,100	590	141
Coal	1,900	220	5,200	50	200	70	7,300	340	45
Misc	5,800	1,370	23,100	490	600	340	29,500	2,200	75
Total	39,700	8,110	150,700	2,400	6,400	2,080	196,800	12,590	64

Source: 'Svenskt Transport Vasende', Carl Wilhelm Petri Industriens Utredningsinstitut, Stockholm 1952.

Table IV—Changes in Internal Goods Traffic in Sweden 1950—1956

	Tonnage Lifted (mn)		Transport Work (mn ton km)		Average Haul (km)		Transport Worth (mn Kroner)	
	1950	1956	1950	1956	1950	1956	1950	1956
Road trucks	167	290	2700	5760	16	20	1150	2400
Railways	41	46	8600	11000	209	239	510	930
Boats	8	8	2500	2700	324	324	60	80
Towing in canals	9	9	700	700	80	80	13	20
Timber floating	9	10	1200	1500	130	150	50	70
Total	234	363	15700	21600			1783	3500

Source: 'Bilism i Sverige' Automobilindustriforening, Stockholm, 1952.

Table V—Taxes Paid by the Railways and by Road Transport

(Mn Kroner)

Year	Railways	Roads (vehicle & petrol tax)
1950	1.4	471.9
1951	1.8	411.2
1952	2.5	519.7
1953	1.6	602.4
1954	1.8	818.8
1955	2.5	1,042.5
1956	2.5	1,017.5

Sources:

For Railway figures 'Sveriges Jarnvagar', SOS Stockholm, 1957.

For Road figures, 'Riksrakenskapverket', quoted in 'Belism I Sverige'. (Road figures refer to financial year.)

Table VI—Deficit on the Swedish Railways* 1950—1956

(Mn Kroner)

1950	1.8
1951	11.6
1952	39.0
1953	50.5
1954	52.4
1955	50.8
1956	58.6

Source: 'Sveriges Jarnvagar', SOS Stockholm, 1957.

*State owned and Private

Table VII—Employment in Industries Related to Road Transport

(Numbers)

	1950	1956
Road vehicle manufacture	7,100	14,000
Road building	4,200	5,000
Motor vehicle trade	6,900	10,000
Petrol & Lubricants	9,700	12,000
Total	27,000	41,000

Source: For 1950: 'Svenskt Transport Vasende', Petri. For 1955: 'Svensk Vag Forening', Stockholm.

Table VIII—Axle Pressure Limits

VOLVO TITAN L 395
Scania Vabis Regent L 7146

	Axle Pressure Limits (tons) 5	6	7	8
Capacity that can be utilized	3.0	4.2	5.4	6.0
Wasted capacity	3.0	1.8	0.6	0
Wasted capacity as %	50	30	10	0

VOLVO TITAN LF 398
Scania Vabis LS 7150

	Twin Axle Pressure Limits (tons) 8	10	12	14.5
Capacity that can be utilized	4.5	6.7	8.9	11.0
Capacity that is wasted	6.5	4.3	2.1	0
Wasted capacity as %	59	39	20	0

Source: F von Heideken, A B 'Svenska Cellulosa Svenska Vagforeningens Tidskrift', No 5, 1955.

By 1955, road transport had achieved an almost dominating position in the movement of passengers. Road vehicles carried almost eighteen times as many people as did the railways, and the value of their services was almost live times that provided by the railways.

large Share of Ore Traffic

Turning now to goods traffic the second world war, and the period immediately following it, saw many restrictions on the civilian use of road transport vehicles. Nevertheless, by 1949 goods trucks on the mads had acquired a considerable share of the total frame. This is shown in Table III. It underlines the predominance of railways on long distance traffic. In tonnage, the railways lifted only atraction of the goods lifted by road transport vehicles. Because their average haul was longer, the actual work done by the railways was considerably greater than the work done by road transport vehicles. The second point to note is the extent to which the railway performance is built on a single commodity, Lappland ore. which accounts for almost a quarter of the total tonnage lifted by the railways. The traffic which is located in the barren and sparsely populated Northern stretches of Sweden, is an effective monopoly operated by the Government-owned mines and the Government-owned railways

Special Factors

These two sectors represent the stronghold of the railways. In what follows it will be suggested that the railway hold over long distance traffic is due to no technical factors of significance, but due to the unsatisfactory condition of the roads. As the comprehensive plan for expanding and improving the roads, detailed in 'Vagplan for Sverige' (Statens Offentliga Utredningar 1958) is Implemented, the railways will be seriously challenged in this vital sector. As far as ore is concerned there Is already a powerful movement towards road transport, and in the case of new mines that come into operation, a high and increasing proportion will rely primarily on road transport.

For the moment, however, we shall trace the changes that had taken place in the situation already described by 1956. It will be seen from Table IV that both forms of transport registered increases, but the roads registered far higher rates of expansion than did the railways.

The railways owed their performance to a number of special factors among which, perhaps, the most important was State policy. The import *of* railway rolling stock was, for example, free of customs duties, and the railways were exempted from the investment taxes of 1951 and 1952. It may be said that the railways owed their continued existence to the fact that they hardly paid any tax at all. (See Table V).

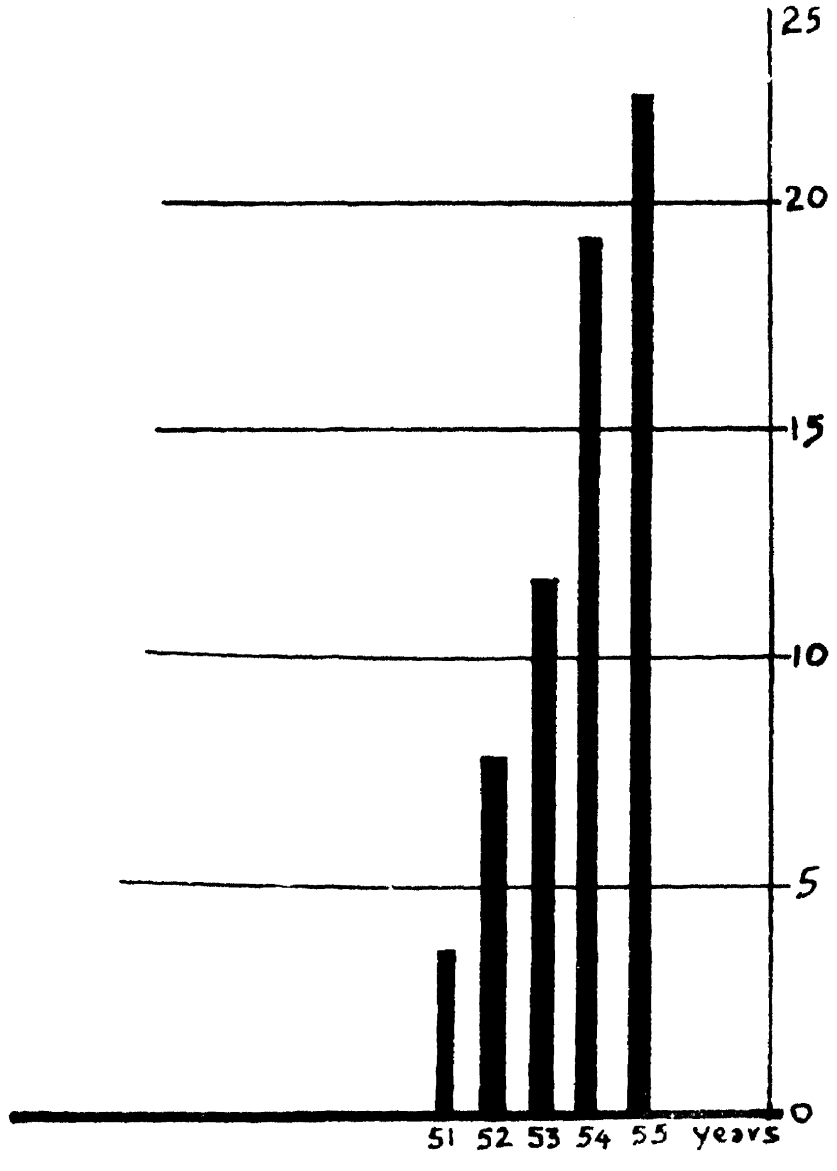
In spite of these concessions the railways operated at a deficit. After calculating interest charges on fixed capital at 3.32 per cent, the rate applicable to Government long term borrowing, the deficits in the railway accounts were as shown in Table VI.

larger Employment in Road Transport

As far as employment is concerned, the railways which in 1920 employed 62,000 men thirty-six years later employed 66,000 men, while road transport which was a negligible employer in the twenties, employed 150,000 men in 1950. *By* 1956 this had increased to 191,000 men. There wa.s also a powerful expansion in the number employed in ancillary industries during this period. See Table VII.

It would have seemed that in India, the enormous employment potential of road transport would have decided planners to .give ii a

CHART I Transport Volume
(Mn ton km)



Source :B Gabrielsson of Bolidon, A B, in Svenska Vagforeningens Tidskrift'. No 5, 1955

rather larger share of resources, than In fact was allocated to it. That no such concession was made is explained by maintaining (1 that road transport is technically unsuitable for carrying such materials as iron ore and coal, (2) that it is unsuitable for long distance traffic, and (3) that the costs of road transport are essentially, for technical reasons higher than the costs of rail transport. The Swedish experience throws interesting light on these contentions,

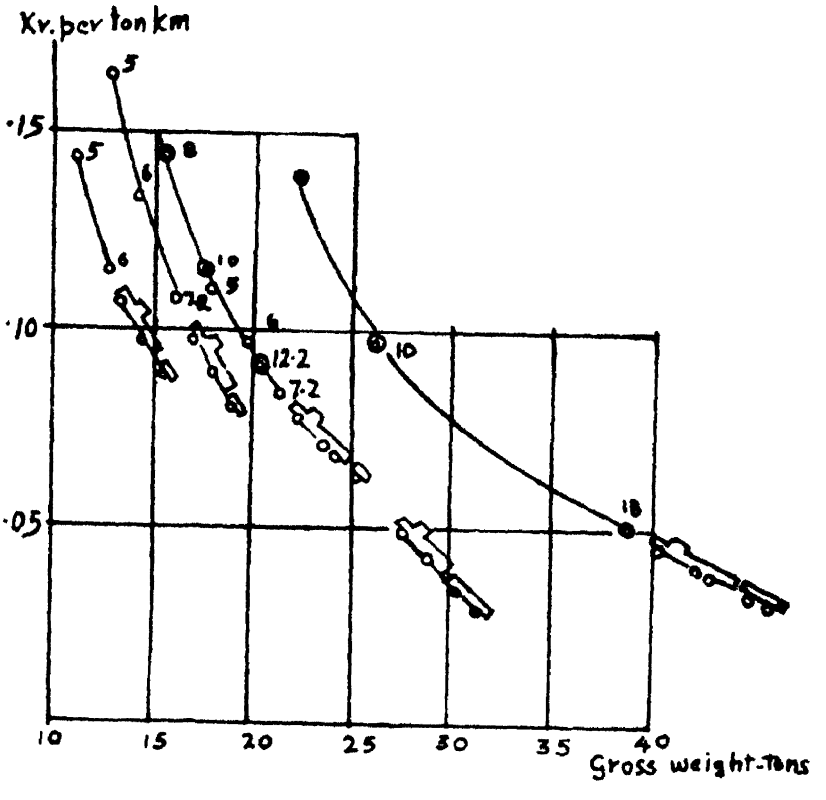
Ore Transport

The case of Lappland ore referred to earlier, would tend to confirm the accepted ideas of the Indian Planning Commission, but the experience of the private-owned mining companies, where competition is more evident, is, interestingly, different. In the case of newly opened mines there is a tendency to move the entire production on road vehicles. Unfortunately no overall statistical information is available, but Chart 1 (p 15) illustrates the increased use of road transport in one of the largest Swedish ore companies. The company, Bolldon A B, also uses railway lines for its old mines, and even a conveyor belt. In 1955, of its total ore trans port work of 80 million ton km, the railway accounted for 45 per cent, the conveyor belt for 30 per cent and road trucks for the remaining 25 per cent amounting to 20 million ton km. The significant point is that since 1945 the volume handled by the conveyor belt and the railway has remained unchanged, but the quantity handled by roads has increased phenomenally. Incidentally, the longest haul undertaken by the company is in the region of 65 km. The other large Swedish ore companies, Stora Kopparbergs Bergslag and Sandvikens Jernverk, are said to be adopting similar practices,

In 'Svenska Vagforeningens Tidskrift, No 5, 1955, B Gabrielsson, Director of Bolidon A B, details the technical factors responsible for this change. He points out, that after an ore field has been proved, it takes between five and ten years for production to be established on a commercial scale. During this period large amounts of earth have to be removed, buildings and sheds erected, machinery brought into position etc. All this is usually done on roada, to and over the site. When production starts, one has consequently the choice of either building an entirely new transport means, i e, a railway, or of reinforcing an already existing means, and carrying the ore *on* it. A railway line is a very heavy piece of Investment, that is recovered only after many years of continuous high production. Very few mines are large or rich enough to guarantee this. In fact for most new Swedish mines the cost of a railway line would exceed the cost of all other equip-

CHART II

Cost per ton km for Road Transport And Its Relation to Road Restrictions
5-6-7.2 single axle pressure; 6-10-12.2*18 twin axle pressure
The Lowest Point on Each Curve Gives Gross Weight Corresponding to Maximum Load



Source : F von Heideken, Svenska Cellulosa, A B in 'Svenska Vagforeningens Tidskrift', No. 5, 1955.

Table IX—Rolling Stock on Swedish Railways*

	1914	1925	1935	1945	1950	1956
Passenger coaches	4,048	4,333	3,998	4,331	4,733	5,018
Goods wagons	54,413	59,535	50,035	52,748	53,470	56,167
Length of line-km	13,829	15,981	16,772	16,711	16,640	16,117

Source: 'Sveriges Jarnvagar'. S O S. Stockholm. 1957. *Both State and private.

Table X—Road Vehicles on the Swedish Roads

	1914	1925	1935	1945	1950	1956
Passenger cars	...	59,000	109,000	50,000	252,000	735,000
Buses	...	1,300	3,900	4,000	7,500	8,300
Goods trucks	...	19,000	46,000	42,000	85,000	112,300

Source: 'Central Bilregistret'. Quoted in 'Bilismen i Sverige' Sveriges Automobilindustriforening. Stockholm

ment required for working It, and if there were no alternative to building railway lines to new pit heads, mining: would become uneconomic. Gabrielsson concludes his study by expressing his anticipation of a sharply expanding trend in the future in the rate of ore transport toy road.

Vehicle Utillisation

The crucial factors in determining the costs of road transport are limitations on vehicle utilization imposed by the road authorities These concern permissible single axle pressure, twin axle pressure, and total weight. How these restrictions affect vehicle utilization is illustrated in the case of some well known Swedish trucks in Table VIII.

Restrictions regarding single axle pressure and twin axle pressure are, incidentl y, calculated from the condition of the road surface. Restrictions regarding total vehicle weight are primarily reflections of the carrying capacity of bridges. The cost of carriage generally falls as the total vehicle weight rises, because the proportion of utilized weight in the loaded vehicle increases as Its .size increases, while the expenses for maintenance, fuel and staff rise much more slowly. The relation between limits on single axle pressure, twin axle pressure, and total weight are admirably summarized in Chart II op 171 It illustrates the remarkably low costs that can be achieved on good roads by intelligent combinations of vehicles and trailers. but it also Illustrates how sharply costs can be raised by restrictions on the roads. A bridge with a limit of 15 tons for example, would prevent all vehicle combinations except the two most expensive, i e, a two axled truck, with a single axle trailer.

The graph indicates, that where single axle pressures of over 6 tons, twin axle pressures of over 10 tons and gross vehicle weights of over 40 tons are permitted it is possible to operate at costs between 0.05 and 0.10 Kroner per ton mile. In the case of ore, the evolution of a number of special type trucks promise even further cost reductions. (See B Gabrielsson in 'Svenska Vagforeningens Tidskrift". No 5. 1955

The economies of the heavy vehicle combinations are reflected in the actual figures. In the period 1945 to 1953, trucks in the 5-6 ton category increased three times, the number of even heavier vehicles increased 5 times. In the light of current discussions in India on the possibility of using trailers, It is Interesting to note that the impressive increases marked up by road transport in Sweden were much assisted by the use of trailers. The number of trailers increased from 16,210 in 1950 to 25.514 units in 1957.

It is rather difficult to isolate and analyse the precise cost relationships between road and railway transport that underlie these developments As far as the cost of carriage on the railways are concerned. Petri in his researches. referred to earlier, mentions a figure of 0.06 Kroner per ton km (see p 15, 'Svenskt Transport Vasende but this refers to 1950. Since then there has been a very general inflation in the country. The present figure may be assumed to be in the region of between 0.07 and 0.09 Kr per ton km. This is confirmed by information available on the Lappland ore traffic. In 1956 this traffic amounted to 2,209 million ton km, and brought in an income of 154.9 million Kroner (Source: Svreriges Jarnvagar'. Stockholm 1957 This gives an average cost of carriage of 0.07 *K* per ton km. This may be considered an extremely conservative figure. The traffic is highly mechanized, almost completely homogenous, and represents perhaps the most efficient sector of the railways' operation. It would seem that where a road system provides for a high degree of vehicle utilization, road transport can, and does compete, with railway transport in terms of ton km costs

The point is of crucial importance The allocation between road and rail transport in India's Five Year Plans was significantly influenced by calculations made by a study group which compared the Railway cost of between 20 and 40 pies per ton mile with a figure of 70 pies per ton mile for road transport, a. figure calculated from the financial results of State operated road vehicles. Subsequently this cost difference has been treated as if it were a reflection of an adamantine technical railway superiority, instead of what it in fact is -the result of heavy taxation and legal restraints on road vehicle utilization, neglected roads, and preferential treatment for state-owned railways.

To return to Sweden the low costs referred to earlier obtain only on *very* limited stretches of the Swedish roads. Only 30 per cent of the existing national main roads will take single axle pressures of over 6 tons, and of the country's 9,000 bridges, only 20 per cent will take vehicles with gross weights of over 10 tons. But current plans intend a much enlarged road network by 1975, with a uniform single axle standard of 10 tons, twin axle standard of 18 tons and a uniform standard for bridges- of 22 tons twin axle pressure. It is calculated that the first stage of this plan, between now and 1967, which will cost 14,000 million Kroner, can be financed out of present road taxes without any increase in their rates!

It will, of course, be advanced against the arguments detailed or suggested here that the Swedish experience is in some ways unique, and that the conclusions suggested by it are not applicable to Indian conditions In fact Sweden does not represent any disproportionate development of road transport. It is true that in the number of personal cars per 1.000 inhabitants, it has recently achieved the highest figure in Europe, but in terms of road trucks per 1,000 inhabitants Sweden is still behind Australia Canada, the United States, Great Britain, France. Norway and Germany.

The fundamental argument for using scarce resources for developing road transport, vehicle manufacture, and for building roads rather than railways is however ret her more broadly based than the arguments so far advanced have suggested. Road transport industry is involved in *every* held *of* development. In particular it is concerned with three sectors or vital importance, and this constitutes an overwhelming' argument for giving road transport a higher priority in national planning than it has enjoyed to date. First, road vehicle manufacture is the basis for aircraft production. In Sweden S A A B turn out supersonic jet aircraft and motor vehicles with equal facility. The industry also manufactures tractors of crucial significance in agricultural production-and, finally, it manufactures the vehicles on which military power, and the mobility of personnel, artillery and supplies depend.