Recipes for disaster

Emu Plains, Penrith, Richm

UP	39	183	36	X16	D252	153										
MONDAYS TO FRIDAYS	Pass.	Pass.	Pass.	Light Locos	X200 Tractor	Pass.	Pass.	Pass.	Pass.	Pass.	Pass.	Pass.	Pass.	Pass.	Lignt Loco	Pass.

What makes timetables fail?

Recipes for disaster How timetables fail?

NSW CityRail timetables have become something of a cause celebre in recent years. But never so much as back in 1975, when chaos reigned over the tracks for 10 weeks. Was it bad planning or the subtle effects of chaos theory at work? GEOFF LAMBERT *tries to analyse what happened.*

*D*isaster narrowly averted! is the sort of headline the railway potboilers reserved for narrow squeaks along the line- the boy hero who noticed the open switch. But, in 2002 it could equally have been said about CityRail's new timetable, due to come into effect on 21st April, but cancelled 12 days beforehand. By so doing, CityRail hoped to avert a repeat of the disasters arising from the radical new timetables of May 1975 and November 1996—both of which had to be withdrawn and both of which resulted in management heads rolling.

What does one mean by "disaster" anyway—how does one distinguish between a "bad hair day" (or a succession of them) and a truly flawed plan that makes inevitable that every day will be a bad hair day? It does seem that disruptions to services in a good timetable are of the same nature and produce the same immediate effects as those that cause a bad timetable to fall apart–trains break down or run late, drivers can't be found, the wrong sort of rain falls in the wrong places, and so forth. It is the robustness of the timetable that determines whether the system succumbs to these misfortunes on an isolated and contained basis, or whether it succumbs on a regular and propagating basis.

What happened in 1975?

The 18th May 1975 NSW Public Transport Commission (NSWPTC) suburban timetable was widely heralded beforehand as a step forward which would bring radically improved services to Sydney. Commuters were promised more trains, faster trains, greater choice, less crowding and a free set of steak knives with every trip. In the event, things went wrong from hour 1 of day 1 (Sydney Morning Herald report of 22 May, above, right).

Immediately prior to May 1975, the timetable in effect was essentially that of May 1968, only minor tinkering had occurred to the latter in the succeeding

The evening chaos reigned at Wynyard

Railway officials threw away their controversial new timetables last night as Sydney's suburban train services became hopelessly snarled.

With trains running an hour or more late, drivers and guards were given hurried new routing instructions as they pulled into stations.

Indicator boards flashed like pinball machines and confused commuters strained to hear muffled announcements before cramming into already packed peak-hour trains.

Many trains left with briefcases, shopping bags and even bodies protruding from the doorways.

At Wynyard, harassed railway police moved up and down the platforms pleading with dense crowds to keep back from the lines.

Drivers inched their trains into the station, blasting their horns continuously while the public address system called for passengers to stay clear.

Several times, officials ordered the gates to all platforms closed when the crush became too great and trains did not arrive.

And when they did come, it was in bursts. At one stage, four all-stations trains to the North Shore went through Wynyard followed by a 19-minute delay before the next.

At 5.09 pm, one eight-car train pulled into Wynyard, with the guard calling: "This train terminates at North Sydney."

But, a dispatcher ran from the control room with a slip of paper and a change: "No, no. Make it all stations to Hornsby."

Several minutes later irritated commuters on platform four watched the board indicate all stations to Chatswood, then change to all stations to Hornsby, then go blank completely before settling on all stations to Lindfield.

Next door, on platform three, the announcer and the attendant handling the indicator board could not agree on whether the next train was going to Parramatta or Strathfield.

Soon after 6 p.m. as the peak-hour crowds began to dwindle, one of the Public Transport Commission's shiny new double-decker trains came in on platform four.

The guard was handed a piece of paper. He looked at it and laughed. "We were supposed to be going back to Central but it seems we're going to Gordon." And where then? "I don't know."

But he need not have worried. Within a few minutes it was found that the train had developed a brake fault and was going nowhere but the repair shop.

With a few ironic cheers and handclaps, the passengers crowded back on to the platform to await the next Shirley Special.
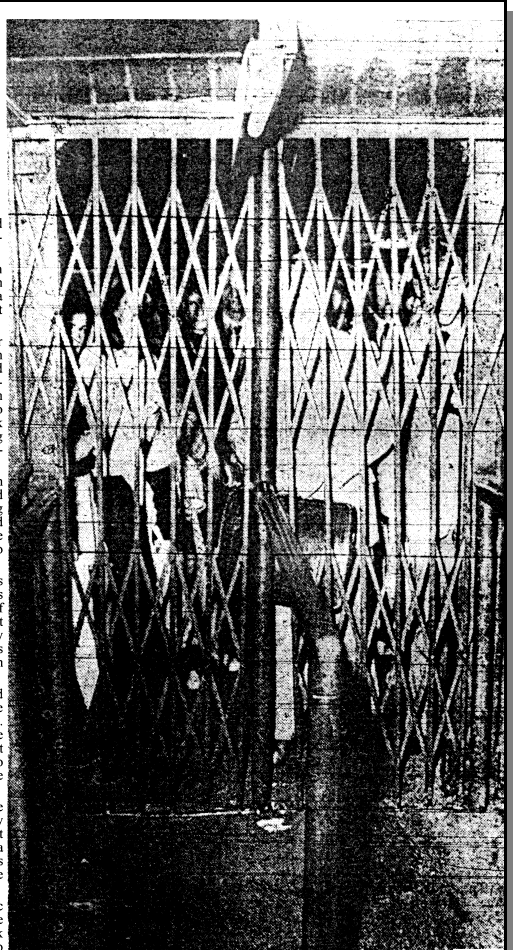
Evening commuters waiting behind locked gates to get ... to the crowded Wynyard platforms.

7 years- the WTT had been re-issued in October 1970, November 1971 and March 1973. During this time, a major change in the system had been the introduction of double-deck power cars, to form complete double-deck sets, where previously there had only been DD trailer cars spotted among the single-deck sets. During this period too, the Department of Railways had been subsumed into the new NSWPTC, under the control of Philip Shirley, one of the brains behind the dismemberment of British Railways in the 1960s. People suspected him of similar motives when he came to NSW and wondered if the timetable was a tool to that end. It was widely held that, as a matter of public policy, the railways were being starved of funds and allowed

to run down. The maintenance problems were to result in the calamitous Granville disaster of early 1977. The new timetable came upon a system that was starting to fall apart, where track and rolling stock were in disrepair and where the staff were demoralised. It was not an auspicious time to introduce something radical.

There was, it seems, never a full public timetable published for this new service—they "were ready for mass production" but this never took place. A few individual line brochures were produced- one for the Cronulla line said "trains will run at frequent, but irregular, intervals". The Working Time Tables were delivered very late, some drivers did not receive them until the evening of the 17th. Shirley

blamed the Government Printing Office for this- it had printed the Railway's timetables for decades, but it did not do so for much longer. Reportedly an NSWPTC official nearly "came to blows" with the Government Printer over the delay. The WTT was issued in 2 volumes in a rather cumbersome *foolscap folio* size (previous and later timetables were *royal octavo* size). The Saturday/Sunday working timetable was hand-lettered rather than printed, such was the haste of its preparation—"*Interim timetable until normal book is printed*" appeared on its fly-leaf. Both had many errors and were supplied with correcting amendments- one driver said, "*On Saturday (17/5) they gave me 2 working books in one hand and 300 amendments in the other*".

After 8 weeks of chaos, the PTC decided to return to the previous timetable, although even then travel was fraught with delays. In essence there was a return to the March 1973 timetable. New working timetables dated 20th July were hastily issued. The haste was apparent in the pages of the timetable, it being a blotchy photo-offset mishmash of the original 1973 timetable, overlaid with hand-written and pasted down amendments. May's new services to Riverstone were retained and some of the fast peak-hour services to Liverpool, but essentially it was back to square 1.

Teetering on the brink of chaos

In this article there are many comparisons between a timetable that "worked" and one that failed miserably. Charts and tables which display turn-around times, travelling times, speeds, densities and stopping patterns are numerous. To a statistician's eye, the charts don't really look like they show significant differences—5 to 10% is the usual variation in measures between the good and the truly awful.

This highlights a problem with train scheduling, a problem that was described in a *Times* article on computer-generated timetables in July 2000. The problem is that the relationship between "input" and "output" is highly non-linear and basically as hard to predict as the course of a chess game, because of the complexity of the interactions and the number of options available during the running of the timeta-

ble. When one is well within the "envelope" of possibilities there is plenty of room for manoeuvre or adjustments up and down, but the membrane between order and chaos is very thin and once ruptured chaos is as certain to occur as it is unpredictable in its nature.

The 1975 timetable disaster occurred at a seminal time in the development of so-called chaos theory, where mathematicians, physicists, biologists and economists were beginning to analyse the behaviour of complex systems in terms of their non-linear mathematics. In chaotic systems, the state at a particular point is a mathematical function of a previous state. Although the mathematical function relating the two states can be extremely simple, its results can be startlingly variable. With particular changes in starting conditions and particular changes in the parameters in the function (as small as one part in the 15th decimal place), the result can move from smoothness and predictability to one that is, to all purposes, utter chaos.

Perhaps timetables are like this, perhaps the July 1975 timetable pushed over one of these mysterious boundaries. Certainly what happens at any spot in a timetable is strongly dependent on what has gone before—each train service is a descendant of another, each train service can interact with others, and so forth. It is not easy to predict in advance, even in the simplest chaos models, what changes to the initial conditions or perturbations of the process will push the system into chaos. One has to suck it and see. For instance, the reduction of dwell times at train termini from 11 to 10 minutes might initiate timetable chaos. But equally feasibly, a further reduction to 9 minutes might eliminate the chaos. This is a dispiriting unpredictability because it means that a timetable planning process is never guaranteed of success—an unwitting alteration of the tiniest feature of it might precipitate a disaster. The best one can do is to understand which characteristics of the timetable tend to produce the unpredictability and to try to minimise them. For instance—and this has happened in more modern timetables—the interactions between

trains can be reduced by minimising the numbers of flat crossings of train paths. There are obvious practical limits on what can be done with such manipulations of course. One might try to ensure stability by extending the turn around times of trains at termini from minutes to hours. But that would not be cost-effective, because it would require the purchase of far more rolling stock and the idleness of a great deal of it for an undue proportion of time.

A 1975 Snapshot

The Sydney suburban rail system is one of the biggest and busiest in the world and always has been. But in 1975, it was near the bottom of a significant trough in passenger journeys (*page 4, left*). Suburban passenger train kilometres (*page 4, right*) had not declined so much, presumably because of a shift of commuters from inner to outer suburban areas. This decline in traffic was shared with other Australian suburban systems, though not with many internationally. Train services had also generally decreased in frequency over this period- which begs the question of whether the patronage fall was the result of the service reductions or the cause of them. Service reductions had been particularly marked on the Illawarra lines.

The network map (bottom, page 4), taken from a contemporary working timetable, shows a system of some 304 route kilometres, much smaller than that of today– because there was no Eastern Suburbs or Airport line, and the Wollongong, Goulburn, Lithgow and Newcastle areas were not then "suburban". The latter consideration means that passenger loadings in the 1975 core area were heavier than today, even though today's traffic is greater overall. The places named on the map represent all of the places in the 1975 timetable where trains originated or stabled or turned back in their tracks. All told, there were about 200 stations and timing points on the network; 71 of them were signal-boxes.

There was no centralised signalling in 1975, trains were passed from signal box to signal box, mostly using the telephone as an information mechanism for 'out of course' running. There was, however, a central supervisory office—*Traffic Trouble*—which allowed an overview and control func-

Sydney suburban passenger journeys

Passengers (millions)

Sydney suburban passenger train kilometres

Train kilometres
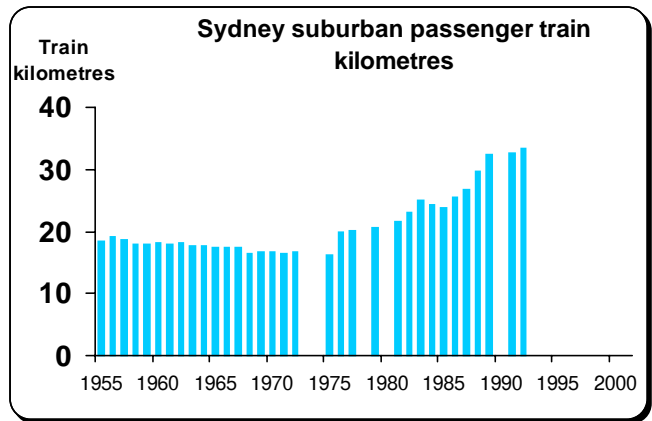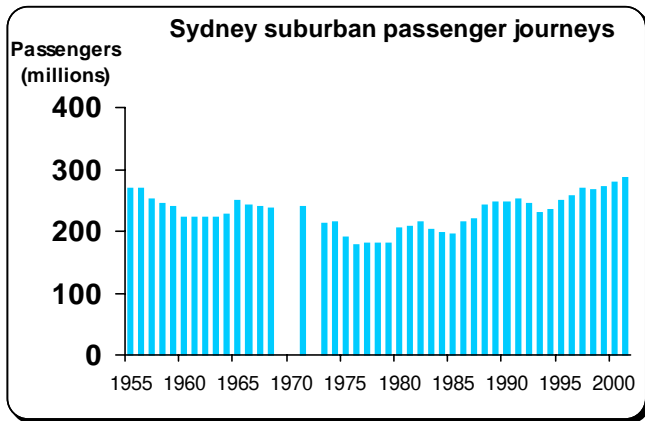
tion to the operations. Traffic Trouble had plenty of it in May 1975. The number of tracks between stations ranged from a high of 10 (Central-Illawarra Junction) to a low of 1 (Cronulla, Riverstone). The greatest proportion of route mileage was of double track. The signalling system was largely double-line track block automatic with 4-aspect colour light signals, mostly with separations of the order of about 450 metres. For trains travelling at about 65 km/h (the average speed of an Illawarra Junction-Strathfield express service), this should have allowed a train separation of about 1500 metres, equivalent to a headway of about 82 seconds and a capacity of over 40 trains per hour. In practice, prudent separations were deemed to be nearly twice this and the train capacity only half of the theoretical, especially on tracks with many station stops. Signal separation was longer on some of the other lines and hence capacity was somewhat less on them.

Like all urban railways, the 1975 Sydney system was geared to handling commuter traffic and therefore had two peaks, in the rush hours. A lower level of service was maintained between the peaks and in the evening. Before the morning peak, minimal service were run- the morning peak virtually arose from a slumber state. Both working and public timetables were geared to this cycle- they presented trains on a 24-hours basis starting at 3 a.m. one day and finishing at 3 a.m. the next. This was only a reflection of the way people lived their lives after all; perceptions of day "flip-over" seem to occur at the "wee small hours", rather than formally at midnight. The trains actually lived their diurnal rhythm within these limits as well. In all the timetable, there was

only one train that ran all night and didn't "go to bed" before 3 a.m. Country passenger and all freight timetables, however, were laid out on a midnight to midnight basis.

By their numbers ye shall know them—train identification

In any rail network it is fairly clear that the train service, as perceived by the passenger who reads the many columns of a public timetable, is made up of a limited number of physical trains which shuttle back and forth during the day. In the May 1975 NSWPTC Sydney suburban timetable, a customer would perceive that the total of train services on offer was about 750, but this service was actually provided by a maximum of about 125 physical trains. On average there were 66 physical trains in operation. These peripatetic individual trains have been known since the inception of the Sydney electric system as "runs" and they

have always had a formal existence as separately numbered entities. It is possible to trace the operation of a set of cars throughout the system by following its "run number" in the working timetable. In this, the Sydney system differs from, say, the Melbourne network where the working timetable segregates by number each service more or less in the same manner as does the public timetable- even though Melbourne trains "shuttle" just as much as do Sydney trains. The Sydney working timetable has a semi-graphical counterpart—the zig-zag diagram— which represents each run in a kind of ladder diagram.

Reading a NSW suburban working timetable is somewhat of an art; there is a lot of information to be had from it, but you need to have a "key" beside you to translate it. Understanding it is helpful in following the complexities to be described in this article. In the May 1975 timetable, the NSWPTC
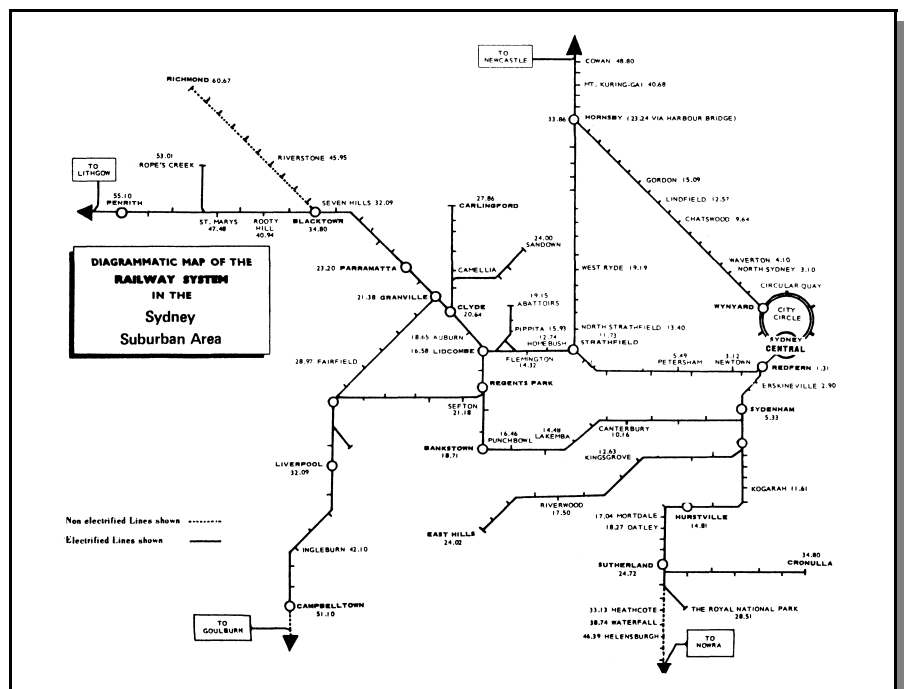
adopted a more rigorous run numbering convention than it had used previously, and it became possible to ascertain by the number alone what type of car set was running the service. In previous (and later) NSW timetables, the run number gave little clue to the nature of the cars involved, but in the May 1975 timetable, runs 1 to 60 were formed entirely from double-deck (DD) cars, runs 61 to 80 were formed from sets containing single-deck (SD) motor cars with double-deck trailers, and runs 100 and over were formed from SD cars only. These numbers applied to 8-car sets—for 4-car sets the suffixes 'a' and/or 'b' were added, it being nearly always the case that 2 runs like 101a and 101b had been formed by the splitting up of an 8-car set with run number 101. Runs were not physically identified on the car sets; they did not necessarily remain associated with a given set of cars throughout the day anyway. In the computerised train describer system of the 21st century, run numbers do appear.

To complicate matters, for rolling-stock classification purposes a "set" of double-deck cars was held to be 4 cars in length, the basic building block for the other sets was 8 cars. This probably accounted for the divergent practice of identifying the 4-car DD sets—a run numbered 4 would split to form 2 runs numbered 4a and 38a and so there was no such a thing as a 4b 4-car DD set, neither was there a 38 8-car DD set. Only about 14 single car sets were divided during the day, whereas nearly all double-deck sets were divided, sometimes twice. Run numbers were allocated to sets in blocks, according to the starting point of the sets in the morning. Thus runs 101-109 originated at Hornsby Car Sidings and runs 158-160 at Sutherland. Only 16% of sets ended the day at the place where they started, but each place where

trains were stored overnight stabled the same number of the same types of cars in the evening as it had originated in the morning.

Just as runs were categorised, so were the actual train sets- each set of cars was identified by a "set" designation. These classifications originally described the originating depot of the set, but by 1975 were used to describe the type of cars contained in it. The purely double-deck sets were the S-sets, the mixed double/single sets were either W sets (with power-operated doors) or M sets (without). The purely single-deck sets, by far the most numerous, were either B or H sets. These classifications, together with the actual set number, appeared on "target plates"- small plates below the driver's cabin thus: S12 (S-set number 12). The nomenclature allowed for further subdivision into 2-car sets, but there were no such cars in the 1975 timetable. Even the colour of the target plate was important- sets with red plates were divisible, sets with blue plates were not.

Timetable characteristics that led to chaos

The trains were too fast

Sydney to Liverpool in 29 minutes. In the 1990s, the XPT was scheduled to cover this distance in 36 minutes but, in the May 1975 timetable, a double-deck suburban set was timetabled to make the dash in one minute under the half hour—a timing never before or since bettered. This was an average speed of 65 km per hour, over a line where the maximum allowable was usually 100. Unlike the country WTTs, the suburban WTT did not publish running times for trains. In the May 1975 timetable, travel times for trains running trips that lasted between three-

quarters of and hour and an hour had been reduced by about 4 minutes, or 8% compared with the previous and later timetable (chart below left).

The reduction in travel times had been achieved, at least partly, by the reduction in the number of stops made by each service. The chart (below right) which covers the same trains shown in the 'travel times' chart, shows that an average of up to 3 stops had been shaved from trips on several lines, especially the two routes to Liverpool.

There was too little slack

A general precept of train timetabling is to allow time for recovery from adverse incidents. This usually takes the form of a "recovery time". In the Sydney system where the same runs shuttle back and forth, this recovery time is theoretically built into the "turnaround" time at terminals. In the first place, the turnaround time needs to be long enough for all the tasks necessary to turn the train around: driver and guard swapping from one end to another, shunting from one track to another, etc.

In all, there were some 744 "turn-arounds" in the May 1975 timetable, not counting turn-arounds where the train also divided from or amalgamated with another. The average time allowed for this was 8¾ minutes, although times as short as 1 minute were called for; the most common times allowed were 6 or 11 minutes (charts, page 6).

These were significantly shorter turn-around times than had been allowed for in the preceding and succeeding working timetables.

A turn-around could be a simple or a complicated affair. At a station such as Mount Kuringai, where 3 trains reversed in the evening peak, a simple cross-over movement was all that was

Travel times

Number of stops
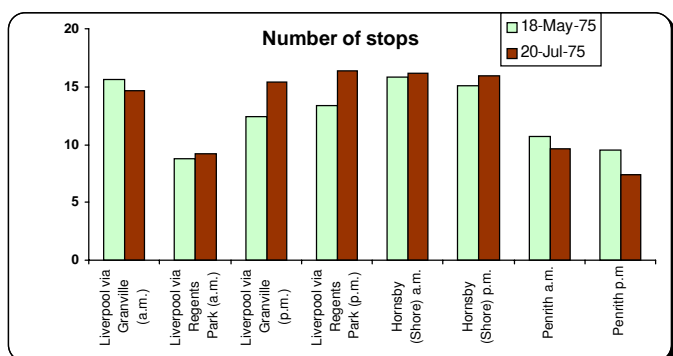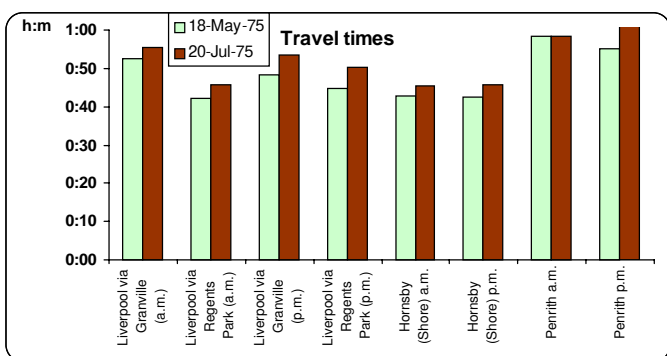
needed, and 4 minutes were generally allowed. At Hornsby, there could be a complicated procedure of running north out of the station to Hornsby Yard and return to the station after that, possibly to a different platform. Sixty-two trains did this, it was scheduled to take an average of 6¾ minutes averaged throughout the day. In the morning and evening peaks, turn-arounds here were scheduled for 13¾ and 11½ minutes- these were 9¼ and 7 minutes shorter than they were in the July 1975 timetable.

Was the train density too high?

One way in which the May 1975 timetable did not differ from its predecessor and successor was the number of trains run per hour during the peak hours, when most of the trouble occurred. There are differences—both higher and lower—between the May and July timetables, but overall there is no significant change, the July timetable having 6.0 trains per hour on the 4 services just considered, compared with 5.7 per hour in the disaster timetable, a difference of only 4%. These are rather low densities compared with what can be achieved with a good signalling system (the London Underground managed up to 43 trains per hour between the world wars) but we should remember that these are the densities at the outposts of the system.

The train densities on the busy Strathfield-Central lines in the two timetables are shown in the table on the next page. Again, there is little difference.

However, it was in the off-peak hours that the May 1975 timetable displayed increased train numbers over timetables that came before or after it. The PTC generally aimed for 20 minute

Turn-around times in the May and July 1975 timetables
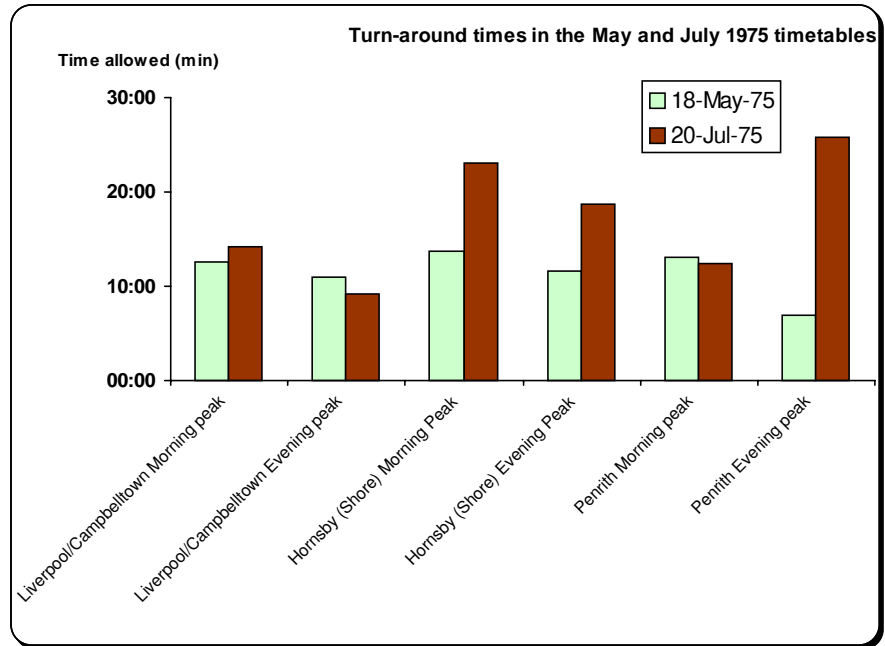
train intervals as far out as Hornsby, Liverpool and East Hills and 40 minutes to places like Campbelltown, Riverstone and Cowan. The latter represented a 33% reduction in train intervals. But these densities come nowhere near the limiting densities for the lines concerned.

Train density, in terms of trains per hour certainly *can* be a determining factor in whether a timetable is workable. There is a standard set of rules which enable one to work out what the headway time or its equivalent number of trains per hour can be for a signalling system of a given type, handling trains of particular sizes and braking attributes. For Strathfield-Central, which had a line speed limit of 100 km/h in 1975, the theoretical minimum headway on the Main (express) lines works out to be about 80 seconds, or about 40 trains per hour. Nobody anywhere in the

world runs this density of service. The volume handled in the NSW 1975 timetables is obviously well below the theoretical maxima, so that timetabled train densities do not even begin to approach those that might cause trouble.

Timetable too complex

The suburban rail timetables of NSW were known for their bewildering heterogeneity and the May 1975 timetable displayed this in extreme form. This chiefly manifested itself in the stopping patterns of trains on each line. According to Dornan and Henderson's 1976 book on the Sydney system, "skip-stop" services had been introduced in the 16 April 1962 timetable and the travelling public had reacted badly to them. The instance of skip-stop services was greatly reduced in subsequent timetables, but substantial numbers persist to this day.

In the two charts on the top of page 8, we show the stopping pattern of evening peak hour trains to Liverpool in the May (left) and July (right) timetable, segregated into via Granville (G) and via Regent's Park (RP) services. Dark squares indicate that a train stops at that station. For the 19 trains listed in the May timetable, 9 ran via Granville and 10 via Regents Park. For the 9 via Granville trains, there appear to be 8 different stopping patterns and for the 10 via Regents Park trains there are 9 different stopping patterns. In all, one has a choice of 17 different patterns among the 19 trains. The total number of stopping patterns in the July

Distribution of turn-around times in the May 1975 timetable
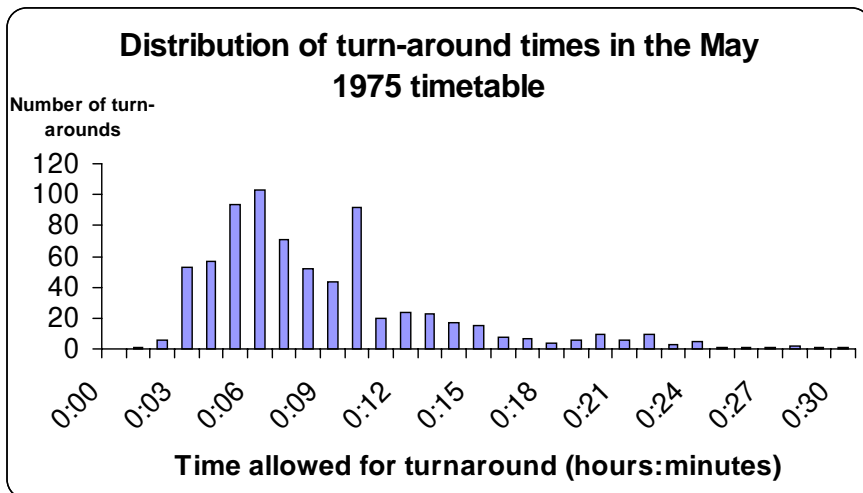
1975 timetable is only 9.

Among the May timetable trains one has a choice of services that make 0, 3, 7, 10, 12, 13, 14, 16, 18, 19 or 23 station stops between Central and Liverpool. Even for the trains that run to an identical travel pattern do not necessarily reach Liverpool in equal times. Runs 126 and 33a, two *via Granville* services, take 51 and 49 minutes on the journey. Nor is the number of stops necessarily an indicator of travel times. The two fastest trains, runs 16 and 17, each take 31 minutes Central-Liverpool, but 16 has 3 stops and 17 has no stops (in fact 17 doesn't even stop at Liverpool itself—it is a "first stop Macquarie Fields" service). Run 17 picks up 3 minutes on the travel time of Run 16 by the time it gets to Strathfield, a result of running express, but then loses them again between Strathfield and Liverpool, even though both trains run express between these two stations. One minute of this is due to its necessity to cross from the Main to the Suburban line at Homebush.

This story is repeated on nearly all lines, particularly at peak hours, but occurs also during the "steady" traffic periods in the middle of the day. Assistant PTC Commissioner Joshua Trimmer asserted in an internal memo that the fundamental problem with the timetable was that the PTC had tried to mix trains with 3 different speeds over the same tracks.

Variability applies also to the variety of termini for trains on the one line. For the North Shore line, a fairly short and straightforward part of the network, no fewer than 8 stations act as termini for northbound trains throughout the day: North Sydney, Waverton, Chatswood, Lindfield, Gordon, Hornsby, Mt Kuringai and Cowan.
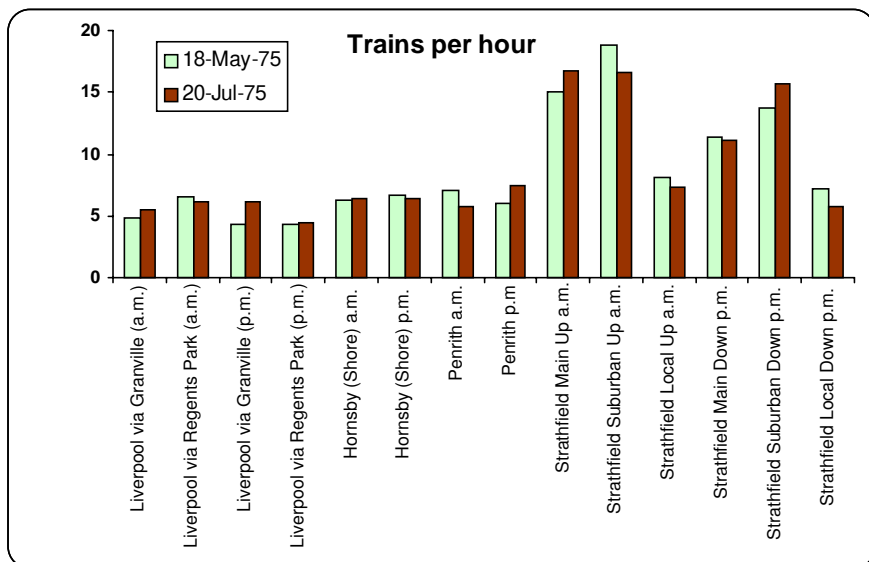
In a timetable with such a diversity of stopping patterns, travel times also become very variable, the paths on a traffic graph are no longer parallel. It can be shown mathematically, and it is certainly true from experience, that this reduces line capacity. In fact, the capacity of a section of railway carrying trains at two different speeds (or transit times) is less than one which carries either all fast or even all slow trains. In the controversial 2001 "Christie Report": *Long-term strategic plan for rail* , Ron Christie stated that the 2001 mix of long-distance, express and stopping trains reduced line capacity by 35%.

Such diversity may or may not affect timetable performance, but it certainly seems to affect customer satisfaction, especially when coupled with a paucity of timetable information. While variety may be the spice of life, it would seem that the number of options made available to the customer could well be counterproductive. It was widely reported in the daily and railway press at the time of the 1975 timetable that a high proportion of passengers were being overcarried because they had boarded a train which stopped, or failed to stop, at places which caught them by surprise. We can see what might be regarded as some examples of this in the stopping patterns charts on page 8. Run 108, for instance, runs express through Strathfield, a most unusual occurrence, but stops at Flemington and Lidcombe. In the Fairfield-Liverpool section, nearly all 'via Granville' trains are all stations, but run 13, for some inexplicable reason, runs express through Canley Vale and Warwick Farm.

On the single-tracked Cronulla line, we can see a variation on these irregular patterns. Here, the irregularity arises because of changes in sectional running times and of waiting times at stations where crosses of opposing trains must take place. At the bottom of page 8 appear graphical timetables for the 4:30 PM to 7:00 PM period for this line for the May (left) and the July (right) working timetable. The first impression one gets when comparing the two is that the July timetable seems more "orderly" or "regular", while the May timetable appears somehow rather higgledy-piggledy—its lines seem more bent, less parallel and more unevenly spaced. They are. In the Cronulla-Caringbah section, for instance trains in the May 18 timetable are scheduled to take 3 minutes, 4 minutes or 5 minutes (1 train, 7 trains, 14 trains respectively), whereas, in the July timetable, all trains were scheduled to take 5 minutes. In statistical terms, the travel times and their standard deviations were 4m33s ± 35s compared with 5m ± 0s respectively.

Once again, this variability has its effect on line capacity and the sensitivity of the track to disturbance. In the May timetable, the single line section Gymea-Sutherland is occupied for 77% of the time between 4:30 PM and 7:00

Trains per hour	18-May-1975	20-Jul-1975
Strathfield Main Up a.m.	15.0	16.7
Strathfield Suburban Up a.m.	18.8	16.6
Strathfield Local Up a.m.	8.1	7.4
Strathfield Main Down p.m.	11.4	11.2
Strathfield Suburban Down p.m.	13.7	15.7
Strathfield Local Down p.m.	7.2	5.7

Trains per hour

18-May-75 / 20-Jul-75

Liverpool via Granville (a.m.), Liverpool via Regents Park (a.m.), Liverpool via Granville (p.m.), Liverpool via Regents Park (p.m.), Hornsby (Shore) a.m., Hornsby (Shore) p.m., Penrith a.m., Penrith p.m, Strathfield Main Up a.m., Strathfield Suburban Up a.m., Strathfield Local Up a.m., Strathfield Main Down p.m., Strathfield Suburban Down p.m., Strathfield Local Down p.m.

Run number	11	108	13	138	30	197	5a	126	33a	132	191	16	17	131	130	120	169	184	4a
Via	G	G	G	G	G	G	G	G	G	RP	RP	RP	RP	RP	RP	RP	RP	RP	RP

Stations: Redfern, MacDonaldtown, Newtown, Stanmore, Petersham, Lewisham, Suumer Hill, Ashfield, Croydon, Burwood, Strathfield, Homebush, Flemington, Lidcombe, Berala, Regents Park, Sefton, Chester Hill, Leightonfield, Villawood, Carramar, Auburn, Clyde, Granville, Merrylands, Guildford, Yennora, Fairfield, Canley Vale, Cabramatta, Warwick Farm, Liverpool

Stops: 14 7 11 11 17 11 15 17 17 24 4 0 24 19 8 20 13 13

Run number	119	117	156	10	50	35	5	146	105	57	151	106	162	34	116	17	136	31	109
Via	G	G	G	G	G	G	G	G	G	G	G	RP	RP	RP	RP	RP	RP	RP	RP

Stations: Redfern, MacDonaldtown, Newtown, Stanmore, Petersham, Lewisham, Suumer Hill, Ashfield, Croydon, Burwood, Strathfield, Homebush, Flemington, Lidcombe, Berala, Regents Park, Sefton, Chester Hill, Leightonfield, Villawood, Carramar, Auburn, Clyde, Granville, Merrylands, Guildford, Yennora, Fairfield, Canley Vale, Cabramatta, Warwick Farm, Liverpool

Stops: 15 17 12 16 13 18 14 17 17 16 17 24 24 5 24 0 24 7 24

PM, but in the July timetable this is only 60%. General reckoning is that the "true" capacity of a single-track line is reached when section occupation times reach 40%, so the May times definitely represent an attempt to run a service much further beyond the capacity of the line to handle it than does the July timetable.

Close examination of the July timetable shows an apparent curiosity:- a number of trains pause for 1 minute at Caringbah and Gymea, without actually crossing another train. There are 10 such pauses altogether. In the May timetable, there are only 3 such pauses. These pauses seem to be instances of "recovery times" being inserted into the timetable. The May timetable, with less recovery time is therefore less able to recover when things go wrong. It should be noted though that the actual number of trains handled on the Cronulla line in the two timetables is very similar–in the May timetable there are 22 and in the July timetable there are 21—it's not the density that's the problem, it's the pattern. According to the NSW Railway Digest the Cronulla line was a particular thorn in the side during the period of the May 1975 timetable.

There was too much interaction between trains and lines.

Making a timetable that has too many system interactions is asking for trouble. There are fundamentally two types of interactions here: ones where the paths of different trains intermingle and raise the probability of cross-interference and ones where the running of particular services is dependent upon the on-time running of prior services. These are situations prone to spread the disease of lateness and cancellation- the former is like a contagion, the latter is a kind of genetic disorder- trains inherit their lateness from their forebears. Both are sometimes called "knock-on" delays and their potential magnitude is said to be inversely proportional to headways.

All suburban networks in which train sets shuttle back and forth during the day are subject to "knock-on" delays between one run and the next. But, in the case of the May 1975 NSW timetable, the effects of breakdowns or delays were much more serious because of the way trains sets were managed. One of the salient features of the May 1975 timetable, widely trumpeted beforehand, was the attempt to make widespread use of double-deck trains by splitting and amalgamating 8⇔4 car double-deck sets throughout the day. Ideally, this

should have provided more people with more double-deckers. In all, the May 1975 timetable saw 49 trains split this way, with the average interval between arrival at the splitting point and the first of the resultant departures being 22 minutes and the average interval to the second being 42 minutes. By comparison, in the succeeding July 1975 timetable, there were only 19 splits and the intervals were longer, at 29 and 59 minutes. In the May timetable, trains were amalgamated before the morning peak hour, divided after it, amalgamated before the evening peak and split after it. Some runs went through all of this each day.

It was generally regarded that this feature of the May 1975 timetable was the crux to understanding its downfall. Said NSW Railway Digest, "… *the many (in traffic) amalgamations and divisions made transposition a rather 'chancy' practice because of the obvious complications when an 'S' set came to be joined to a 7 car 'red' set.*" The apparent error of dividing trains for off-peak services was repeated to a lesser degree in the timetable of November 1996- another timetable which fell flat on its face. The concordance between splitting and failure is probably not a chance one.

Splitting and amalgamating trains cre-

May 1975

July 1975

train of interest [Run 8] in the afternoon) is one of a pair of trains, 42a and 43a, which in turn have been formed by the splitting of run 42, which in turn has…… Indeed, the drawing of such a diagram has nearly limitless ramifications, forming a kind of chicken wire mesh that crawls all over the system. One can see therefore that if something goes wrong with one of the trains that forms run 42 before the morning peak, run 8a's service in the evening peak is liable to get out of whack.

The other crippling feature that lead to the propagation of delays across the system was the extent of cross-fertilisation between lines. Instead of confining trains to particular sectors (as we would now call them), trains wandered willy-nilly from sector to sector. Run 8, even in its own unified identity, touches upon many lines and therefore creates the potential for causing delays across the system should something go wrong. In its 2 peak-hour lives, it visits the North Shore line, the Main South line, the Bank-

ates a kind of double jeopardy—two trains must both run to time in order that the amalgamated train may run to time and, if a train which is about to split loses time, it potentially affects the subsequent running of two trains. But, in the May 1975 timetable it was even worse than this because the two cycles of division and amalgamation might involve different components in each cycle, thus propagating any delay almost endlessly.

The chart above is an attempt to display the intricate pattern of divisions and amalgamations. It takes as its central character Run 8, an 8-car double-deck set that begins life at Hornsby at 0537. It makes a return trip to Ingleburn and, when it arrives back in Hornsby almost 4 hours later, it splits into runs 8a and 9a. Run 8a basically runs a Northern Line/Western Line shuttle until it teams up with run 43a at Homebush to give run 8 a second birth in mid-afternoon. The born-again run 8 then takes a new life on the Bankstown/Illawarra lines until the end of the peak hours when it reaches North Sydney and fissions back to runs 43a and 8a. 8a resumes its life as a Northern/Western shuttle until it finally pops off after midnight at Flemington Car Sidings. Run 43a runs a Northern/Southern line service until the end of the day's activities. Meanwhile, run 9a the twin from run 8's split in the morning follows in its twin's tracks for a while, running a Northern/Western service and, as evening peak hour approaches, gets together with another 4-car set. But it is not reunited with its sibling 8a, it is joined with Run 23a, a run that has been living a complicated life of its own during the day. As Run 23 the pair have a short life running City-Oatley-City-Cronulla, after which they resume their original identities 9a

and 23a. As such, they both spend a relatively boring evening running services to and from Cronulla, around and around the City Circle.

There are other players in this game-players whose on-time running is important if all the later amalgamations and divisions are to mesh properly. For instance, 23a has a partner 25a—they unite briefly in the morning to form an earlier incarnation of Run 23—and 25a has its own complications. Run 43a (the run that teams up with 9a to reincarnate our

The conflicts of Run 45

Place	Time	Movement	Conflicting run numbers
Punchbowl CS	2:39 PM	Car Sidings to Up Bankstown	130
Canterbury	2:47 PM	Cuts across Goods Lines	137
Sydenham	2:53 PM	Up Bankstown to Up Illawarra	130, 173
Illawarra Junction	2:58 PM	Cuts across Local-Illawarra Local	105
Flying Junctions	3:01 PM	Up Illawarra Local to Up Local	72
Flying Junctions	3:01 PM	Up Local to Up Suburban	29a, 130
Waverton (out)	3:23 PM	Waverton Neck to Up Shore	32, 189, 193, 15a
North Sydney	3:36 PM	North Sydney #2 plat to Up Shore	29a

stown loop and the Illawarra line. Its progeny visit in addition the Western line, the Richmond line, the Cronulla line and the Main North line.

We illustrate this phenomenon with two of the most widely travelled trains in the May 1975 timetable, runs 20 and 30 in the chart at the bottom of page 9 (thanks to Chris Brownbill for this amazing piece of art-work). Run 20 is formed in the morning from run 20a/30a, of which 30a later combines with 19a to form run 30. In all these wanderings, the only lines not visited are the lines beyond Sutherland, the East Hills line beyond Riverwood and the newly-electrified Riverstone line.

How does this affect performance of the timetable?- probably via 2 fundamental mechanisms.

First, a train that manages to become late in one sector has to be found a new path when it changes to another sector- at the very least delaying other trains in spatial and temporal proximity to it, but possibly even displacing them.

Second, a train that changes from one running line to an adjacent parallel one must cross the path of other trains on the system. It has been acknowledged by the present CityRail that 'flat crossings' of one train in front of another are a potential source of delay. In the May 1975 timetable, there appear to have been about 1200 crossings between parallel lines, the greater proportion of them occurring in the Redfern area. "Crossings" also occur when a train moves from the Down to the Up line at a turn-back point– there were over 730 of these. They also occur at junctions where a Down branch line train cuts across the path of an Up main line train– there were several hundred of these as well. This makes a grand total of at least 2,500 instances of train interference, where one train crossed the path of a "competing" train.

In the May 1975 timetable, and in many since, a number of trains were stored during the middle of the day at Mortdale and Punchbowl Car Sidings. Some of these were returned to traffic as far away as North Sydney to run Shore, Western and Northern line services. To achieve this, they had to make numerous crossings of other inbound and outbound tracks in the Illawarra Junction-Redfern-

Central area. These trains were perhaps the worst offenders in causing "crossing delays".

The chart above shows (as a heavy line) the path of run 45, which commences empty at Punchbowl Car Sidings, becomes a passenger-carrying train at Sydenham, then makes its way over the Flying Junctions to the Suburban line whence it runs to North Sydney, where it discharges all passengers. It then makes a short run to terminate in the shunting neck at Waverton and emerges a few minutes later to cross the Down and Up lines to return to North Sydney. From there it recommences its afternoon passenger-carrying expeditions with a trip to Fairfield (itself a rather uncommon terminal). On its run from Punchbowl to North Sydney, there are 8 potential conflict points (circles), where there are 13 other runs in close proximity in time or space.

In the lead-up to the non-introduction of its April 2002 timetable, Cityrail advanced as a desirable feature of the timetable that it should minimise these flat-junction crossings and said that the new timetable would reduce them from 528 in the 2000 timetable to 352;

obviously Cityrail has come a long way since 1975, but still hopes to do better.

Today's system map, is colour-coded for its different sectors (map, right), but it also serves to illustrate the way in which most trains are confined to the sectors and makes clear to what extent the peregrinations represented in the chart on page 9 have been done away with. Although it is really a route map, it is also essentially a train-running map, representing the modern reality that trains stay on their own lines.

Even so, interactions between lines and trains cannot be abolished. In any system with multiple track junctions and parallel pairs of running lines there are going to be times and places where the paths of trains cross. Most especially this occurs at multiple track junctions where the path of a train diverging onto a branch cuts across the path of non-diverging trains

They didn't tell anybody what they were doing

In 1975, according to John Gunn's "Along parallel Lines", *Drivers and guards did not know their destinations and were given hurried instructions as their trains pulled into stations … public-address systems announced routes and stops that were completely at odds with indicator boards*" The Sydney Morning Herald story (our page 2) gives a graphic account of this confusion.

On the first working day after the Christmas break in 1996, many commuters arrived at their departure stations to find that the trains they were accustomed to catch didn't show up. Unbeknownst, CityRail had decided to operate a reduced service timetable in the Christmas-New Year week, but had omitted to tell the customers. This came at a time when CityRail's regular timetable, introduced on November 3, was displaying many flaws. CityRail's stated justifications for running the reduced service, variously referred to as a "reduced weekday service" or an "enhanced weekend service" was containment of staffing costs and reduced demand. The former was entirely negated by an arrangement with the transport unions that staff could show up for work as per a normal weekday, but then lounge around on full pay

without having to work trains. While it was certainly true that there was reduced overall demand for travel in this week, there was no reason to suppose that the pattern of demand and the concentration of demand into the peak period was altered in an way. There certainly seemed to be no justification for springing the "enhanced weekend timetable" as a surprise. A principal function of having a published timetable is to forewarn passengers of when they can travel from point A to B.

There was not enough healthy rolling stock

The May 1975 timetable required the rolling stock, shown in the table below, which lists stock by train sets in the way in which the PTC considered the sets to exist.

In fact many of the 8-car sets were

only made up of 7 cars. In the M and W sets this usually meant the loss of a double-deck trailer. But in the B and H sets, there were often only 3 power cars instead of 4 per train. This significantly affected performance. The NSW Railway Digest described the single-deck sets as being "*in a parlous state, 30 odd having only 7 cars, whilst others had defective cars marshalled in reverse and were [therefore] not divisible.*

The chart on page 12 shows the way in which the number and types of sets in service varied throughout the railway day, the peaks in this graph represent the numbers in the table on this page.

There were too few crew

In the 1975 timetable the maximum number of sets in traffic at any one time was 125, each naturally had one driver at the controls. For the entire

Set type	Fleet size	No. needed	No. usable
B & H sets (8 -cars)	98	81	
M sets (8-cars)	6	12	??
W sets (8-cars)	10		
S sets (4-cars)	42	42	38

Sets in traffic, May 1975

Number of sets

Legend: 8DD, 8M, 8SD, 4DD, 4M, 4SD
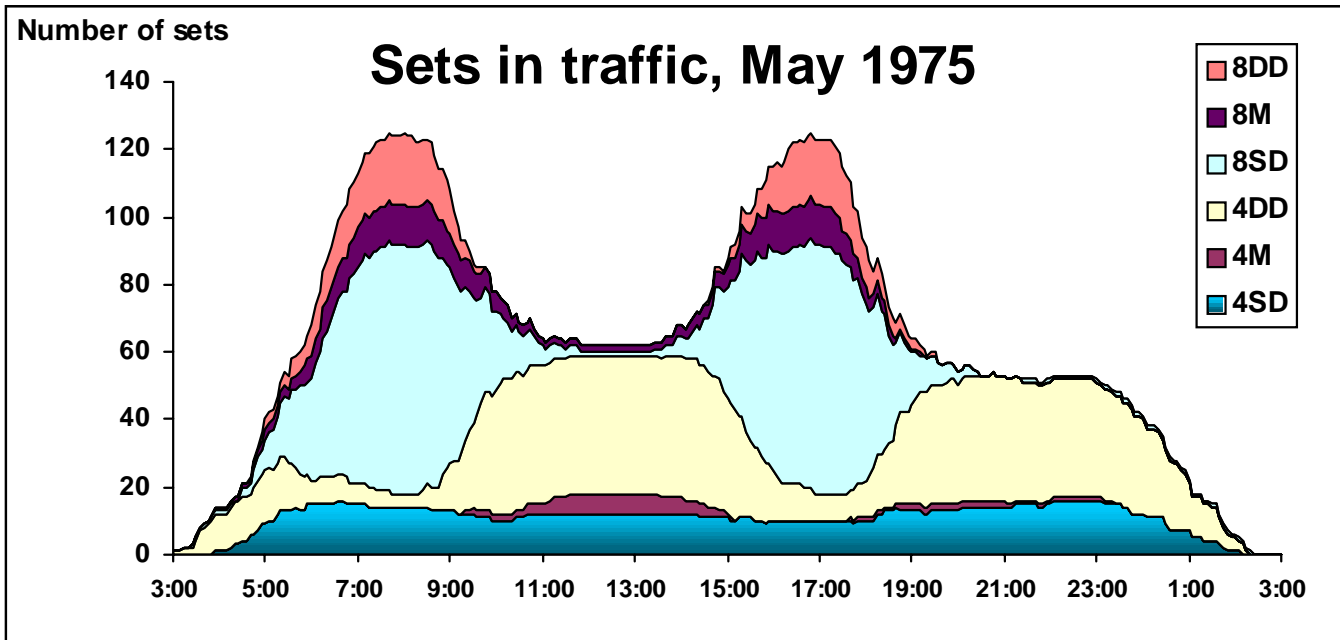
day, taking account of the start and stable times of all the suburban sets in traffic, a total of 1560 running hours were clocked up. For a 5-hour driving day, this equates to 312 drivers. Allowing for weekends, a 5-day working week, crib allowances, annual leave, sickness and other requirements, the total number of drivers required to run the Sydney suburban component in the 1975 timetable would have been about 440. How many were actually available? I don't know. It was reported the absences among guards, where the requirements would be similar to those for drivers, was 21 in 1 week and 17 in the next. This would represent about a 5% reduction. ABC Television news reported at one stage that services would be reduced by 19% because of "sickness". This is a much bigger drop-out rate, presumably over 40 drivers or guards.

Train timetable and crew rosters have generally been separate exercises in the NSW suburban system– at least until recently. In general, a timetable would be drawn up by the planning section with scant regard for how crew were to be provided. The timetable plan would then be handed over to those responsible for crew rostering– they had to work with what they were given. This has changed somewhat recently– reportedly Cityrail has developed more computerised schemes of rostering that mesh more closely with

the timetable-compilation computer programs. When these rostering programs began to warn of difficulties in the 2002 timetable, extensive double-checks were carried out and confirmed the problems; this was the stated principal reason for cancelling this timetable.

20:20 vision… could it happen again?

All this is hindsight, of course—and hindsight has 20:20 vision. Could the breakdown of the 1975 timetable been predicted in advance? Was the breakdown predicted in advance? We may never know. If the same timetable were to be attempted today, would it again fail? The 2002 experience seems to show that some level of analysis had been applied to a new timetable and that enough had become apparent for the planners to take fright and call the whole thing off. Cityrail produced a number of discussion papers prior to the introduction of its 1996 timetable, setting out a number of principles of operation, including:

Turn-around times of a minimum of 7 minutes.

Minimum headways of 3 minutes.

Realistic station dwell times, adjusted up or down in response to traffic levels.

3% recovery margins at junctions (3% of what?, it might be asked).

Cityrail has said on the web-site established for introduction of the new timetable in 2002 that it has used a "computer program" to test the reliability of the proposed timetable, but I am not certain what this might mean and what type of analysis such a program could be capable of. CityRail timetables are now mostly compiled using a proprietary product called TrainPlan, developed by an ex-NSWGR employee. Fundamentally, it is a computer-aiding method which allows human planners to quickly draw up schedules and then allows potential conflict areas to be identified by simulation. There is also a competing program called Simu++, used for similar purposes. I get the feeling that there is a certain amount of angst within the organisation over all of this, especially the "competition" between the two programs.

Analytical and modelling methods for predicting delays in urban rail networks have not been very well developed, although they do exist. At least some of the principles are known-some of them have been alluded to this article-although implementation of them to a point where such a model could have been used to predict the 1975 chaos in advance has even now not reached the practical stage.

New South Wales Government Railways' *Composition and Marshalling of Express, Mail and Country Passenger Trains* books : a different type of 'timetable'
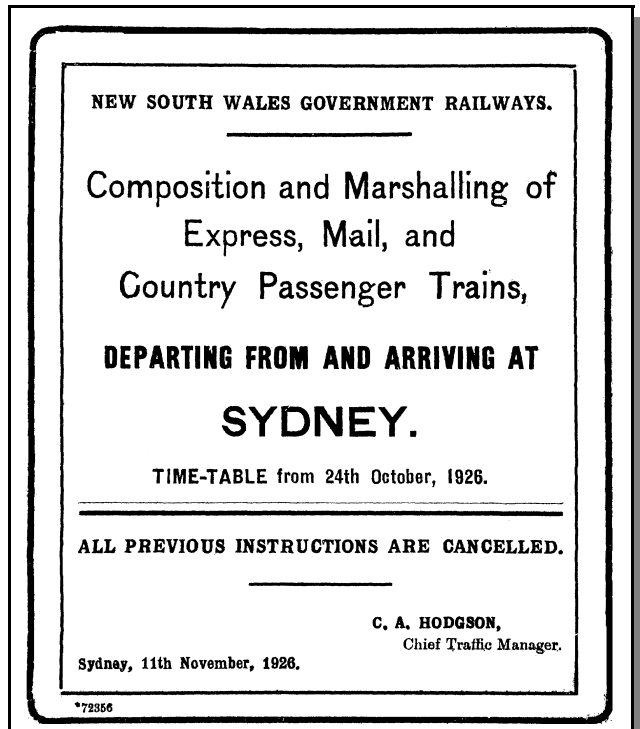
STEVEN HABY *reviews one of the items listed in the current AATTC catalogue– a train make-up book from the NSWGR.*

Apart from timetables, one of my interests in railways is the composition of passenger trains. It was therefore a pleasant surprise when I was asked to write a critique on a very interesting document published by the NSWGR. I refer to a small book with the lengthy but informative title: Composition and marshalling of express, mail, and country passenger trains departing from and arriving at Sydney. A date 'Time-table from 24th October, 1926' is shown on the cover and, interestingly, further down a smaller date states '11th November 1926' which is presumably a printing date (right).

The 76-page booklet lists the composition of all country trains de-parting from Sydney (Central) station and is arranged by line—Illawarra line, Southern line, Western line and Northern line. At the rear of the book information on the carriage codes (including suburban stock) and tonnages thereof is contained.

Apart from the arrival and departure times of trains, information is shown on which services are used for the balancing of carriages

NEW SOUTH WALES GOVERNMENT RAILWAYS.

Composition and Marshalling of Express, Mail, and Country Passenger Trains,

DEPARTING FROM AND ARRIVING AT

SYDNEY.

TIME-TABLE from 24th October, 1926.

ALL PREVIOUS INSTRUCTIONS ARE CANCELLED.

C. A. HODGSON,
Chief Traffic Manager.

Sydney, 11th November, 1926.

*72356

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BALANCING OF CARRIAGES.

Week-days	No. 9	2·55 a.m.	Sydney–Orange	4·7	p.m.
Saturdays exepted	No. 215	7·16 a.m.	Penrith–Mt. Victoria	9·32	a.m.
Saturdays excepted	No. 216	2·12 p.m.	Mt. Victoria–Blacktown	4·41	p.m
Saturdays excepted	No. 123 (E)	4·55 p.m.	Blacktown–Riverstone	5·11	p.m
Saturdays excepted	No. 138	5·20 p.m.	Riverstone–Blacktown	5·39	p.m
Saturdays excepted	No. 231	6·1 p.m.	Blacktown–Penrith	6·35	p.m
Saturdays	No. 215	7·16 a.m.	Penrith–Mt. Victoria	9·32	a.m.
Saturdays	No. 218	10·44 a.m.	Mt. Victoria–Penrith	12·32	p.m
Wednesdays & Saturdays	No. 93	7·55 a.m.	Sydney–Lithgow	12·10	p.m.
Wednesdays & Saturdays	No. 48	5·25 p.m.	Lithgow–Sydney	9·21	p.m.
Week-days	No. 23	8·17 a.m.	Sydney–Mt. Victoria	12·6	p.m.
Week-days	No. 26	1·0 p.m.	Mt. Victoria–Sydney	4·12	p.m.
Week-days	No. 31	9·27 a.m.	Sydney–Dubbo	9·55	p.m.
Week-days	No. 28	7·3 a.m.	Dubbo–Sydney	6·50	p.m.
Fridays	No. 25	11·25 a.m.	Sydney–Mt. Victoria	3·5	p.m.
Fridays	No. 48a	10·45 p.m.	Mt. Victoria Clyde Sidings	1·22	a.m.
Saturdays	No. 25	11·25 a.m.	Sydney–Mt. Victoria	3·5	p.m
Sundays	No 94	6·0 p.m.	Mt. Victoria–Sydney	9·16	p.m.
Week-days	No. 43	11·55 a.m.	Sydney–Mt. Victoria	3·41	p.m.
Week-days	No. 36	4·20 p.m.	Mt. Victoria–Sydney	7·26	p.m.
Saturdays	No. 97	12·0 p.m.	Sydney–Mt. Victoria	3·42	p.m.
Sundays	No. 96	6·15 p.m.	Mt. Victoria–Sydney	9·22	p.m.
Saturdays	No. 45	1·0 p.m.	Sydney–Mt. Victoria	4·28	p.m
Sundays	No. 90	4·25 p.m.	Mt. Victoria–Sydney	7·28	p.m
Saturdays	No. 47	1·25 p.m.	Sydney–Mt. Victoria	5·9	p.m
Mondays	No. 10	5·57 a.m.	Mt. Victoria–Sydney	8·49	a.m
Saturdays	No. 55	2·5 p.m.	Sydney–Mt. Victoria	5·37	p.m.
Sundays	No. 76	5·20 p.m.	Mt. Victoria–Sydney	8·13	p.m.
Saturdays	No. 67	2·25 p.m.	Sydney–Lithgow	7·2	p.m.
Mondays	No. 14	5·54 a.m.	Lithgow–Sydney	9·44	a.m.
Fridays	No. 75	3·47 p.m.	Sydney–Lithgow	8·2	p.m.
Saturdays	No. 14	5·54 a.m.	Lithgow–Sydney	9·44	a.m.
Fridays	No. 77a	4·0 p.m.	Sydney–Mt. Victoria	7·35	p.m.
Saturdays	No. 30	3·0 p.m.	Mt. Victoria–Sydney	6·3	p.m.
Mondays to Thursdays	No. 77	4·0 p.m.	Sydney–Mt. Victoria	7·33	p.m.
Tuesdays to Fridays	No. 14	6·49 a.m.	Mt. Victoria–Sydney	9·44	a.m.
Mondays to Fridays	No. 57	5·18 p.m.	Sydney–Mt. Victoria	8·40	p.m.
Tuesdays to Saturdays	No. 10	5·57 a.m.	Mt. Victoria–Sydney	8·49	a.m.

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BALANCING OF CARRIAGES—*continued.*

Saturdays	No. 79	6·15 p.m.	Sydney–Mt. Victoria	10·2	p.m.
Sundays	No. 92	5·35 p.m.	Mt. Victoria–Sydney	8·23	p.m
Sundays	No. 87	6·15 p.m.	Sydney–Lithgow	10·35	p.m
Mondays	No. 18	8·52 a.m.	Lithgow–Sydney	12 53	p.m.
Fridays	No. 83	6·30 p.m.	Sydney–Mt. Victoria	9·50	p.m.
Fridays	No. 48a	10·45 p.m.	Mt. Victoria–Clyde Sidings	1·22	a.m.
Mondays to Thursdays	No. 85	6·35 p.m.	Sydney–Lithgow	11·5	p.m.
Tuesdays to Fridays	No. 18	8·52 a.m.	Lithgow–Sydney	12·53	p.m.
Fridays	No. 85a	6·35 p.m.	Sydney–Lithgow	11·11	p.m.
Saturdays	No. 18	8·52 a.m.	Lithgow–Sydney	12·53	p.m.
Daily, Saturdays excepted	No. 61	7·27 p.m.	Sydney–Coonamble	12·35	p.m.
Week-days	No. 56	1·0 p.m.	Coonamble–Sydney	6·28	a.m.
Saturdays	No. 81	7·55 p.m.	Sydney–Orange	4·56	a.m.
Sundays	No. 20	9·5 p.m.	Orange–Sydney	5·47	a.m.
Daily, Saturdays excepted	No. 49	7·55 p.m.	Sydney–Forbes	9·30	a.m.
Week-days	No. 6C	4·20 p.m.	Forbes–Sydney	5·31	a.m.
Daily, Saturdays excepted	No. 59	8·55 p.m.	Sydney–Nyngan	12·21	p.m.
Week-days	No. 58	2·33 p.m.	Nyngan–Sydney	5·47	a.m.
Daily, Saturdays excepted	No. 63	9·50 p.m.	Sydney–Mudgee	6·51	a.m.
Week-days	No. 54	8·5 p.m.	Mudgee–Sydney	5·5	a.m.
Saturdays	No. 151	10·15 p.m.	Sydney–Penrith	11·53	p.m.
Sundays	No. 161	2·30 a.m.	Penrith–Mt. Victoria	7·7	a.m.
			(Unbalanced.)		
Wednesdays	No. 68	9·45 a.m.	Mudgee–Wallerawang	1·45	p.m
Wednesdays	No. 7	2·45 p m.	Wallerawang–Mudgee	6·22	p.m.
Fridays	No. 68	9·45 a.m.	Mudgee–Wallerawang	1·45	p.m.
Fridays	No. 7	2·45 p.m.	Wallerawang–Mudgee	6·22	p.m.
Saturdays	No 70	8·50 a.m.	Mudgee–Sydney	5·32	p.m.
Saturdays	No. 71	11·20 p.m.	Sydney–Lithgow	3·55	a.m.
Sundays	No. 74	6·30 p.m.	Lithgow–Sydney	10·17	p.m
Sundays	No. 53	8·15 p.m.	Sydney–Blayney	4·10	a.m.
			(Unbalanced.)		
Sundays	No. 41	8·55 a.m.	Sydney–Mount Victoria	12·40	p.m.
Mondays	No. 12	6·20 a m.	Mount Victoria–Sydney	9·5	a.m.
Sundays	No. 95	9·55 p.m.	Sydney–Lithgow	2·40	a.m.
			(Unbalanced.)		

72356—C

4

ILLAWARRA LINE.
DOWN.   WEEK-DAYS.

No. 9 Mixed.
2·10 a.m. from SYDNEY, arrive NOWRA 9·50 a.m.

E H O
B X
L F X

Other Traffic as required.

No. 109 Pass.
8·10 a.m. from SYDNEY (Saturdays), arrive KIAMA 11·34 a.m.

E H O
V F X
V B C
M C X
L F X
L F X

(Load 200 tons.)

No. 111 Pass.
8·20 a.m. from SYDNEY, arrive WOLLONGONG 10·58 a.m.

B H G
C X
2 B B
5 F A

(Load 190 tons.)

No. 117 Pass.
9·10 a.m. from SYDNEY, arrive NOWRA 1·12 p.m.

L F X
B X
L F X
E H O
L F X
B X } Wollongong.
L F X }
C X }
L F X } Saturdays.
L F X }

Mon. to Fri. ... 185 tons.
Saturdays ... 260 tons.

No. 151 Pass.
12·3 p.m. from SYDNEY (Saturdays), arrive WOLLONGONG 2·41 p.m.

*L F X
*L F X
B X
E H O
C X
B X
L F X
H F X
L F X
L F X

(Load 260 tons.)

* For passengers, Loftus Junction to Waterfall.

5

Illawarra Line—*continued.*
WEEK-DAYS—*continued.*   DOWN.

No. 181 Pass.
12·57 p.m. from SYDNEY (Saturdays), arrive KIAMA 4·25 p.m.

E H O
L F X
B X
B X
L F X
L F X
L F X
L F X   Wollongong.

(Load 210 tons.)

No. 209 Pass.
2·0 p.m. from SYDNEY (Saturdays), arrive WOLLONGONG 4·32 p.m.

E H O
B B Label 2nd class.
2 B B }
3 F A } Car Set.
3 F A

(Load 205 tons.)

No. 203 Pass.
2·15 p.m. from SYDNEY (Saturdays excepted), arrive KIAMA 6·12 p.m.

L C C Stand by.
E H O
L F X
B X
L F X
B C
L F X Mondays and Fridays. } Wollon-
F N} Wednesdays. } gong.
C C}
*2 F A
F K—Tues. & Thurs., Waterfall

Load :—Mondays   ... 195 tons.
     Tuesdays   ... 190 tons.
     Wednesdays ... 210 tons.
     Thursdays   ... 190 tons.
     Fridays   ... 195 tons.
On Mondays 1 C C A instead of 1 F A.

No. 229 Pass.
2·50 p.m. from SYDNEY (Saturdays), arrive NOWRA 6·57 p.m.

E H O
L F X
L F X
B X
B X
L F X
L F X
L F X   Wollongong.

(Load 210 tons.)

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for return services. A example of such a list is shown on our page 13, bottom.

A example of 2 typical pages of the composition books appears above. Shown is the down departures from Sydney on the Illawarra line. The listing of the trains commence with the last carriage first. Departure times from Sydney and arrival times at the terminating station are shown as well as other instructions.

The first train on p. 4 of the composition book is no. 9 mixed departing at 0210 with a load of EHO van, BX (first-class express) and a LFX (second-class express). No. 9 was the paper train and conveyed milk tankers and 'other Traffic as required' according to the composition book. Interestingly, a maximum tonnage limit is not indicated—yet other trains show the tonnage.

No. 203 down to Kiama departing at 1415 (shown on p. 5) was an interesting train and the composition varied depending on the day of the

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Southern Line—*continued.*
DOWN.   SUNDAYS—*continued.*

No. 17 Mail.
8·25 p.m. from Sydney, arrive HARDEN 5·13 a.m.

E H O }
A J }
B X } For Cowra.
L F X }
C X } Harden.
L F X }
L F X   Goulburn
(Load 180 tons.)

No. 11 Mail.
8·40 p.m. from Sydney, arrive COOMA 7·24 a.m.

L F X   Picton.
E H O }
C X } Bombala.
L A M
B C
L F X
B C
L F X
L F X }
L F X } Goulburn.

From Sydney ... ... 265 tons.
From Picton ... ... 240 tons.
From Goulburn... ... 190 tons.

No. 23 Mail.
10·5 p.m. from Sydney, arrive JUNEE 8·10 a.m.

A J Crookwell
A C X Tumut.
K P Cootamundra to Junee.
A M Junee.
L F X }
B X } Leeton.
E H O }
L F X }
B X } Hay.

From Sydney ... ... 220 tons.
From Goulburn ... 195 tons.
From Cootamundra ... 195 tons.

No. 7 Mail.
10.45 p.m. from Sydney, arrive ALBURY 12·30 p.m.

K P Junee to Albury
E H O
A D Junee.
B X
L F X
B X
L F X
C X }
L F X } Junee to Albury.

Load :—
From Sydney ... ... 175 tons.
From Junee ... ... 215 tons.

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Southern Line—*continued.*

DOWN.   WEEK-DAYS—*continued.*

No. 191 Pass.

5·20 p.m. from Sydney (Saturdays excepted), arrive PICTON 7·37 p.m.

Mons. to Thurs.	Fridays.
F O	L F X
B I	B X
H F X	H F X
H O	E H O
F N ⎫	L F X ⎫
F N ⎬ Campbelltown.	B X ⎬ Campbelltown.
F N ⎭	L F X ⎭
F N	L F X
(Load 170 tons.)	(Load 210 tons.)

No. 1a Express.

7·10 p.m. from Sydney (Saturdays), arrive ALBURY 6·50 a.m.

E H O
T A M (10)
T B C (7)
T F X (8)
T F X (9)
C X Goulburn.
(Load 230 tons.)

No. 1 Limited Express.

7·25 p.m. from Sydney, arrive ALBURY 7·10 a.m.

M H O
T A M (1)
T A M (2)
C A M (3)
T A M (4)
T A M (5)
(Load 260 tons.)

No. 33 Pass.

7·35 p.m. from Sydney (Saturdays), arrive GOULBURN 12·57 a.m.

L F X   Picton.
E H O
M B X
M F X (601)
T B C
T F X

(Load 230 tons.)

No. 3 Express.

7·50 p.m. from Sydney (Sats. excepted), arrive ALBURY 7·55 a.m.

E H O
T A M (6)
T B C (7)
T F X (8)
T F X (9)
B X
L F X

(Load 260 tons.)

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Southern Line—*continued.*

WEEK-DAYS—*continued.*   **DOWN.**

No. 5 Mail.

8·10 p.m. from Sydney (Sats. excepted), arrive TEMORA 7·58 a.m.

†C X ⎱
†C X ⎰ Wyalong.
A M   Temora.
E H O   Wyalong.
E H O ⎫
B C ⎬ Griffith.
L F X ⎭
A J   Cowra.
K P   Coota. West.
B L V   Coota. West to Temora.
From Sydney ... 235 tons.

† Tri-weekly to Lake Cargelligo.

No. 11 Mail.

8·40 p.m. from Sydney (Sats. excepted), arrive COOMA 7·24 a.m.

B X   Goulburn, Fridays.
E H O   Queanbeyan.
E H O ⎱
C X ⎰ Bombala.
L A M
L F X
B X
L F X
Fridays ...   . 225 tons.
Fridays excepted   ... 195 tons.

No. 231 Pass.

9·5 p.m. from Sydney (Saturdays), arrive PICTON 10·53 p.m.

F O
B I
H F X
H O

(Load 90 tons.)

No. 23 Mail.

10·5 p.m. from Sydney (Sats. excepted), arrive JUNEE 8·10 a.m.

L F X ⎱ Goulburn (empty)
B X ⎰ Fridays.
A C X   Tumut.
K P   Cootamundra to Junee.
A M   Junee.
L F X ⎫
B X ⎬ Leeton.
E H O ⎭
L F X ⎱ Hay.
B X ⎰
B L V   Hay, Fridays.

From Sydney ...   Fri.   270 tons.
From Sydney ...   F.E.   195 tons.
From Goulburn ...   F.E.   195 tons.
From Goulburn ...   Fri.   215 tons.
From Cootamundra   F.E.   195 tons.
  „   „   Fri.   215 tons.

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Southern Line—*continued.*

WEEK-DAYS.   UP.

No. 14 Mail.

6·15 p.m. from COOMA, Sundays excepted, arrive Sydney 4·50 a.m. Tuesdays to Saturdays, and 5·7 a.m. Sundays.

E H O ⎱
C X ⎰ Bombala.
L A M
L F X
B X
L F X
L F X   Attd. Queanbeyan, Fri.
A J   Attd. Goulburn, off
    No. 20 Fridays.
Fridays excepted ... 170 tons.
Fridays   ...   ... 220 tons.

No. 6 Mail.

4·50 p.m. from TEMORA, Sundays excepted, arrive Sydney 5·10 a.m. Tuesdays to Saturdays, and 5.40 a.m. Sundays.

A J   from Cowra.
A M   attached Temora.
*B C   attached Temora.
†E H O ⎫
C X ⎬ from Lake Cargelligo
C X ⎭ and Wyalong.
E H O ⎫
B C ⎬ from Griffith.
L F X ⎭
B L V   Temora to Coota. West.
Load from Harden :—
Mon., Tues., Wed.   ... 205 tons.
Thursdays and Fridays... 230 tons.
Saturdays   ...   ... 180 tons.
   * Thursdays and Fridays.
   † Saturdays excepted.

No. 10 Mail.

6·10 p.m. from JUNEE, Sundays excepted, arrive Sydney 5·33 a.m. Tuesdays to Saturdays, and 5·55 a.m. Sundays.

A C X   from Tumut.
A M   from Junee.
E H O ⎫
B X ⎬ from Leeton.
L F X ⎭
B X ⎱ from Hay.
L F X ⎰

(Load 195 tons.)

No. 8 Mail.

3·0 p.m. from ALBURY, Sundays excepted, arrive Sydney 5·55 a.m., Tuesdays to Saturdays, and 6·12 a.m. Sundays.

B L V   Albury to Junee.
K P
A D   attached Junee.
E H O
L F X
B X
L F X
B X
C X   detached Junee.

Load from Junee :—205 tons.

week. Normally the train comprised a LCC (a 'Redfern' composite car), EHO van, LFX, BX, LFX and a BC (first-class car with coupe ends). On Mondays and Fridays an additional LFX, FN (second-class car) and two FA were added and detached at Wollongong (with a CCA van composite substituting for one FA on Mondays). On Wednesdays this was substituted with a FN and CC (a 'Redfern' composite) and, finally, Tuesday and Thursday trains had a FK (a Russell first-class saloon) which was detached at Waterfall.

The Southern line (above) had its share of interesting trains, ranging from the prestige to the lowly. No.1 Limited Express to Albury departed Sydney at 1925 with a load of relatively new express cars of MHO van, TAM, TAM (sleeping cars), CAM, (sleeping/ first class sitter) and two further TAMs. Note how the cars are numbered 1 through 5. No. 3 Express departing at 1950 had only one sleeping car and comprised EHO, TAM, TBC, (first-class), TFX,

TFX (second-class), BX and LFX. Cars with the exception of the BX and LFX were numbers 6 to 9.

The South ran some interesting mail trains. No. 5 Mail to Temora (our page 14, lower) departing at 1910 had cars for Wyalong (extending thrice-weekly to Lake Cargelligo), Griffith, Cootamundra West and Cowra. Note the inclusion of the BLV van from Cootamundra West to Temora. Presumably this was shunted on at the former station. The AJ car to Cowra was a composite branch line sleeping-car providing first and second class sleeping, luggage and brake facilities.

An interesting entry is on p. 23 for Sunday's no. 1a Express which shows no composition. The note states that the load is arranged as per the Sleeping Car List. Perhaps this train's composition was dependent on bookings?

Up trains on the Southern line had some interesting compositions. No. 10 Mail from Junee (p.25; our page 15, lower) conveyed an ACX (composite sleeping-car) from Tumut, an AM from Junee, EHO, BX, LFX from Leeton and BX, LFX from Hay. On p. 29, trains terminating at Junee and Goulburn from outlying destinations are shown. One assumes No.2 Passenger from Yanco arriving at Junee then connects with no. 10 Mail shown on p 25.

The Western Line had its share of well known trains. No. 57 Express to Mount Victoria departed Sydney at 1718 arriving at 2040 after detaching a LFX and CX at Penrith. On Fridays an additional CX was added presumably to cater for holiday traffic. An unusual working to include in the composition book, as it did not arrive at Central, was No.48a Empty cars which conveyed two car sets on Fridays from Mount Victoria and was timed to arrive at Clyde Sidings at 0122.

On Sundays there were no arrivals

in Sydney until the evening when six trains arrived between 2013 and 2217, presumably carrying holidaymakers back from the Blue Mountains, shown on pp. 48 and 49.

A busy line was the Northern, with mail trains initiating many services to the far North and North West of the state. There were still a few mixeds with no. 19 Express Mixed to Newcastle (a paper train) departing at 0115 with EHO, BX, LFX, LFX (Mondays only). No. 5 Passenger to Kempsey departing at 0920 was a long train with 10 cars, five for Newcastle and the rest proceeding to Kempsey with a CX for Taree.

No. 13 Mail to Glen Innes departing at 2015 contained LFX, AF, BX, LFX, EHO, HV, CX, CX. The AF was for Armidale, the HV and CX were for the Barraba branch and the other CX was for Narrabri. At Newcastle the consist was reversed – in other words the train terminated and reversed direction rather than diverting at Hamilton.

There were also a number of shorter runs shown – for example no. 316 from Hawkesbury River

which departed at 1705 arriving in Sydney at 1855. The consist was 6 FA cars and 2 BB cars, for a load of 160 tons.

In summary, the composition books published by the NSWGR are an excellent source of primary source documentation for the researcher interested either in passenger train operation or carriage consists. Although not a timetable in the true sense, nor a WTT they are similar to docking sheets issued by the V.R., for example, which providing information on the arrival and departure of trains at Spencer Street station.

I am not aware of many other documents of this nature being issued by Australian railway administrations. V.R. WTTs for many years included details of carriage stock and which carriages were to be marshalled on specific trains, eg dining cars.

References

David Cooke, Don Estell, Keith Seckhold & John Beckhaus. Coaching stock of the NSW railways. Eveleigh Press, Matraville, N.S.W. 1999.

Was it in the book? A suburban set at Strathfield in 1926, the year of publication of the composition book. . Photo R. B. Clark, courtesy ARHS Bulletin.