

The "Ed" Class Locomotives of New Zealand Railways

By T. A. McGavin

TEN electric locomotives placed in service at Wellington between 1938 and 1940 are now reaching the end of their useful lives, the introduction of diesel-electrics between Paekakariki and Wellington having reduced the need for straight electrics, which now are used only on peak-hour suburban trains. Multiple-unit electric trains provide the basic suburban service. The locomotives now being withdrawn are the 87-ton "Ed" class, of which only two or three are now required in use each morning.

When it was decided to electrify the railway between Wellington and Paekakariki, 24½ miles via the Tawa Flat deviation then under construction, the opportunity arose to design the first electric locomotives that would be required to work heavy express trains and goods trains over more than six or eight miles in New Zealand. So, just over two years later, in December 1935, Mr G. H. Mackley, General Manager of Railways, announced on behalf of the Government Railways Board that eight main-line electric locomotives had been ordered, the first to be manufactured in England, and the remainder to be built in the Hutt Workshops, using imported electrical equipment. The report of this announcement, together with a reproduction of a pencil sketch of the new locomotive, appeared in the *Evening Post* of 13 December 1935. The locomotives were designed to work on the 1,500 volts direct-current overhead-contact system that had been adopted as standard practice by New Zealand Railways.

The contract for the supply of the locomotive and additional electrical equipment was placed with the English Electric Co. Ltd., with R. & W. Hawthorn, Leslie & Co. as subcontractor for the mechanical portion. Two additional sets of equipment were ordered for similar locomotives to be built at the Addington Workshops for use between Otira and Arthur's Pass. It was reported in 1937 that complete sets of material, drawings, and patterns were being supplied for the nine locomotives to be built in New Zealand.

The design requirements included the haulage of 250-ton passenger trains at speeds up to 55 m.p.h., and 500-ton freight trains at speeds up to 45 m.p.h. It was required that the 500-ton load must be started and accelerated to 20 m.p.h. on the 1 in 57 grade approaching Pukerua Bay, and that the maximum axle load be limited to 16 tons.

Although all previous electric locomotives on New Zealand Railways, those built in 1922 for the Otira Tunnel service, and those built in 1928 for use through the Lyttelton Tunnel, were of the double-bogie



Photograph: N.Z. Railways Publicity

With a Wellington-Paekakariki suburban train in 1949, "Ed" 109 crosses the Hutt Valley line and the Hutt Road to enter No. 1 Tunnel. Readers familiar with the area will detect many changes since this photograph was taken, including electrification of the Hutt line, construction of a motorway beyond the railway embankment, relocation of the down Hutt Valley line, and erection of many tall buildings in Wellington city, seen in the background.

total-adhesion type, the new "Ed" class was of the 2-8-4 or 1-Do-2 type. At that time the "total adhesion" type was believed to be unsuitable for high-speed work.

In a report prepared by Dr E. Meyer and Ch. Stihloul of the Swiss Federal Railways for the International Railway Congress Association in 1949 on electric locomotives for fast trains, the authors discussed practice in nine European countries, "fast" trains being defined as those required to run at 120 km./h. (75 m.p.h.) and over. They wrote, *inter alia*: "Most of the high speed electric locomotives in service at the present time are fitted with a main frame carried on the driving wheels. This arrangement, derived from the steam locomotive, has been accepted for a long time as the only possible for high speed work. It requires a guiding bogie or at least a carrying axle at each end to give the guiding needed for good running and for avoiding stresses damaging to the track. Then, too, when the first high speed electric locomotives were built it was not possible to build vehicles powerful enough within such a weight that carrying axles could be suppressed. . . . The whole of the present stock of high speed electric locomotives of the SNCF is of this type (with four driving axles, and four carrying axles arranged in two guiding bogies). . . ."

"Total adhesion vehicles, i.e. with no dead weight, would be of much more interest still. Such locomotives as the Bo-Bo of the SNCF and the Co-Co of the German and Spanish Railways have been in existence for some time but were built for speeds under 105 km. (65 miles) an hour. At that time the powers developed were limited by the weight of the locomotive and prevented a high enough tractive effort being developed for high speeds. . . ."

The authors, however, went on to refer to the development of the first high-speed total-adhesion electric locomotive in Switzerland, with a load of 20 tonnes per axle and a speed of 125 km. per hour. These developments did not take place until the 1940s, so it is clear that the design of the "Ed" class locomotives for the Wellington-Paekakariki electrification was in accordance with the accepted practice of the 1930s.

Contemporary descriptions of the "Ed" class indicate that the driving-axle load was limited to 16 tons, which was said to necessitate the incorporation of a four-wheel

bogie and a pony axle into the design, in order to carry the necessary equipment whilst keeping within this loading limit. Four motors with a total one-hour rating of 1,240 h.p., rigidly mounted in the main frame, were provided, one driving each axle and geared to provide a maximum speed of 55 m.p.h.

To provide the flexible drive required between the motors and the driving wheels, the torque of each motor was transmitted through a quill and cup mechanism. Spur gearing, consisting of a 19-tooth nickel-steel pinion and a 71-tooth gear wheel, was arranged between the motor armature and a quill that was concentric with the axle. The quill consisted of a hollow steel shaft fitted over the axle between the road wheels and carried by bearings supported from the motor frame, thus ensuring that the quill would always remain parallel to, and a fixed distance from, the armature shaft.

Clearance between the inside of the quill and the axle allowed for both eccentric and angular displacement of the latter resulting from movement of the axleboxes in the horn blocks. At each end of the quill, a set of six spring cup brackets was secured: these brackets projected between the spokes of the driving wheels and carried the spring cup units that transmitted the motor torque to the driving wheels. Each of these cup drive units engaged in either direction of locomotive travel with the spokes of the driving wheel, to which were welded hardened steel plates to take the thrust. When free, the cups were slightly clear of these pads, which were of sufficient area to allow a considerable amount of freedom of relative movement between the quill and the axle.

Each pair of traction motors was ventilated by a separate motor-driven blower operated directly from the 1,500-volt power supply and capable of delivering 3,000 cubic feet of air per minute. The incoming air was drawn through filters and delivered to the motors through ducting, after which it was discharged out to the track.

Electro-pneumatic unit switch control was provided, the whole of the 1,500-volt control gear being mounted in an interlocked high-tension compartment, access to which could be obtained only when all high-tension apparatus was made dead. A corridor linking the two driving cabs was arranged along one side of the locomotive behind the equipment compartment, and



Photograph: N.Z. Railways Publicity

The first "Ed" class electric locomotive, No. 101, supplied by the English Electric Co. Ltd. early in 1938, in Hutt Workshops when it was being prepared for service. The "skirts" hiding the wheels were removed not long after the locomotive started work.

roof hatches were provided to facilitate the removal of the larger items of equipment for maintenance or renewal. Two lightweight double-pan pantographs were provided; these were mounted in wells in the roof because the minimum contact wire height above rail level was only 12 feet.

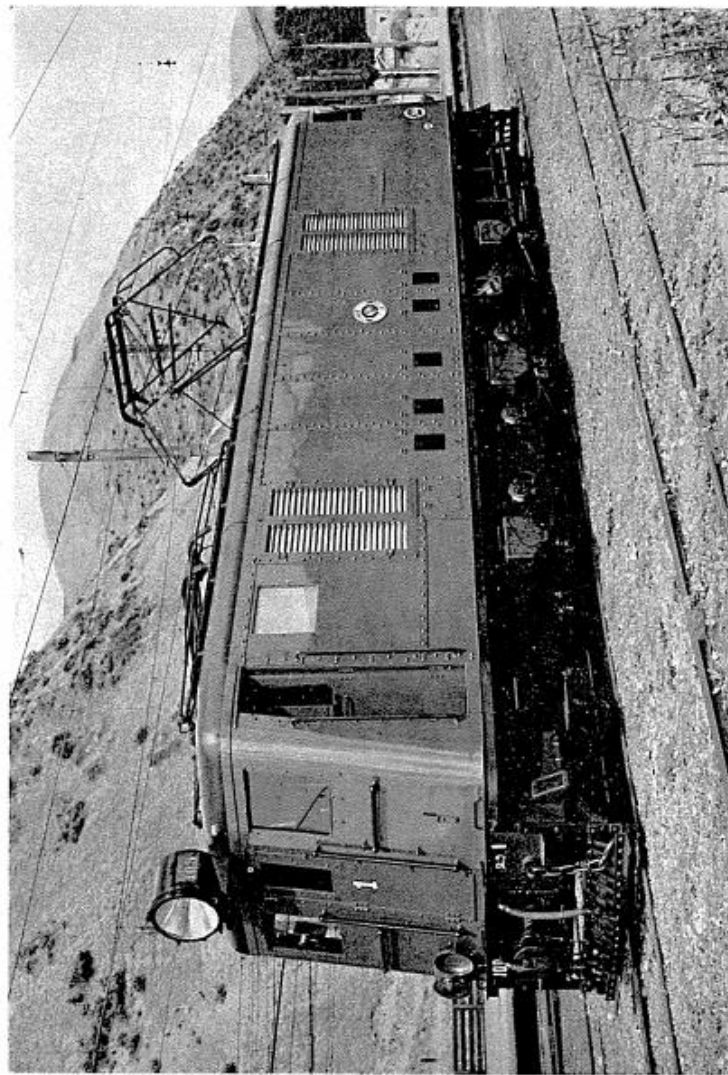
As the locomotives were originally built, access to the end cabs was obtained through doors centrally located at each end, but these were later replaced by a door in the left-hand side of each cab. This was done to provide more satisfactory access and egress, especially in the event of a collision.

All axleboxes were of cast steel and fitted with S.K.F. roller bearings. Westinghouse type A7EL automatic and straight air brakes were fitted, and an independent hand brake was provided at each end of the locomotive. A dead-man pedal device was incorporated, as well as a control to prevent the locomotive from being started

if the brake air pressure was not up to standard.

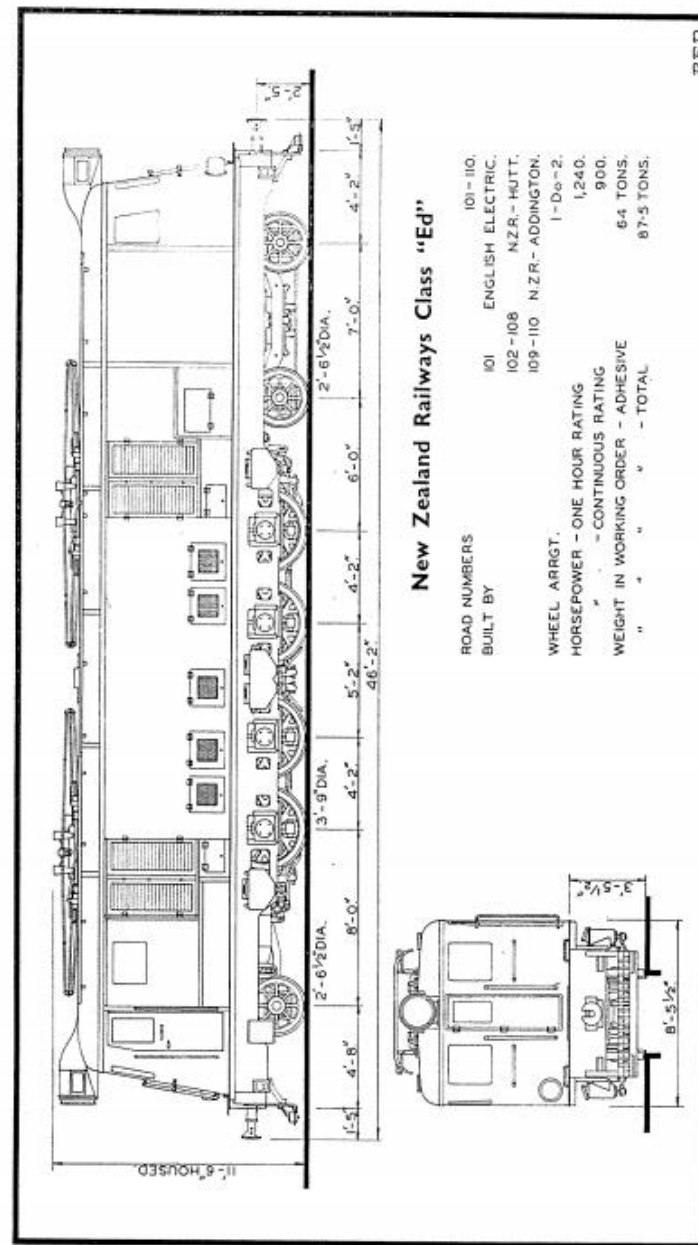
A fully automatic Sentinel-type oil-fired boiler was installed in a compartment behind the driving cab over the double-bogie on the first eight "Ed" class locomotives to supply 250 lb. of steam per hour at a pressure of 40 lb. per sq. in. when required for train heating. Tanks were provided for 400 gallons of water and 50 gallons of fuel to enable the boiler to steam continuously for about four hours. On the two locomotives built for service at Otira (but transferred to Wellington in 1941 because of increasing traffic), rheostatic braking resistances were installed instead of the train-heating equipment. The latter was itself removed from the first eight locomotives because of maintenance difficulties during the wartime years.

The first "Ed", No. 101, was ready for service in May 1938, but it could be used



Photograph: N.Z. Railways Publicity

This familiar illustration of "Ed" 109 was taken in April 1949 at Paekakariki. No. 109 was one of the two Addington-built "Ed"s tried on the Otira Tunnel service in 1940, but transferred to Wellington in 1941. They were distinguished by the plain "non-streamlined" headlights (compare with the illustration on page 108).





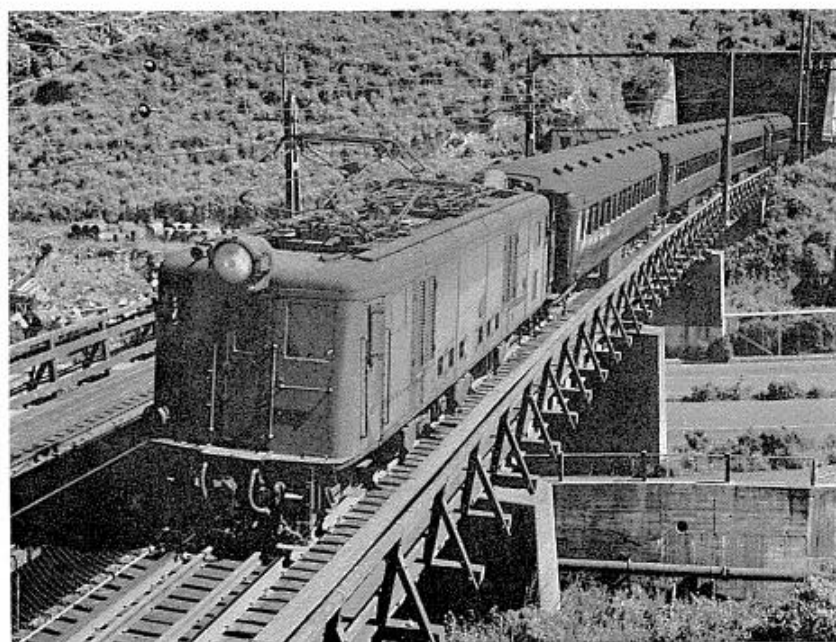
Photograph: N.Z. Railways Publicity
"Ed" 103 at Wellington in June 1939 after completion at Hutt Workshops, showing the corridor side.

only to a limited extent at first—on goods trains on the Johnsonville line after this was electrified in July 1938. The New Zealand-built locomotives began to appear from Hutt Workshops in May 1939, but it was not until June 1940, after the last one had been completed, that it was reported that test runs were in progress on the Wellington-Paekakariki section. They were introduced into service gradually, on the lighter suburban trains at first, with loads restricted to 260 tons, but the Napier express leaving Wellington at 9.40 a.m. was changed over from steam to electric operation from Monday 8 July. Later it was reported that, on 24 July, 29 outward and inward services, including the 7.15 p.m. Limited express for Auckland, were now hauled by the new "Ed" class locomotives. The two inward expresses from Auckland each morning, and the 10.15 a.m. New Plymouth and 3 p.m. Auckland expresses from Wellington, were the last to be changed over to electric working.

My own first experience of electric traction on this line was on 6 July 1940, when "Ed" 105 was at the head of the 8.30 a.m. all-stations train for Palmerston North. The light 140-ton load was handled easily, as

might well be expected, but perhaps my greatest impression was of the ease with which the train soared up the 1 in 57 grade to Pukerua Bay at a steady 35 m.p.h., where with steam power it had been exceptional to do better than 20 m.p.h. Returning with the down train due in Wellington at 10.49 a.m., No. 105 completed the 24.4 miles with seven intermediate stops in 58½ minutes, or 48½ minutes running time. The load was nine total for 192 tons tare and about 200 tons gross.

Five weeks later I rode on a nine-total Napier express of 204 tons tare and 220 tons gross headed from Wellington to Paekakariki by "Ed" 104. This train was taken quietly up through the long tunnels at 35 m.p.h., the summit, 6.1 miles from the start, being cleared in 11 min. 52 sec. A rate of 50 m.p.h. was touched briefly approaching Tawa Flat, 8.5 miles passed in 15 min. 30 sec., but then came a long series of speed restrictions, for the new "Ed"s had proved very hard on the track, especially on the 10-chain radius curves which then abounded between Porirua and Plimmerton. Here the rails of 70 lb./yard were not standing up very well to the side thrust of 64 tons of adhesion weight concentrated



Block courtesy N.Z. Railway Bulletin

Train No. 626, the 3 p.m. (until April 1954) Wellington-Auckland express, headed by an "Ed" class electric locomotive, crosses Ngauranga Gorge between Nos. 1 and 2 Tunnels 3½ miles from Wellington.

on a wheelbase of only 13ft. 6in., and some urgent track repairs were in progress. So we spent 19 min. 18 sec. in negotiating the 7.0 miles from Tawa Flat to Plimmerton. Thence we climbed the 1 in 57 grade to Pukerua Bay at 26 m.p.h. and descended with the usual caution down through the tunnels to Paekakariki, the 24.4 miles being completed in 54½ minutes, against the 51-minute schedule.

Returning the same day from Palmerston North on the down Napier, an 11-total train of 245 tons tare and about 265 tons gross weight, I found "Ed" 106 replacing "Ka" 952 at Paekakariki. There was a 9½-min. halt at Plimmerton waiting for a tardy train 626, the 3 p.m. for Auckland, to come off the single line. Then came the series of speed restrictions, so that we were 9 minutes late through Tawa Flat, where we slowed to 15 m.p.h. for the turnout from single to double line, but we acceler-

ated to 38 m.p.h. up the 1 in 100 through Takapu Road, touched a maximum of 55 down through the tunnels, and completed the final 8.5 miles in 13 min. 16 sec. This included an unusually fast run in to the stop at platform 9.

The busiest period in the life of the "Ed" locomotives was during 1942 and 1943 when United States Marines were encamped near Paekakariki, and numerous special troop and supply trains were being run as well as normal services. During the twelve months from April 1943 to March 1944, each "Ed" was used, on average, on 289 days out of the 365, and ran an average of 187 miles per day in use to give a total engine mileage for the ten locomotives of 541,211. Subsequently each locomotive averaged between 46,000 and 51,000 miles a year until multiple-unit electric trains began to replace some of the suburban services from September 1949. Then, with

N.Z.R. WELLINGTON-PAEKAKARIKI

Train No.	626	688	612	610	110	612
Date	25/10/40	24/10/41	3/1/42	19/1/46	27/12/51	30/12/53
Locomotive No.	101	106	102	103	101	101
Load, number of cars	12	10	11	14	8	13
tons tare	317	282	265	348	217	322
tons gross	345	305	285	385	235	350

Miles	Timing Points	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
0.0	WELLINGTON	0 00	0 00	0 00	0 00	0 00	0 00
1.6	Kaiwharawhara	4 34	3 12	3 31	3 53	3 30	3 54
							S/R
6.1	{Summit}	12 27	10 59	10 45	12 15	10 28	11 28
7.4	Takapu Road	14 33	13 09	12 44	14 36	12 19	13 30
8.5	Tawa Flat	16 05	14 45	14 12	16 33	13 53	15 17
11.0	Porirua	19 20	18 18	17 21	*22 03	17 55	*20 11/31
13.8	Paremata	24 50	23 32	22 06	28 07	22 37	25 54
							S/R
15.5	Plimmerton	28 36	27 16	25 40	31 40	25 31	29 29
			S/R				
19.1	Pukerua Bay	36 09	36 09	34 00	40 00	31 47	36 21
			S/R				
24.4	PAEKAKARIKI	49 00	48 35	47 45	52 08	42 11	48 20

* Train passed through crossing loop at reduced speed.
S/R Temporary speed restriction.
† Exit from Tunnel No. 2.

the introduction of the "Ew" class locomotives in 1952, and with the replacement of several express trains by diesel railcars from 1955, the "Ed"s became in effect a reserve fleet. Statistics are not so easily obtainable after the introduction of the "Ew"s, but the annual statement in 1960 showed that their mileage by then was down to 9,633 per locomotive during the preceding financial year, and that they had been used on only 131 days out of the 365 to give an average of only 74 miles per day in use. By this time, their principal use was on peak-hour suburban trains, the Hutt Valley line having by now been electrified.

A selection of timed runs behind "Ed" locomotives between Wellington and Paekakariki, mainly during the period when they "ruled the roost", is tabulated, the arrangement being in chronological order. The first, on train 626, the 3 p.m. Wellington-Auckland express, loaded on this occasion to 345 tons gross, was a very typical and ordinary run. Speed fell gradually from 40 m.p.h. at Kaiwarra (as it was then spelt) to 32 up the 1 in 122 through the tunnels, was allowed to touch 48 briefly on the descent to Porirua, and was then restricted for the curves around the foreshore through Paremata to Plimmerton, where there was a further reduction to 20 m.p.h. through the turnout on to the double line. From 36 m.p.h. at the foot of the 2½ miles of 1 in 57 up to Pukerua Bay, speed settled down to a steady 28, but an

ultra-cautious descent to Paekakariki resulted in a loss of one minute on the 48-minute schedule.

"Ed" 106, with a 305-ton load on train 688, the 7.15 p.m. Limited express for Auckland, did rather better, largely because of an earlier acceleration out of the platform at Wellington. This time Kaiwarra was passed at 42 m.p.h., but speed was allowed to fall gradually to 30 m.p.h. at the summit, and was more restrained down to Porirua. From a slowing to 12 m.p.h. for track repairs on the 1 in 57 beyond Plimmerton, there was an acceleration to 25 m.p.h. on the grade.

Run No. 3, with "Ed" 102 at the head of train 612, the 9.40 a.m. express to Napier, was one of the best I ever noted behind this class on this line. The driver took the 285-ton train smartly out of Wellington, through Kaiwarra at 42 m.p.h., up through the tunnels at 35, and held speed between 45 and 48 m.p.h. down to Porirua, passed in only 17 min. 21 sec. The train was now well ahead of time on its 51-minute schedule, and there was nothing further of note.

Train No. 610, the 10.15 a.m. to New Plymouth, on 19 January 1946, was one of the heaviest I ever timed out of Wellington with an "Ed" for motive power. With 385 tons, No. 103 maintained 31 m.p.h. up through the tunnels, but it was not hustled down to Porirua, where it was necessary to slow to 20 m.p.h. through the loop to



Photograph: N.Z. Railways Publicity

"Ed" 101 in its later form leads an 11-total train 626 out of platform 8 at Wellington in 1950. Until September 1949 the "Ed" locomotives worked practically all trains between Wellington and Paekakariki, the principal exceptions being diesel railcars, and at that time were running upwards of 500,000 miles a year, of which some 360,000 were train-miles. In 1948-49 the trains they hauled averaged 278 tons in gross weight.

cross a down train at the platform. From 15 m.p.h. at Plimmerton, the train was accelerated to 34 at the foot of the 1 in 57, which was surmounted at a steady 24½ m.p.h.

My fastest actual time behind an "Ed" to Paekakariki is shown in column 5. No. 101 left Wellington five minutes late with a special "Daylight Limited" for Auckland, loaded to the usual maximum of 235 tons,

but allowed 49 minutes for the 24.4 miles. The climb through the tunnels was taken at 35-38 m.p.h., speed did not exceed 43 down through Tawa Flat (by this time the normal maximum operating speed for these engines had been reduced to 40 m.p.h.), and the 1 in 57 to Pukerua Bay was surmounted at a steady 33 from an initial 40 m.p.h. This brought the train into Paekakariki 1½ minutes early.

N.Z.R. PAKAKARIKI-WELLINGTON

Train No.	913	227	913	229	913	913	227
Date	31/8/40	15/4/41	10/5/41	19/7/41	15/12/41	10/1/42	30/11/47
Locomotive No.	108	106	101	107	103	104	101
Load, number of cars	16	10	18	11	9	19	12
" tons tare	349	269	431	309	228	406	336
" tons gross	380	290	470	330	250	450	365
Miles	Timing Points	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
0.0	PAKAKARIKI	0 00	0 00	0 00	0 00	0 00	0 00
5.3	Pukerua Bay	11 57	12 02	12 36	12 08	11 14	10 20
8.9	Plimmerton	18 05	18 12	19 07	17 42	16 44	16 15
10.6	Paremata	21 26	21 20	22 08	21 05	19 29	19 17
		S/R					
13.4	Porirua	28 22	26 32	27 13	29 10	26 28	24 17
15.9	Tawa Flat	32 39	30 58	31 38	33 05	28 40	29 02
17.0	Takapu Road	34 54	33 04	34 18	35 16	33 08	31 18
18.3	(Summit)†	37 22	35 22	37 35	37 50	33 48	33 42
22.8	Kaiwharawhara	43 32	41 25	44 35	44 07	40 20	39 58
				sig.		sig.	
24.4	WELLINGTON	47 00	44 15	46 40	47 00	43 45	43 31

S/R Temporary speed restriction.
† Entrance to Tunnel No. 2.

Last choice for runs in this direction is one behind "Ed" 101 in 1953 on train 612, now leaving Wellington at 9.25 a.m. and allowed 49 minutes to Paekakariki. After a 20 m.p.h. restriction at Kaiwharawhara, speed averaged an excellent 37 through No. 2 Tunnel. The run was spoiled by a brief stop in the loop at Porirua, and the old bridge at Paremata was now subject to a 15 m.p.h. restriction, but the 1 in 57 climb to Pukerua Bay was taken in excellent style at just over 30 m.p.h., and the run was completed within scheduled time.

It was in the down direction that I experienced the heaviest loadings. Although the normal maximum load in passenger train working was 400 tons for the "Ed"s, some wartime trains were made up to loads approaching the full goods load of 500 tons, and these were handled quite competently within the rather easy schedules laid down. The standard schedule from Paekakariki to Wellington for expresses was 50 minutes, but train 913, the down Napier due in Wellington at 4 p.m., was allowed an extra two minutes to pass Plimmerton, where it crossed the up Auckland express.

On the first run tabulated, No. 108 with 380 tons maintained 27 m.p.h. on the 1 in 60 approaching Pukerua Bay, and after a rather liberal interpretation of the 20 m.p.h. limit through the turnout at Tawa Flat, maintained 32 up the 1 in 100 through Takapu Road, and touched 50 down through the tunnels. The lengthy speed restriction between Paremata and Porirua cost at least two minutes.

The second run was a typical steady effort when there was time to be made up (in this instance six minutes), with a gradual acceleration through Takapu Road to 34½ m.p.h., and again with a maximum of 50 in the tunnels, but run No. 3 was an excellent effort with the heaviest train I ever rode on this line. The 470-ton load was lifted up to Pukerua Bay at 20 to 22 m.p.h., but later, after a reduction to 25 for the Tawa turnout, speed tailed away to 23½ on the 1 in 100. The maximum in the tunnels was 42½ m.p.h.

Train 229, the Limited from Auckland, in column 4, was five minutes late out of Paekakariki, but would have been on time in town had it not been for a delay at Paremata awaiting a tardy up train. Minimum speed beyond Takapu Road was 30 m.p.h., and maximum in the tunnels was again 50.

Run 5, on train 913 eight minutes late out of Paekakariki behind "Ed" 103, was one of the fastest times I noted at this period. An excellent climb to Pukerua Bay, with 31 m.p.h. on the final 1 in 60 (the load being only 250 tons), was followed by good steady running, although the 1 in 100 up to Tunnel No. 2 was taken at only 30 m.p.h. The subsequent maximum downhill was 52.

"Ed" 104 worked the longest, though not quite the heaviest train that I timed from Paekakariki to Wellington in the 1940s. With 19 total grossing 450 tons, 23 m.p.h. was maintained up the climb to Pukerua Bay, and 28 through Takapu Road. Maxi-

mum in the tunnel was 50 m.p.h.

The fastest time in this tabulation was achieved by "Ed" 101 with train 227, the first express from Auckland, loaded to 365 tons. Leaving Paekakariki three minutes late, there was a remarkable climb to Pukerua Bay, with an average of 33 m.p.h. all the way up. At this early hour, detailed timing was not undertaken until we had passed Tawa Flat in 29 minutes, a gain of six on the schedule. From 24 m.p.h. at that station, the driver was content to maintain 33 up the 1 in 100. Top speed in the tunnels was not noted, but must have been between 45 and 50 m.p.h. to give the times recorded.

One further, much later, run deserves mention. This was in January 1961, when "Ed" 109 had a 14-total train 227 to bring into Wellington. By this time, the deviation between Porirua and Mana was in use, and double-line had been extended from Tawa to a turnout between Paremata and Mana. With a tare of 390 tons, and an estimated gross weight of 420 tons, the train was

taken over the new distance of 24.2 miles in 42 min. 43 sec. without noticeably exceeding 40 m.p.h. at any point. The climb to Pukerua Bay was completed at 30 m.p.h. Pukerua Bay was passed in 11 min. 22 sec., and Plimmerton in 16 min. 57 sec. After slowing on to the double line, Paremata, 10.6 miles, was passed in 19 min. 47 sec. The train, which was running almost two hours late, was diverted through the loop at Porirua, 13.1 miles in 23 min. 58 sec., but then climbed in good style through Tawa (15.6 miles, 28 min. 31 sec.) and Takapu Road (16.8 miles, 30 min. 23 sec.) to the summit (18.1 miles, 32 min. 38 sec.), with a minimum of 34 m.p.h.

After the introduction of the "Ew" class locomotives in 1952, the use of "Ed"s on the Paekakariki line became rather restricted, as already indicated, and after "Da" class diesels took over in 1967, was virtually eliminated. A few still appear on morning peak-hour trains on the Hutt Valley line, but a discussion of their work on this service will have to await another occasion.

In January 1968 "Ed" 103 was captured on film passing Rocky Point, between Petone and Ngauranga, with the 7.16 a.m. all-stations "subbie" from Taita to Wellington.

Photograph: R. J. McGavin

