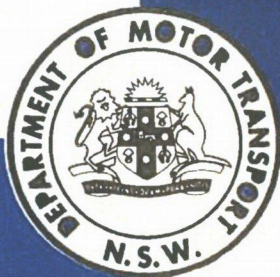
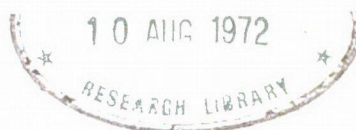


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TARU RN 1/72



TRAFFIC ACCIDENT RESEARCH UNIT



COMPULSORY WEARING OF SEAT BELTS

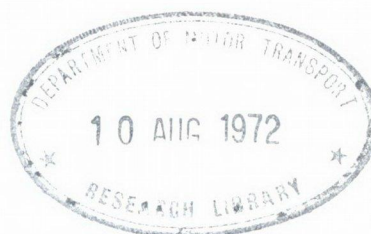
A preliminary evaluation of effects



DEPARTMENT OF MOTOR TRANSPORT NEW SOUTH WALES



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COMPULSORY WEARING OF SEAT BELTS

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TARU research note RN 1/72

COMPULSORY WEARING OF SEAT BELTS

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Introduction

In November, 1970, the New South Wales Cabinet Standing Committee on Road Safety accepted in principle the case for making seat-belt wearing compulsory. The Commissioner for Motor Transport then submitted a detailed proposition in the form of a Traffic Accident Research Unit report, "Compulsory Wearing of Seat Belts : a Feasibility Study" (TARU 6/70), which was published in December and widely circulated.

In December, 1970, as a result of a recommendation by the Victorian Parliamentary Select Committee on Road Safety, seat-belt wearing became compulsory in that State.

February, 1971, saw the publication of a second TARU report (2/71) on the subject : "Seat Belts : a Survey of Usage and Attitudes". This study found widespread public belief in the safety value of seat belts, even among those who never wore them, but a reportedly low wearing rate. One conclusion was : "If seat belts are to continue as occupant restraints, legislation for compulsory usage may be the only way to markedly increase the wearing rate".

The wearing of seat belts when fitted to cars became compulsory in New South Wales on October 1, 1971, but the law was not enforced until November 1, 1971. By early 1972, all States in Australia has enacted similar legislation, making this country the first developed nation in the world to take the step. In New Zealand the decision was taken to follow suit as from June, 1972, bills have been (so far unsuccessfully) presented in a number of American States, the British Minister of Transport Industries has publicly discussed the issue, and in Sweden a Government committee has been established to examine the question in depth.

In this paper the early effects of the legislation in New South Wales are examined.

The target group

The prime objective of this legislation is to save lives, and indeed at this early stage it is only possible to measure the effect on fatalities. (More detailed analysis of injuries will be undertaken at a later date.) First, therefore, it is necessary to assess the size of the population which will be affected by the legislation.

Naturally, only the occupants of passenger cars and passenger car derivatives fitted with seat belts will be affected, and even then not all of the occupants will have seat belts available. Most vehicles with belts fitted have them for the front outer seats only.

There were 1249 people killed in traffic crashes in New South Wales during 1971, of whom 860 were vehicle occupants. The remainder was comprised of pedestrians, 250; motorcyclists and pillion passengers, 122; and pedal cyclists and others, 17. Of the 860 vehicle occupant fatalities, 775 (90.1%) were occupants of passenger cars and their derivatives, and it is only on this group of fatalities that the legislation can at present operate (seat belts are not at present required to be fitted to heavy vehicles).

Even when seat belts are fitted and correctly worn there are many crashes which a properly restrained occupant cannot survive because of any one or a combination of the following factors: first, very high deceleration forces above the survivable threshold; second, major structural failure which in turn results in restraint system failure; third distortion of the passenger compartment which brings the occupant into direct contact with unyielding surfaces and projections.

A detailed examination of police reports forms for all fatal accidents which occurred during 1971 indicated that 478 (61.7%) persons were killed in crashes which, in respect to the person killed in each

case, were assessed as being unsurvivable whether a seat belt was worn or not.¹ Therefore only 297 (38.3%) of the persons killed in passenger cars and derivatives could have been saved if belts had been worn universally. Moreover, in 160 of these cases there was no belt fitted for the particular seat, and therefore only 137 of the persons killed in traffic accidents in 1971 would have been affected by compulsory-wearing legislation if it had been in operation throughout the year.

On the basis of the above survey of fatal crashes it could be estimated that there would have been a reduction in total vehicle-occupant deaths of something like 16% if all seat belts available had been worn, and if a similar pattern of accident survivability continues, then a similar conclusion would hold for subsequent years. If, however, some allowance is made for inaccuracy in predicting survivability and if the actual wearing rate of seat belts (in fatal accidents) is 75% of those fitted (the reported rate for the first quarter of 1972), then the likely reduction is reduced to just over 10%.

However, a factor which would affect this estimated reduction in deaths is the increasing number of cars in which seat belts are fitted; naturally, as more seat belts become available for use, greater reductions should be expected. An analysis of the proportion of cars in fatal accidents fitted with seat belts indicates that there was an increase from just on 50% in 1971 to 62% in the first quarter of 1972. Not all of this increase is attributable to the Australian Design Rule requirements for new cars, as there is evidence that there has been a considerable degree of voluntary retrospective fitting of seat belts to older cars: a survey in May, 1972, of 978 passenger cars and derivatives parked in the Rosebery area showed a fitting rate of 76% to front outer seats, with 16% of vehicles having belts fitted to all seats.

¹ In order to assess "survivability", a set of objective criteria were developed around the factors stated to have been operating in each crash. When assessments based solely on these criteria were compared with the actual results of fatal crashes in which seat belts were known to have been worn by the deceased, it was found that in 85% of cases the assessor rightly judged that the occupants in question would have been killed.

Design Rule 4 (seat belts for front seats) was enforced in New South Wales from January 1, 1969, and applied to rear seats from January 1, 1971, Approximately one-third of the passenger cars now on the register will on this basis have had seat belts fitted in the front as original equipment, and this proportion will rise at the rate of 7-8% per annum over the next three years. For rear seats, only 15% of currently registered passenger cars will have had belts fitted as original equipment.

No accurate figures are available on a State-wide basis as to the number of belts fitted as original equipment before these dates, or for the number of belts fitted voluntarily but clearly a very large number have been. Around one million lap/sash seat belts are produced for "retrofitment" each year in Australia, of which about 400,000 would be destined for New South Wales. Assuming that these would normally be sold in pairs, this is equivalent to fitting out the front seats of about 200,000 used cars each year, or 10% of the car population.

Assuming that the seat-belt fitting rate for vehicles involved in fatal accidents remains at 62%, and if the 85% accuracy of prediction used previously and the observed 75% wearing rate in fatal accidents are used as a basis for calculation, the overall real reduction in vehicle-occupant deaths to be expected would be 13.6%. If, on the other hand, instead of remaining at the observed value for the first quarter the fitting rate in fatal accidents increased to 68% and the wearing rate increased to, say, 85%, then the overall reduction in occupant deaths to be expected would be about 20%.

Effect on wearing rate

The ultimate objective of this legislation can be taken as the saving of lives, but to fulfil this aim a necessary prerequisite is the raising of the proportion of car occupants using those seat belts which are available to them.

Surveys of seat-belt wearing in daylight commuter traffic, during off-peak times and in shopping traffic, showed that the overall wearing

rate of seat belts in front seat positions rose from levels of around 25% before the legislation to around 75% very soon afterwards, equivalent to an almost 100% wearing rate from those vehicles with seat belts fitted.

Previous attempts in this country and overseas to increase voluntary wearing rates by propaganda have been unsuccessful. It is reliably reported that the \$51 million multi-media advertising campaign conducted during 1968 in the United States to persuade occupants to wear seat belts did not raise the wearing rate from the disappointingly low level before the campaign, and, more recently, tightly controlled research in American on the effect of television propaganda messages has led to similarly pessimistic conclusions. It does appear, as predicted in TARU report 2/71, that the only way to markedly increase the wearing rate of seat belts is to make wearing compulsory.

Public opinion

Public and mass media opinions have been in almost universal support of this legislation, an effect which might have been forecast by the Traffic Accident Research Unit's earlier finding that there was widespread acceptance of the benefits of seat belts. By mid-1971, the general attitude could have been summarised as : "I know seat belts are good, even though I don't usually wear them; but I will when they're made compulsory".

There have been some comments that the feeling of security engendered by seat belts would promote reckless driving, but this view has been countered by others who opine that the general use of seat belts stimulates an awareness of the importance of traffic safety. Neither view has been tested empirically.

Requests for exemption from wearing belts have been very small in number, totalling only 262 in all. In only three cases was exemption granted, and in 104 cases exemption was already covered by the wording of the regulation.

Effect of legislation on fatalities in New South Wales

The seat-belt wearing rate has been trebled, and there has in addition been a "spin-off" effect manifest by a considerable amount of voluntary fitting of seat belts to older cars by their owners.

To a very large extent the objective of this legislation appears to have been fulfilled - that is, that car occupants involved in survivable crashes who have donned seat belts because of the regulation are now having their lives saved.

A comparison between the fatal accidents which occurred in 1971 and those which occurred in the first quarter of 1972 shows that, in 1971, 297 (38.3%) of the 775 deaths in passenger cars and derivatives were judged as occurring in crashes which could have been survived if a seat belt had been worn. However, in the first quarter of 1972 this percentage dropped to 25%, an indication that because of an increase in seat-belt wearing fewer people were being killed in survivable crashes.

A direct comparison between the number of occupants of passenger cars and derivatives killed in the first quarter of 1971 with those killed in the first quarter of 1972 shows a reduction from 172 to 133, or 23%.

Cumulative weekly totals of deaths to occupants of all types of vehicle are depicted in Figures 1 and 2, in association with lines fitted to the data in order to demonstrate general trends over particular time periods. The "trend line" for the period from the week ending July 5, 1970 to the week ending October 31, 1971 (immediately preceding compulsion) shows an excellent fit. By extension to this line, predictions as to future numbers of deaths can be made. In this way, by extending the line to the week ending July 2, 1972, a cumulative total of occupant fatalities of 418 might have been predicted if circumstances had remained unchanged.

VEHICLE OCCUPANT FATALITIES (CUMULATIVE TOTAL)

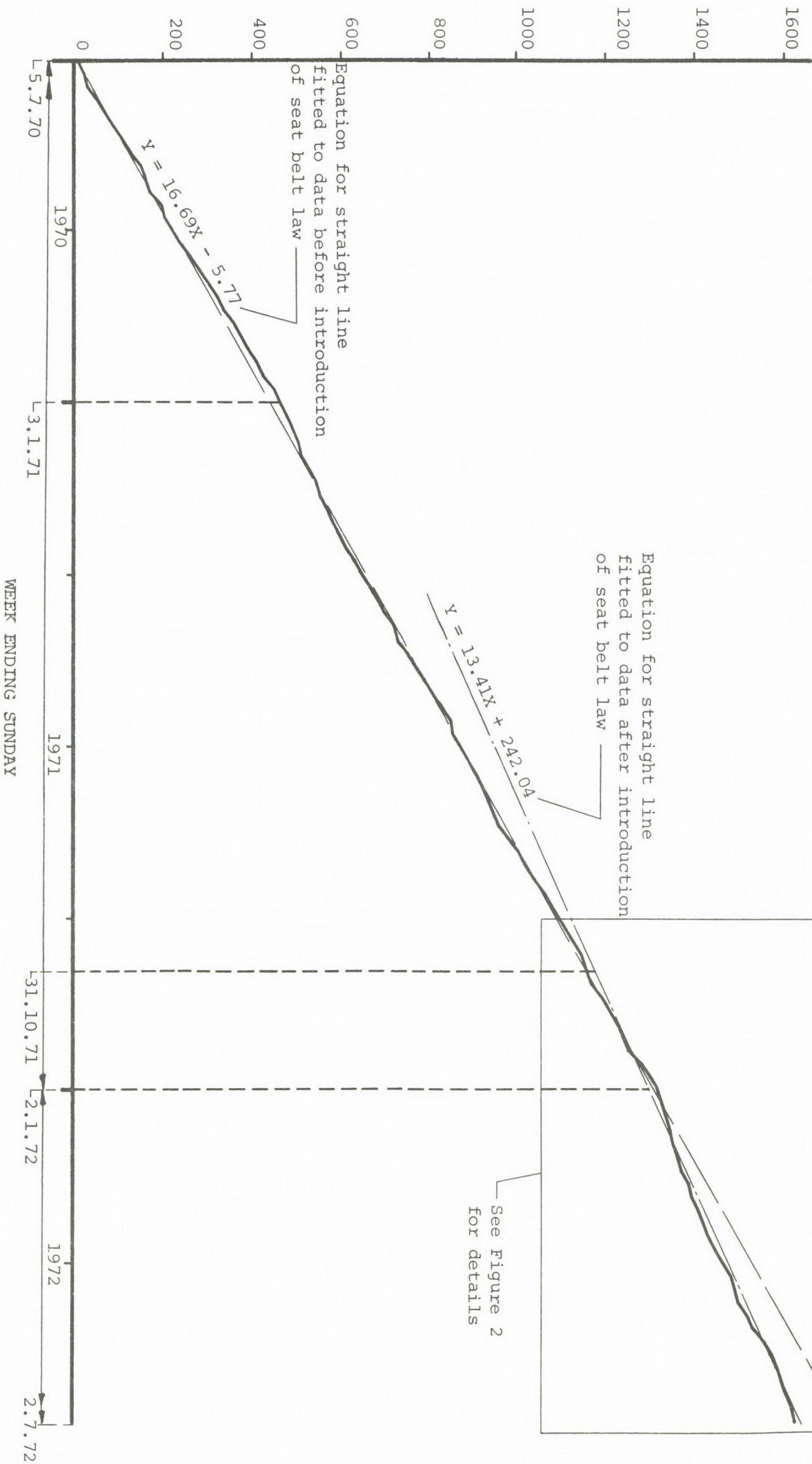


FIGURE 1 : TRENDS FOR CUMULATIVE WEEKLY TOTALS OF ALL VEHICLE OCCUPANT FATALITIES, BEFORE AND AFTER INTRODUCTION OF SEAT BELT LAW

- Notes (1) Predicted from trend established before seat belt law
- (2) Predicted from trends established after seat belt law

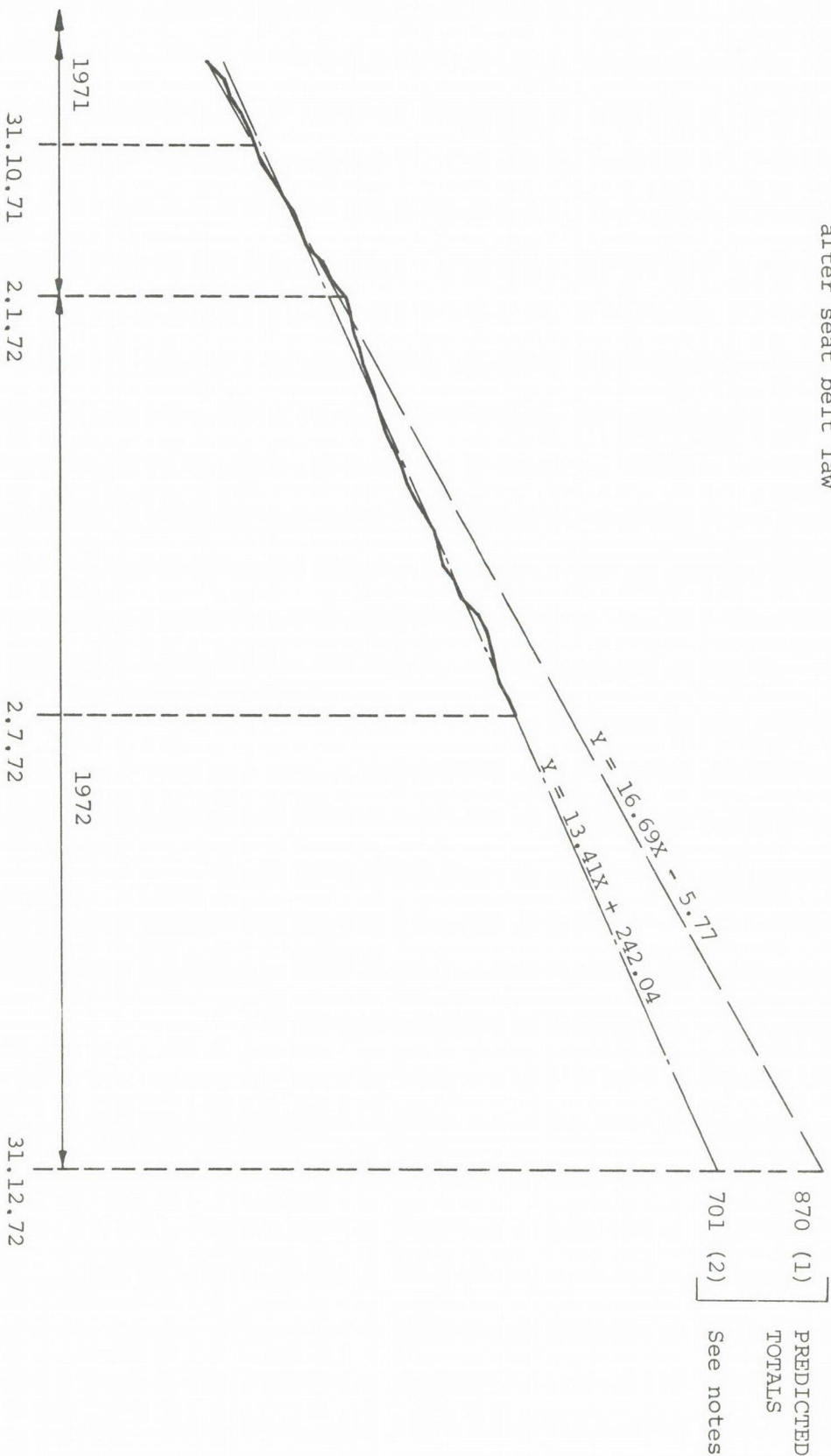


FIGURE 2 : Prediction of 1972 Total Vehicle Occupant Fatalities

In fact, however, the actual cumulative total for the period to the week ending July 2 was 332, or 86 fewer than might have been predicted. If the period January 1 to July 2, 1972, is compared to the same period in 1971 the actual drop in fatalities is found to be 88, a figure virtually identical with that which could have been predicted by projection of the "old" trend line. This is because at around the turn of the year 1971/72 there was a deviation in the steadily climbing trend of occupant deaths, and a new linear trend has been established which is equivalent to a constantly-maintained decrease in vehicle occupant deaths of about 20%.

The law requiring seat-belt wearing came into enforced operation on November 1, 1971, but the deviation downwards is not apparent until the turn of the year. The intervening period might be regarded as one of transition, during which time vehicle occupants became accustomed to belt wearing and the wearing rate built up to its present high level. However, even if a trend line is fitted to the date from November 1 onwards, the new trend still indicates a similar reduction of 20% in occupant deaths and, if maintained, predicts that the total number of occupant fatalities in 1972 will be about 700 instead of the value of 894 which could have otherwise been reliably predicted by the previous annual trend established over the past 20 years. This is an unprecedented drop, but one which is very closely in accord with that already reported for Victoria.

Discussion and conclusions

The compulsory wearing of seat belts legislation has trebled the wearing rate of seat belts, which in turn has resulted in a reduction in deaths among vehicle occupants of about 20%. That a similar reduction either in the number and/or severity of injuries in non-fatal crashes has taken place is almost certainly so. However, at this stage it is not possible to properly assess injury reduction in detail.

There still remain something like 400 deaths per year which occur in crashes judged as being unsurvivable even when a seat belt is properly worn. Crashes assessed as being unsurvivable but in which seat belts were available can be categorized as follows:

Collision with tree or pole at roadside	30%
High speed frontal impact or side-swipe with car	23%
Side impact in angle collision with other vehicle	21%
High speed collision with other fixed object or rollover	10%
Frontal impact with heavy commercial vehicle	7%
Other types	5%
Penetration of occupant space by fixed object	4%

Crashes in which vehicle occupants are killed are characteristically regarded as high-speed collisions involving tremendous exchanges of energy. However, even preliminary examination of the results of the fatal crashes which are now occurring, after the introduction of the new regulation, reveals that a high proportion (probably more than half) of the deaths are associated with massive deformation, intrusion and sometimes destruction of the occupant space at relatively low impact speeds.

If continuing inroads are to be made on the number of people killed in cars, then the group of most immediate concern is composed of vehicle occupants who die when wearing seat belts. The poor resistance to side intrusion in most current models (even in collisions with identical vehicles) and the ease with which solid objects such as trees and poles cause such devastating structural deformation indicate that strengthening of the passenger space and lessening the hostility of the environment have become areas of prime concern since the introduction of this legislation.

The influence of the Australian off-side priority system on the incidence of right-angle crashes has never been properly examined, but

the results of the current priority road experiment in Sydney may prove enlightening. Certainly, a rational priority system, designed in accordance with driver expectations and capabilities, should minimize the number of collisions which result in intrusion of the passenger space from the side.

Clearly, however, in those side impacts which do occur, those occupants who are wearing seat belts are being afforded little protection thereby, and therefore the effects of American legislation which proposes minimum standards for side intrusion should be examined as a matter of urgency.

Further, a rigid roadside pole can destroy a car whereas a "breakaway" pole cannot. Guarding, moving, reconstructing or modifying roadside obstacles could save hundreds of lives over the years. As a measure of the potential savings, the cost to the community of the 120 or so deaths which occur in collisions with trees and poles in New South Wales is approximately \$6 million, and this does not include the costs in injury and property damage. On the fact of it, therefore, similar expenditure in countermeasure programmes could be justified.

Summary

The New South Wales legislation requiring the wearing of seat belts when fitted to cars has been associated with a sudden, but sustained, drop in vehicle occupant deaths of 20% in this State.

Further improvements in occupant protection must be sought in increasing resistance to deformation of the vehicle passenger space, together with improved restraints to obtain maximum advantage of this, and reduction of the hostility presented by rigid obstacles at the roadside. It is fair to assume that the seat-belt legislation will in fact be as successful as is now hoped, and therefore these other improvements to the system - which can only be implemented over a comparatively long term - should be considered without delay.