governmental corporation in October 1953 and provided half the ¥2,000 million capital, gave subsidies, bond guarantees, and bond-issue limits, and offered treatment as a favoured corporation. To firm its base for beginning international air transport, the country joined the International Civil Aviation Organization in October 1953. In February 1954, JAL started its first routes, flying between Tokyo, Honolulu, and San Francisco and between Tokyo and Naha (Okinawa). By 1960, it was flying the polar route to Europe, as well as offering direct service to North America and Asia.

Local domestic routes to the east of Osaka were initially assigned to Nihon Herikoputa Yuso, while those to the west were handled by Kyokuto Koku. The two companies were amalgamated into Zen Nippon Kuyu (All Nippon Airways) in December 1957. Other local airlines started before 1960 were Aoki Koku (later Fujita Koku), Nihon Kanko Hiko Kyokai (later Nitto Koku), Kita Nihon Koku, Toa Koku, Fuji Koku, and Naka Nippon Koku.

Despite the decrease in motor vehicles (reportedly by at least 20 per cent) during the war, as the industry recovered, it first increased small three-wheeled motor vehicles, the numbers in 1948 surpassing those for 1940, and by the beginning of the 1950s, they had exceeded the prewar levels for all vehicle types. From 1951 on, progress in medium- and long-distance lorry hauling was dramatic, the number of transport lorries in 1952 already having exceeded prewar levels. Although lorries were not carrying as much in ton-kilometres as the National Railways in 1952, motor vehicles hauled 65 per cent of the tonnage (ton-kilometres was 12 per cent), another figure that surpasses any of the prewar levels. From then on, through the latter half of the 1950s and the 1960s, motor vehicles gradually took larger and larger chunks of the domestic transport volume.

Supporting these trends were strong highway-building and road-traffic policies such as the 1952 revision of the Road Law and motorway construction regulations adopted in the last half of the 1950s. But the overall road level remained low throughout the country, while the number of vehicles continued its rapid upward climb. This resulted in a growing imbalance between vehicles and roads that is undeniably one of the major reasons for the subsequent soaring number of traffic accidents and widespread environmental destruction. One factor in the growth in motor vehicles at this time was the change in energy source from coal and electricity to petrol; an energy system based on petrol was a fragile one, for no one could know when international political trends in petrol would cause it to collapse.

Railroads

Katsumasa Harada

Recovery in Railroad Transport Power

The road of railroad recovery was a hard one. The shortage of labour and materials during the war had brought rolling-stock and equipment to the

verge of collapse, and the bombing raids on the Japanese main islands brought almost complete destruction. When the war ended in August 1945, every railroad, national and private, had a very difficult time just running their trains. But the fact that the railroads continued running on the day of the surrender gave courage to those crushed with grief.

For people whose livelihood had been destroyed, the fact that the trains were running, even if they could not operate as they should, gave them a sense of the daily rhythm of life and an incentive to rebuild their lives.

Railroad employees worked under severe handicaps, with an awareness that people were expecting a great deal from them. The opportunity for railroad recovery was very important for the feelings of reliability between customers and employees and the sense of mission that arose out of that confidence.

Recovering from the pain of defeat required a great deal of effort and time. Restoring rolling-stock, equipment, and buildings required strength in manufacturing, a system of material supply, and the labour force. The lack of a supply of steel at the time prevented the replacement of rails that was so needed for operation. It was not until 1948 that the capacity to produce rolling-stock reached the prewar levels. Attention was given to upgrading manufacturing capability in order to produce locomotives and electric multiple units, and the old munitions factories were used at the maximum levels reached during the war for maintaining and repairing rolling-stock.

Private railroads operating electric trains in the vicinities of the large cities were particularly hurt by the shortage in rolling-stock and an inability to recover from damages. Many eventually had to adopt emergency measures in which they took over and repaired worn and damaged cars from the National Railways. However, private railways with the same track specifications as the National Railways were able to use rolling-stock manufactured for National Railway recovery, which later provided an opportunity to unify the specifications of the National Railways and private railroad commuter rolling-stock.

The Dodge Line, mentioned previously, put a severe damper on plans for rebuilding the National Railways and private railroads in 1948 and 1949, but the outbreak of the Korean War in 1950 changed the situation completely. The war made imperative the quick transport of large amounts of men and *matériel* from Japan to the Korean War zone. The volume transported far surpassed the amount for Japanese units during any similar period of the Pacific War and was the largest military transport the National Railways had carried since its inception. For a time, the situation was one of extreme confusion at the munitions shipping stations near the port of Yokohama and at troop departure stations such as Sasebo and Moji, but if these shipments had not accelerated the speed of recovery, Japanese industry would not have been able to keep up with UN force requirements.

Under SCAP control, the National Railways moved forward in its plans for recovery, and despite the restrictions mentioned previously, progress

was slowly being made on electrifying the railroads and introducing electric trains. The so-called Shonan trains that appeared in March 1950 on the Tokaido Main Line between Tokyo and Numazu violated conventional wisdom about electric trains in that the motors were distributed among the electric cars rather than being concentrated in one locomotive pulling the cars. These distributed-power commuter trains of 10 or more electric multiple units demonstrated their superiority to motive power concentrated in one locomotive. The Shonan trains are historically very significant because their success led to the expanded use of the distributed-power system in middle- and long-distance service, in high-speed express trains, and eventually in the Shinkansen plan.

Guidelines on similar forms of distributed power for diesel railcars were adopted in 1952. Research on internal-combustion engines had lagged behind that of other countries since before the Second World War. At the time of World War II, Japan still had not completed research on how best to use the internal-combustion, diesel locomotives received as reparations after the First World War, and so the research on these internal-combustion engines was still at an extremely low level when it was abandoned. Later, the importance of railroad electrification was keenly felt in the extreme post–World War II shortage of coal. Yet, many strongly advocated a programme for the introduction of internal-combustion engines for those areas that could not be electrified. Most internal-combustion engines used by the National Railways during the prewar period were fueled by gasoline, due partly to the lack of prowess in diesel technology. After the war, the use of diesel engines became a major objective, in part for reasons of catching up with the rest of the world in technical levels.

The project got fully under way in 1951 with the building of the first diesel locomotive in 1953, the DD 50, which could be coupled to cars at either end. This led to the eventual construction of a diesel-electric locomotive, which, when put into service, brought about the development of torque-converter-drive diesel multiple units and the subsequent adoption of torque drive as the standard for all diesel cars and locomotives. The first diesel locomotives and cars had engines of around 180 horsepower, which was inadequate; but during the 1960s, a 400-horsepower diesel engine was developed and internal-combustion locomotives and cars were put into service equipped with powerful engines. This allowed the use of low-smoke engines in non-electrified zones, first in passenger rolling-stock. From around the mid-1950s, low-smoke passenger trains were operating in many non-electrified zones. In 1960, diesel multiple units began to be used on express trains in the non-electrified areas of the trunk railroads.

Before the advent of the Shonan trains, Japan's electric car technology had been based on the nose-suspension motor. But research to change this succeeded in applying the flexible joint transmission and drive system during the latter half of the 1950s. Research on these applications to private urban railroads was well advanced, but the National Railways developed in 1957 a new high-performance electric car for electric commuter trains fixed

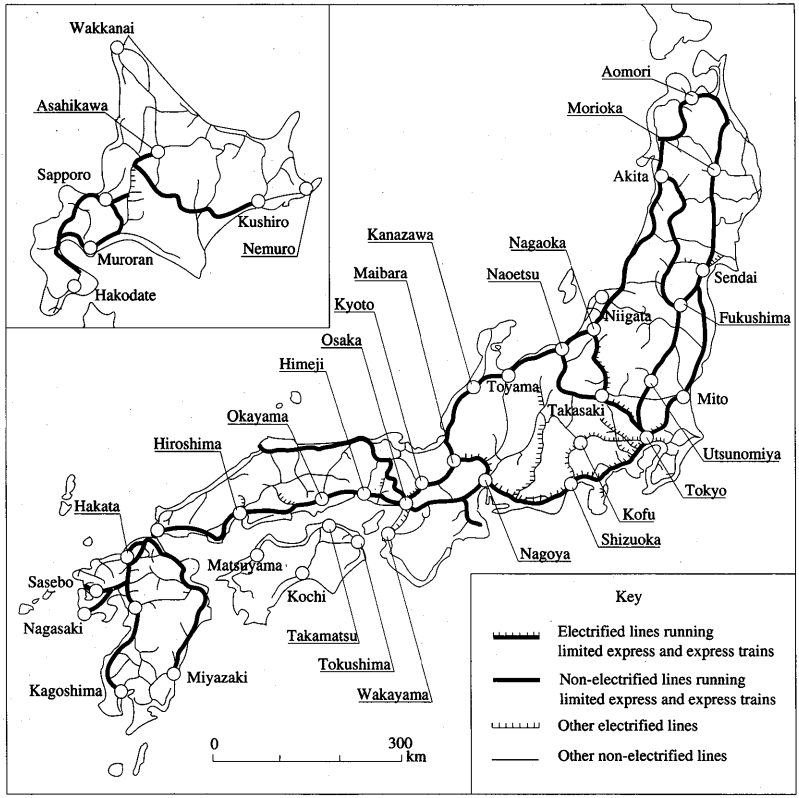

Fig. 1. National Railway network before the high-growth period (1955)

at 10 units. With the placement of this train into service, the transmission and drive system could be applied to high-speed electric trains, and in 1958, a limited-express electric train was built for the run between Tokyo, Osaka, and Kobe that reduced the 7 hour and 30 minute transit time required by locomotive-powered trains to 6 hours and 50 minutes (later 6 hours and 30 minutes) between Tokyo and Osaka. That made possible one-day round trips between Tokyo and the Osaka-Kobe area.

The route to this point led through many accidents caused by the electric cars designed during the war, and the enforcement of a thorough recovery during the years 1951–1953. Around this time the National Railways started a project to convert its wooden-bodied passenger coaches to steel. In several years' time all operating passenger coaches had steel bodies, and thus a large amount of rolling-stock had been fundamentally improved by the mid-1950s.

These improvements in rolling-stock were carried out from the mid-1950s

and thereafter as a part of an active programme to modernize motive power. Express trains were restored to operation in 1949, the standard train schedule was gradually reinstated beginning in 1950, and, by 1953, the prewar levels in transportation had been reached. When the SCAP restrictions were rescinded, construction for electrification moved boldly forward on the trunk lines, with the entire Tokaido Main Line electrified by 1956.

Modernizing Locomotive Power and Technical Reform

To further the recovery, update equipment and rolling-stock, and promote the use of electrical and diesel power, in 1955 the National Railways adopted its first five-year plan (actually launched in 1957), which emphasized improvements in those facilities and equipment that had recovered least. Under the Occupation, the National Railways had been converted (on 1 June 1949) to a public corporation and provided with a budget independent of the government's. The National Railways was now in a position in which it had to rely on this five-year plan to rapidly strengthen transportation power and stabilize its management system.

The five-year plan did not, however, result in an adequate rehabilitation of worn equipment, which gives some indication of how much the equipment had been damaged during the war, but it was also a question of emphasis, for most of the improvements made during the five-year plan were those dedicated to rolling-stock performance. Efforts to increase the load that tracks could bear by increasing rail weight and improving rails and roadbed had still not produced adequate results. The use of alternating cur-

Table 1. Number of kilometres electrified and equipped with automatic signals along National Railway lines

Year	Kilometres of electric operation	%	Automotically controlled/ interlocking block system
1907	12.1	0.2	—
1912	60.4	0.7	(1913) 27
1922	103.0	0.9	269
1932	435.9	2.8	1,126
1942	850.2	4.6	2,126
1947	1,443.1	7.3	2,655
1952	1,750.6	8.8	3,267
1962	3,333.5	16.2	4,812
1972	6,684.5	31.9	9,347
1982	8,829.6	41.3	12,854.5
1983	8,840.1	41.5	13,917.7

Source: Harada Katsumasa, *Tetsudō no kataru Nihon no kindai* (The railroads and Japanese modernization), expanded and rev. ed., p. 245, table 10 (more recent data have been added).

rent as part of the programme to modernize motive power was planned to start in 1953. In 1957, the National Railways succeeded in using 50 hertz (60 hertz west of Fujikawa and Himekawa) commercial frequency, 20,000 V single-phase alternating current, a valuable contribution to reducing the number of substations and improving the operating efficiency for both trunk and local lines. The later technological success of the Shinkansen was due to the achievements made with the Shonan electric trains, the new performance electric trains, and the use of alternating current.

Roads

Hirofumi Yamamoto

Postwar Reform and Road Transport

The end of the Pacific War changed road transport conditions completely by destroying the basis of the system of small transporters and moving system reform forward rapidly, particularly through the abolition of the two laws on small transport.

Reform in the small transport system provided one of the major features of the first part of the postwar era; the reform aimed at increasing the number of small transporters at each station and reorganizing Nippon Tsuun. The move to increase the number of small transporters, carried out with the backing of several laws to democratize the economy – including the April 1947 Anti-Trust Law and the December 1947 Law to Remove Excess Concentrations of Power in the Economy – could not be resisted even by Nippon Tsuun, singled out as a company possessing an excessive concentration of power in the economy. In November 1948, the Transportation Ministry issued a general plan for a system of more than one small transporter at each station and set up a Small Transport Council to investigate licensing standards and other important matters. Their deliberations resulted in the announcement in March 1949 of new licensing standards and the installation of more than one transporter at 33 stations, this number increasing subsequently. The Railroad Freight Handling Operations Law of February 1950 abolished the framework for specifying multiple-operator stations and uniformly licensed all operators meeting with the licensing standards.

Designation as an excess concentration of economic power under the law and abolition in December 1949 of the (1937) Nippon Tsuun Kabushiki Kaisha Law forced the part-government, part-private small-transport overseer to thoroughly reorganize. Concerning the ordered reorganization in relation to excess concentration of economic power in order to ensure that such critical commodities as wheat and rice would get transported, the rather mechanical break-up plan initially proposed was replaced by planned restructuring centred on the transfer of railway station facilities for small transport, ships, and shares in other companies. This part was completed in June 1951. Abolishing its status as a company of "national importance" and