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TRAFFIC ACCIDENT RESEARCH UNIT

# AN ASSESSMENT OF MEASURES TO REDUCE CYCLIST AND MOTORCYCLIST ACCIDENTS

GORDON F. MESSITER,
B.Sc. (Tech.), M.Eng.Sc., M.I.E., Aust.

DEPARTMENT OF MOTOR TRANSPORT NEW SOUTH WALES

The Traffic Accident Research Unit was established within the Department of Motor Transport, New South Wales, in May 1969 to provide a scientific approach to the traffic accident problem.

This paper is one of a number which report the results of research work undertaken by the Unit's team of medical, statistical, engineering and other scientists and is published for the information of all those interested in the prevention of traffic accidents and the amelioration of their effects.

D. R. Coleman

Commissioner.

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Introduction

It seems inconceivable nowadays that the number of pedal cyclists killed on our roads could ever have exceeded either the number of motor vehicle drivers or the number of motorcyclists killed. However, this was the case in New South Wales immediately following World War II.

It was from this time that the number of drivers killed began its relentless climb as the motor car became more and more a part of everyday life. In contrast, the number of pedal cyclists killed has maintained a steady and virtually linear downward trend to become, today, an almost insignificant part of the total traffic accident problem. Pedal cyclists now represent less than 2% of the total traffic accident fatalities despite a recent massive increase in the number of bicycles sold.

The motorcyclist death pattern, however, has since 1945 exhibited quite unique characteristics. Up until 1951 the annual number of motorcyclist deaths increased at a higher rate than driver deaths to reach an all-time high of 145 during that year. No doubt, this was related to usage of the motorcycle particularly by the young male. Even the following year, the number of motorcyclist deaths, 124, was still the highest for any single class of road user. Nevertheless, a decline in motorcyclist deaths had begun and this was to continue until 1963 when the total number killed reached an incredible low of 18 (see Figure 3).

Drastic changes in the socio-economic factors affecting road transportation, however, have brought about a resurgence of motorcycle usage since 1963, which has inevitably led to an increase in the number of motorcyclists killed. While not reaching the proportions of 1951, the problem of the motorcycle in the road-use system has once again become significant with the annual number of motorcycle rider deaths exceeding 100.

While presently representing only about 8% of the total number of road traffic accident fatalities, motorcyclist deaths are unique as a class in that those killed are almost exclusively young males. Because of this the motorcyclist could be considered as a special case of the young driver or, more specifically, of the young male road user.

The "young male" first appears on the traffic accident scene as a pedestrian. While a pedestrian, his involvement rate (per capita) as a traffic accident casualty is twice that of the female until the age of about twelve years, after which his involvement parallels the female until he reaches adulthood. In the later years of life, pedestrian casualties exhibit their own peculiarities of age/sex distribution.

From about the age of nine years, the young male plays a dual role as a traffic accident casualty when he begins his first experience with wheels as a bicycle rider. It is at this stage that his over-involvement gathers momentum. As a bicycle rider his casualty involvement rate is more than ten times that of the female, and is at a peak around the age of puberty. He persists with the bicycle only till he reaches driver licence age; he then transfers his male youthfulness in the road-use system to the motorcycle or car.

During the period of his striving for manhood his traffic crash involvement rate as a car driver is about eight to ten times that of the female as a fatality, and about five times that of the female as a casualty.

However, as a motorcycle rider his involvement as a fatality is many times greater than the female, who very seldom appears as a fatality; the ratio of male riders to female riders injured is about seven to one.

It is of course recognized that the crude numbers of casualties do not take account of the relative exposure of the sexes. Yet it is the very exposure to accidents, through usage to excess of vehicles in the road-use system, that is part of the male youthfulness syndrome. Nevertheless, when some measure of exposure is applied as a control, the young male still maintains his relative overinvolvement as a traffic accident casualty. Foldvary[2] found that for drivers in metropolitan Brisbane, the rates of involvement in accidents, both casualty and property damage, were about three times higher for males in the under 20 age group. In fact, even up to the age of about 40, the male driver retains a two to one involvement ratio over the female.

Reliable measures of exposure to risk in the road-use system, even in such crude terms as gross mileage travelled or total time exposed, are sadly lacking for most of the different categories of road users. This is particularly so for motorcyclists and pedal cyclists. Before any realistic and meaningful comparisons can be made between the sexes, between age groups, or, more pertinently, between the various classes of road users, measures of relative exposure both qualitative and quantitative are required.

In considering the traffic accident problem either in an overall sense or for a particular section of it, the problem can be defined and quantified by reference either, for instance, to the crude numbers of deaths, or to a rate which expresses some measure of exposure such as deaths per mile travelled or per vehicle registered for use on the road. At any given point in time, traffic accident countermeasures are aimed at balancing the number of accidents, deaths or injuries against competing social demands for greater safety as well as continued mobility. This can be achieved by reducing the quantity of exposure, by improving the quality of the exposure or by a combination of both.

For example, if there is a direct causal link between the number of traffic accidents which occur in the road-use system and the mileage travelled on roads, then the reduction in the quantity of exposure by reducing the mileage travelled will result in a reduction in total traffic accidents. Similarly, because the number of traffic accidents on say divided roads is lower than on non-divided roads, all other factors being equal, the conversion of existing non-divided roads to divided roads would be an improvement in the quality of exposure which will similarly result in a reduction in the total number of traffic accidents.

The topic of this paper concerns specifically cyclist and motorcyclist accidents, and assessment of measures to reduce them. Countermeasures aimed at reducing the quantity of exposure as well as those which improve the quality of exposure by reducing the risk of involvement per unit measure of exposure quantity will be discussed as will reduction of severity of the outcome of the collisions which do occur. These pre-crash and crash phase countermeasures will be related to the human, vehicle and environmental aspects of the road-use system.

Motorcycles - The Problem

There were 104 motorcycle riders and 17 pillion passengers killed in road traffic accidents on New South Wales roads during 1971. The total for these two classes of road users represents 9.7% of the total traffic fatalities for that year. By comparison, 470 drivers and 395 passengers of other motor vehicles were killed.

The popularity of the motorcycle has risen rapidly since the hiatus of 1964. The total number of motorcycles registered for use on New South Wales roads has, since then, risen over 300% from 14,887 to a projected total of approximately 65,000 at the end of 1971. This surpasses the previous peak of 40,214 in 1951. (See Figure 1). The number of motorcycle licences on issue has followed a similar trend, reaching a peak in 1952 of 68,630, falling steadily to a low of 33,724 in 1963 and rising rapidly to a projected total of over 100,000 at the end of 1971. (See Figure 2).

While this spectacular revival of the motorcycle has brought with it an increase in motorcycle accidents and casualties, the number of motorcycle riders killed per 10,000 motorcycles registered was 18.2 in 1971, whereas during the 1951 peak this rate was 37.7. The relatively low death rate for the new motorcycle generation was no doubt due to the wearing of crash helmets, an accepted part of the motorcyclist's equipment today but almost unheard of in the fifties. However, the total casualty rate (killed plus injured) per 10,000 motorcycles registered has remained relatively constant over the past 20 years, although there has been a disturbing upswing apparent over the last five years[6].

Just over a quarter of all road traffic accidents reported are casualty accidents. Of motorcycle-involved accidents, however, about 80% are casualty accidents. Usually it is the motorcyclist who is the only casualty. This high rate of injury infliction per accident is no doubt due to the vulnerability of the motorcyclist when involved in a collision with a vehicle or a fixed object. The kinetic forces and kinematics of such collisions make it almost inevitable that injury and sometimes death will result even at fairly moderate collision velocities. This is apparent in the analysis of the location of motorcycle accidents. It has been reported both in Australia[6] and overseas[8] that approximately two thirds to three quarters of motorcycle accidents and deaths occur in urban areas subject to speed limits of as low as 35 mph.

Close to 80% of motorcycle accidents in 1971 involved collisions with other vehicles. A detailed study of fatal motorcycle accidents for 1970 and 1971 has been undertaken, and the data show that 20.5% were right-angle collisions at intersections, 13% involved another vehicle turning right across the path of an oncoming motorcyclist, and 6% resulted from other turning movements with the vehicle and motorcycle travelling in the same direction. 12.4% of the accidents were rear-end collisions, in most of which cases the vehicle collided with the rear of the cycle. 15.7% were same direction sideswipes. Single-vehicle accidents totalled 27.1%, and could be subdivided into 11.4% where the motorcycle collided with a fixed object or parked vehicle, and 15.7% where the motorcycle overturned or ran off the road.

Inexperience of the rider is a predominant factor in motorcycle accidents. Of the 1970 and 1971 motorcycle rider deaths the following distribution of riding experience was noted:

| Years of rider experience | Percentage of rider deaths |
|---|---|
| 0 - 1 | 60% |
| 1 - 2 | 14% |
| 2 - 3 | 9% |
| 3 - 4 | 5% |
| over 4 | 12% |

Youth and inexperience, particularly in combination, are by far the most important common factors in motorcycle deaths. This aspect of the problem, however, is not unique in this country as Harano and Peck[5] in their California motorcycle study reported similar findings.

The role of alcohol in motorcycle accidents is difficult to quantify. The reported findings vary significantly. Raeder and Negri[10] reported that in a study of 7911 casualty accidents which occurred during 1966 and 1967 in New York State only 69 or 0.9% of the motorcycle operators had been drinking to some degree. At the other end of the scale Graham[4], in a study of 352 motorcycle riders and/or passenger fatalities in Los Angeles County during the five year period 1962-1966, found that of the

193 motorcycle operators surviving less than six hours, only 54% had no measurable blood alcohol. 35% had blood alcohol concentrations greater than 0.10 gm% with 11% greater than 0.2 gm%.

In between these two extremes Jamieson and Tait[7] in their survey of Traffic Injury in Brisbane (1962-63 accidents) reported that in the 103 investigated accidents involving motor-cycles, 16 riders were under the influence of alcohol, although no quantification of this was reported.

The effects of alcohol on the operation of a road vehicle would, intuitively, be expected to have more detrimental effects for motorcycles than for four-wheeled vehicles. The lack of inherent stability in the motorcycle requires considerable rider skills in motor co-ordination and balance for its riding, which are not called for in driving other vehicles. Alcohol has a marked effect on these faculties and therefore it would be expected that the likelihood of crash involvement of a drunk motorcyclist would be many times that of an equivalent car driver.

The environmental factors associated with motorcycle fatal accidents do not differ all that much from fatal accidents involving other vehicles. Factors such as time of day, day of week and so on, while exhibiting some minor differences between motorcycle and other vehicle fatal accidents, are remarkably similar for these accidents. Perhaps the only major difference between these classes of vehicles in the accident situation is that, like pedestrian accidents, motorcycle accidents are several times more severe than other vehicle accidents in terms of casualties per accident.

In this work two interesting aspects of the motorcyclist fatal accident problem have emerged, both of which have a socio-economic background. One is related to the occupation of riders killed, and the other is related to the trend in the age groups of persons killed as riders and drivers.

The occupations of motorcycle riders have been analysed for the years 1965, 1970 and 1971. In 1965 28 motorcycle riders were killed. Just over half of those killed for whom occupations were stated, were in the occupation category which included craftsmen, production-process workers and labourers. Of these about half were labourers. (See Table 1)

A similar pattern emerges for 1970 and 1971 when 48 (55%) of the 86 stated occupations in 1970 and 56 (57%) of the 97 stated occupations were in the same category. Again, about half of these were labourers. The next largest single occupation category was that denoted by the Bureau of Census and Statistics as "not in work force". Students and those stated as unemployed are included in this category.

Riders killed with stated occupations in these two largest categories account for 65% of the rider fatalities for which occupations were reported in 1965, for 64% in 1970, and for 75% in 1971.

The trend in the relationship between riders and drivers killed in the various age groups since 1945 is illustrated in Figure 4. It is evident that the percentage of riders in the driver/rider fatality group was extremely high for the young age groups immediately after World War II and remained so until about the 1951 peak. In 1951 nearly 85% of vehicle operator fatalities in the under 20 age group were riders. This percentage fell rapidly as motorcycle usage tailed off to its low point in the mid-sixties, when it reached less than 15%. However, with motorcycles regaining popularity with the young, the percentage of riders as operator fatalities has again risen to the point when more than 40% of the under 20, vehicle operator fatalities are motorcycle riders.

Bicycles - The Problem

Road traffic accidents involving pedal cyclists represent about two percent of the total occurring on New South Wales' roads. They form by far the smallest category of accidents. In many ways they are more a special case of the pedestrian accident than a separate category of their own, particularly with regard to present usage patterns.

Bicycle riding, like motorcycling, has of late experienced a massive resurgence. Late in 1967 the so-called high riser style of bicycle was introduced in significant quantities to the

Australian market. The introduction of this style of bicycle was associated with a revival of the popularity of the bicycle, particularly among the school-age groups. As a measure of this growth, data on Australian bicycle manufacture are shown in Figure 5.

From 1966/67 the demand for bicycles increased the number of new bicycles manufactured in Australia from a fairly constant level since 1960/61 of about 60,000 per year, to a peak of nearly 130,000 in 1969/70. It is estimated by the major New South Wales manufacturer, General Accessories, that approximately 60% of new bicycles manufactured are of the high riser style. Added to this Australian manufacture is a total of approximately 8,000 imported bicycles.

Despite this large increase in bicycle numbers and bicycle usage, a phenomenon similar to that for motor cycles, the number of road traffic accidents resulting in bicycle rider casualties has fallen steadily over the past ten years, and is now at its lowest point since 1945. (See Figures 3) Bicycle rider fatalities have maintained a stable downward trend over the past 26 years (See Figure 5).

One of the major reasons for maintaining the relatively low number of bicycle rider casualties over the past five years, even though the vast increase in the bicycle population could be expected to produce a significant increase, is that the expansion in usage has so far been confined to the younger age groups. Moreover, a large and increasing proportion of the bicycles in use are of the high riser style, which because of their characteristics, are not used for touring or long journeys. These bicycles are mainly playthings which are used more in off-road areas and quiet suburban streets than on the more heavily trafficked roads. Hence, exposure to conflict with other road vehicles is limited.

To make some determination of the many factors operating in accidents involving pedal cyclists a small sample (50) of accidents resulting in pedal cycle casualties which occurred in the last half of 1971 were examined in detail. Characteristic patterns were observed in age of rider, time of day and day of week.

As was expected, the younger age groups were the most affected, 74% of the casualties being aged between 5 and 16 years of age. 84% of the accidents occurred on week days, with 76% of the total occurring in the afternoon or early evening. The involvement of adult cyclists appeared higher in country centres.

A study of the reported injuries, as would be expected from the kinetic forces and kinematics of a vehicle/cycle collision, indicated that most injuries sustained by the cyclist resulted from being struck directly by the vehicle or by contact of the cyclist with the roadway surface. Very few of the injuries, if any, could be attributed directly to the bicycle constructional features.

Pellegrino[9] in a study of injuries resulting from motorcycle (440) and bicycle (177) accidents in Wisconsin noted that 36.7% of the total bicycle riders injured had head injuries, 96% had extremity injuries (divided almost equally between upper and lower) and 4.5% had trunk injuries.

Motorcycle Accidents - Pre-crash Countermeasures

The relatively lower costs of mobility afforded by the motorcycle, the sense of freedom the rider experiences and the temperate climate of this country are at the root of the attractions to this form of transport for the young male. Overinvolvement in accidents and risk of death or serious injury are the only costs of any significance in motorcycling.

When motorcyclist deaths and injuries were at their peak in 1951, the only countermeasures applied were the more traditional punitive legal and economic sanctions, which in time were successful in reducing motorcycle deaths. However, the result of the massive enforcement campaign and the disproportionate increase in insurance and registration fees was in effect to transfer the motorcycle riders into cars. While some short-term effect may have been achieved while the younger riders found the money to move up into the motor car, the overall upward trend in total deaths and injuries remained quite stable. (See Figure 6)

The 'comeback' for the motorcycle heralded a new need for the application of countermeasures. However, this time a more rational and in the end acceptable countermeasure was applied. Rather than aim at the repressive reduction in quantity of exposure, the basis of the previous methods, an attempt was made to improve the consequences of exposure by reducing the likelihood of serious or fatal head injuries with the use of a crash helmet.

Wearing of crash helmets by motorcyclists became compulsory in Victoria in 1961 and although New South Wales did not introduce compulsion until October, 1971 a substantial and increasing rate of voluntary wearing was in evidence in the new motorcyclist generation. The efficacy of this simple and self-enforcing countermeasure has been demonstrated by Foldvary and Lane[3]. Other gross measures such as motorcycle fatality rates show the vast differences between the pre-helmet fifties and the present day, due in no small way to crash-helmet wearing.

However, if the motorcycle is to remain in the road-use system, and there are plenty of arguments to support this belief, modifications to the system will be necessary to provide compatibility between the motorcycle, its rider and the rest of the system.

Lack of skill and experience in handling a motorcycle are clearly major causal factors in crashes. When this is coupled with male youthfulness the results are predictably disastrous. There seems to be some evidence for the need for off-the-road rider training before even a road learner's permit is issued. Because of the predominance of lack of skill and experience in a large proportion of motorcycle accidents and fatalities, the potential for pay-offs from spending on rider training is considerably greater in terms of costs and benefits than for the education of other road users, and it could rank very highly as a countermeasure.

Another major factor in motorcycle accident causation is the apparent difficulty of perception by drivers of a motorcycle in a conflict situation. It has been suggested that the overall size and shape of the motorcycle and its rider are such that the criteria for reliable perception are frequently not met. It is on this basis that many researchers have proposed the daytime operation of headlights by motorcycle riders.

Janoff et al[8] evaluated the effect of daytime use of motorcycle headlights and tail lights on motorcycle accidents, motorcycle noticeability and motorcycle electrical systems. They concluded that a significant decrease in daytime motorcycle accidents occurred in four American states with daytime headlight laws. Daytime noticeability was increased significantly with headlights on, but no increase occurred for tail lights on. In the study it was found that most motorcycles, particularly the major Japanese models, had adequate electrical systems for extended daytime headlight and tail light operation. An economic analysis of daytime headlights yielded a benefit/cost ratio greater than 1.

Following the methods used by Janoff et al a similar economic evaluation of the use of headlights in the daytime has been made for New South Wales.

Based on a projected motorcycle population of 65,000 for 1971, an estimated 71% of which comprises the Japanese makes Honda (40%), Suzuki (18%) and Yamaha (13%), and an estimated average annual mileage of 5000 miles per motorcycle with 160 hours of daytime operation, the total annual cost of daytime headlights would be approximately $780,000 or $12 per registered motorcycle.

Assuming a ratio of 20 injury accidents to 1 fatal accident, and costs of these to be $2,500 and $50,000 respectively (an estimation based on the work of Butlin and Troy[1]) for motorcycle casualty accidents, a reduction of 5% in casualty accidents would yield a cost/benefit ratio of 1.

It should be noted that Janoff reported a 41.3% reduction in daylight motorcycle accidents, while night time motorcycle accidents were reduced 37.5%. The difference of 3.8% was attributed to the compulsory use of daytime headlights on motorcycles. When normalized by total motorcycle registrations this difference was 4.4%.

The current intersection priority rules in New South Wales provide an example of how in many ways the present traffic system is incompatible with motorcycle use. In operation the give way to the right rule is a dynamic priority rule which requires the vehicle to be in a conflict situation before priority is attained. The motorcycle, however, is often disregarded, or not perceived when in such a conflict situation. A static priority rule whereby the priority is inherent in the system by signals, signs or the like, would be particularly advantageous for the motorcyclist.

## Motorcycle Accidents - Crash Phase Countermeasures

Turning to the motorcycle itself it has been suggested by Wilkins[12] that anti-locking brakes could be justified economically in the U.K. if the cost was below about £30 Stg. per machine. However, before this finding could be applied in Australia it would be necessary to take into account the relative weather conditions and occurrence of accidents likely to be prevented by such a device.

The countermeasures discussed so far have their application in the pre-crash phase, except of course for the crash helmet. Safety for the motorcyclist in the crash phase, with the exception of the crash helmet, had been relatively unexplored until motorcycle collision experiments were conducted at the U.C.L.A. by Severy et al[11]. They summarize the situation succinctly when they state: "Except for the advent of protective helmets, there has been no significant improvement in motorcycle crash safety during this century".

The motorcycle is at a significant disadvantage in a collision situation. Its low mass relative to other vehicles and minimal structural protection for the rider usually result in the rider coming into direct physical contact with the other vehicle of the collision, thus sustaining severe injuries.

Fundamentally, in the crash phase the rider of a motorcycle can be likened to a high-speed pedestrian. As with the pedestrian the outcome of a collision in terms of injuries sustained depends on the nature of the impacted vehicle and the orientation of his body as it strikes first the vehicle and then the road surface or other fixed object or vehicle. Because of the high relative crash velocities which can occur because of the pre-crash velocity of the motorcycle, the injuries a rider receives on colliding with a vehicle are likely to be more severe than an otherwise comparable pedestrian or pedal cyclist.

Severy's work comprised a detailed examination of the motorcycle crash by the simulation of crashes with motor vehicles and analysing the relevance of motorcycle speed, size and weight, position of impact with car, and the usage of dummy head protection.

In studying the collision process the deformation of the motorcycle it was demonstrated by the experiments that motorcycle crash performance in terms of 'g' loads generated during the collision process was generally better than is encountered for passenger vehicles. However, as is pointed out, advantage cannot be taken of this characteristic because there is no provision either inherent or otherwise for the rider to remain in place as the motorcycle decelerates (c.f. the use of seat belts, padded dashboards, airbags and so on in cars.) Yet improvement in motorcyclist crash protection must evolve and, therefore, crash performance of the motorcycle will become increasingly important in its development.

The authors, from their observation, conclude that improvements in crash performance can be designed into the motorcycle. As an example they suggest extending and strengthening the front forks which, while not appreciably altering handling, would significantly improve the deformation distance and allow better crash energy absorption for the motorcycle. They cite a crash involving an exaggerated "chopper" style motorcycle in which the extended forks provided an extended deceleration time with lower magnitude of deceleration forces, and also during collapse elevated the front of the motorcycle, serving to slow the rider's pitch against the contacted car. The over 40 m.p.h. impact resulted in serious but not fatal injuries to the rider. The car was a write off.

From their analysis they considered that it would be impracticable to improve the sides of cars to attenuate the force of impact for motorcycles which may strike them. Thus, the suggestion is that any reduction in the injury-producing aspects of the motorcycle-to-car collisions should be accomplished through protective design improvements of the motorcycle.

Development of a passive restraint to provide 'ride down' of the motorcyclist during the collision process would lead to substantial reduction in injuries sustained was one of the more important conclusions of these collision experiments.

Two other observations by Severy are worthy of mention. One is that more suitable crash guards should be incorporated in motorcycle design to prevent a crashed motorcycle from crushing the rider's legs when it falls over. The other is that all heavy trucks should be fitted with under-run guards along the sides as well as the rear. They argue that this would ameliorate the effects of car collisions as well as motorcycle collisions with these vehicles.

<u>Bicycle Accidents - Countermeasures</u>

It seems that special efforts directed to the reduction of pedal cycle accidents is uncalled for in the light of the small numbers involved. However, with the current growth in usage of bicycles, the potential for accidents will increase. Therefore, perhaps now is the time to examine the problem before it gets out of hand.

Yet there is very little that can be done. Licensing of cyclists is simply not feasible. Almost any argument for the licensing of pedal cyclists could be applied equally well to pedestrians, which would be an unmanageable task.

Virtually the only aspect of bicycle usage open to control which could lead to a reduction in their involvement in road traffic accidents is the area in which they are operated. It would seem that the bicycle and its predominantly young rider are more suited to the safety of the footpath than the hostile environment of the road where they are hopelessly out of scale with other traffic units. While it is recognised that the safety of the pedestrian on the footpath needs to be considered, the space available is usually more than ample for both to co-exist.

Recommendations

1. Motorcycles

(a) The daytime usage of motorcycle headlights and tail lights should be greatly increased, and the case for compulsion investigated.

(b) A pilot pre-road training scheme for motorcyclists should be developed and scientifically evaluated as a traffic accident countermeasure.

(c) The economic feasibility of the provision of anti-locking brakes for motorcycles operated on Australian roads should be investigated.

(d) Motorcycle manufacturers should be encouraged to develop passive restraint systems for the crash protection of riders. The air-bag may find further application here, as may the use of efficient crash guards to protect the rider when the motorcycle falls on its side.

2. Bicycles

(a) The feasibility of controlled use of the footpath area by the bicycle rider should be investigated and, where possible, encouraged.

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TABLE 1

Motor Cyclist Fatalities

| Bureau of Census and Statistics Classifications | | Year | | |
|---|---|---|---|---|
| Codes | Occupation Groups | 1965 | 1970 | 1971 |
| 1 - 12 | Professional and Technical | 3 | 5 | 4 |
| 13 - 14 | Administrative, Executive and Managerial | | 1 | |
| 15 - 17 | Clerical | | 2 | 9 |
| 18 - 20 | Sales | | 2 | 3 |
| 21 - 26 | Farmers, Fishermen, Hunters & Timbergetters | | 2 | 1 |
| 27 - 29 | Miners and Quarrymen | | | |
| 30 - 39 | <u>Transport and Communications</u> | | | |
| 31 | Ships Deck and Engine Room Hands | | 1 | |
| 33 | Railway Drivers and Firemen | 1 | 1 | 1 |
| 34 | Drivers, Road Transport | | 5 | 1 |
| 37 | Telecommunication Operators | | 3 | |
| 38 | Postmasters, Postmen, Messengers | 1 | 1 | 1 |
| 39 | Other Transport and Telecommunication Occupations n.e.c. | | | 1 |

TABLE 1 (Continued)

Motor Cyclist Fatalities

| Bureau of Census and Statistics Classifications | | Year | | |
|---|---|---|---|---|
| Codes | Occupation Groups | 1965 | 1970 | 1971 |
| 40 - 60 | Craftsmen, Production - Process Workers and Labourers n.e.c. | | | |
| 40 | Spinners, Weavers, Dyers, etc. | | 1 | |
| 41 | Tailors, Cutters, Furriers | | 1 | |
| 44 | Precision Instrument Makers, Watchmakers | | | 1 |
| 45 | Toolmakers, Machinists, Plumbers, Welders | 2 | 3 | 11 |
| 46 | Electricians, Electric and Electronic Workers | 1 | 2 | 3 |
| 47 | Metal Workers and Elect. Process Workers | | 11 | 3 |
| 48 | Carpenters, Joiners, Cabinetmakers | | 2 | 3 |
| 49 | Painters and Decorators | | 3 | 1 |
| 50 | Bricklayers, Plasterers, Construction | | 2 | 1 |
| 51 | Compositors, Pressmen, Engravers, Bookbinders | | | 3 |
| 53 | Millers, Bakers, Brewers, Food and Beverage | 2 | 3 | |
| 56 | Craftsmen and Production-Process n.e.c. | | | 2 |
| 57 | Packers, Labellers | | 1 | |
| 58 | Stationary Engine, Excavating, Lifting | | | 1 |
| 60 | Labourers n.e.c. | 7 | 19 | 27 |

TABLE 1 (Continued)

Motor Cyclist Fatalities

| Bureau of Census and Statistics Classifications | | Year | | |
|---|---|---|---|---|
| Codes | Occupation Groups | 1965 | 1970 | 1971 |
| 61 - 70 | Service, Sport and Recreation | 2 | 2 | 2 |
| 71 | Members of Armed Services | 1 | 6 | 1 |
| 72 | Inadequately described or not stated | 5 | 7 | 7 |
| 73 | Not in work force | | | |
| | Students | 3 | 7 | 11 |
| | Unemployed | | | 6 |

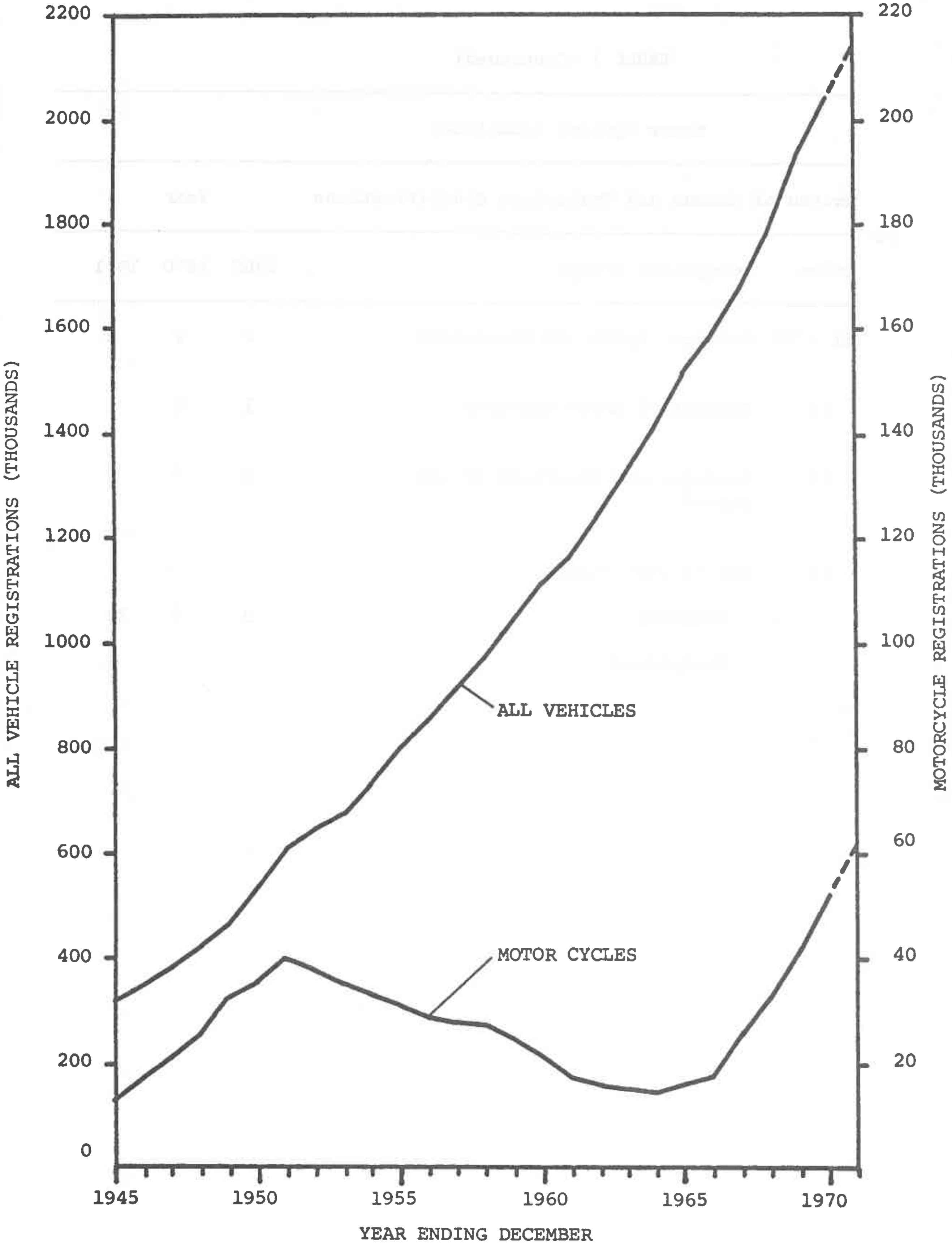


FIGURE 1

VEHICLE REGISTRATIONS (NEW SOUTH WALES)

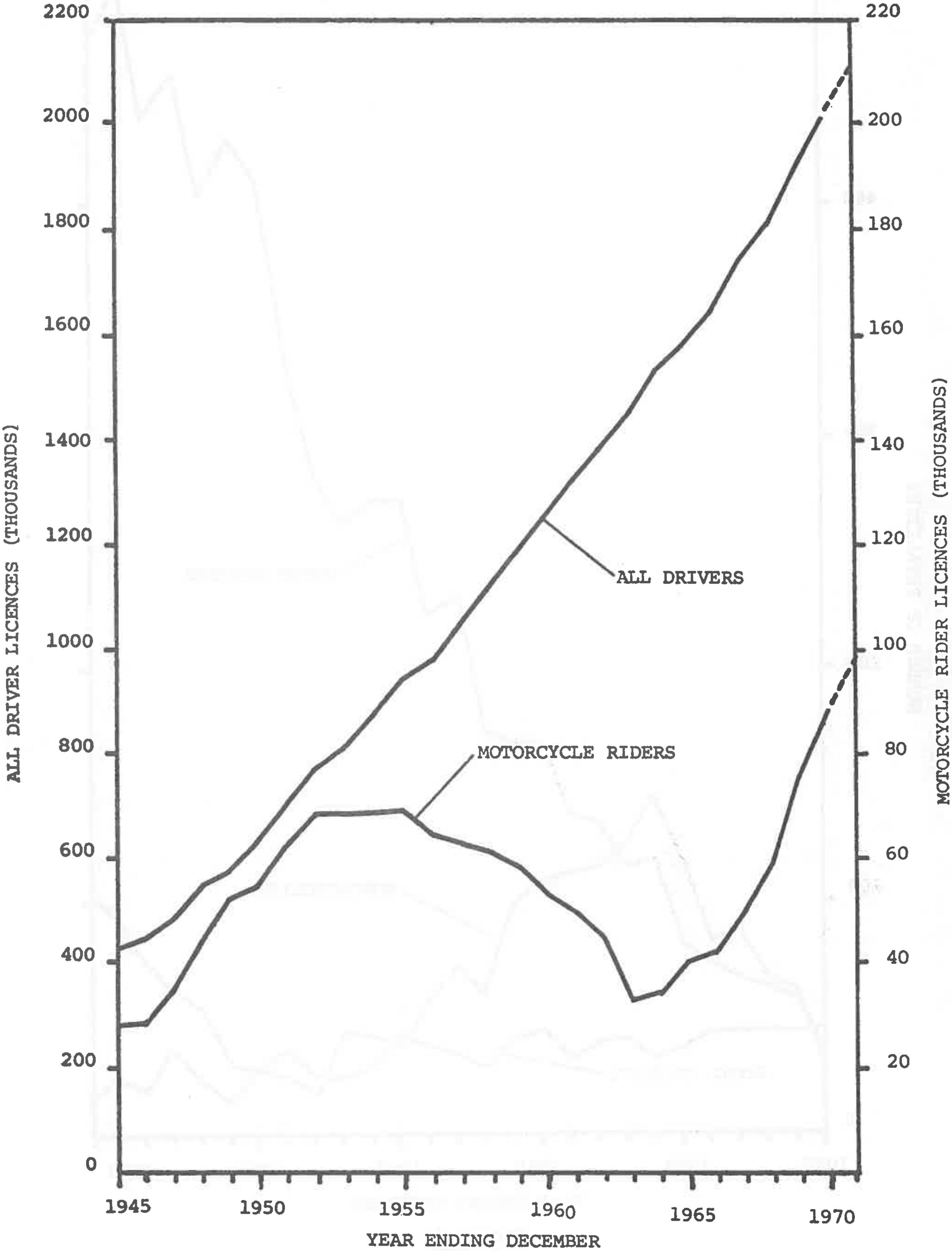


FIGURE 2

LICENCES ON ISSUE (NEW SOUTH WALES)

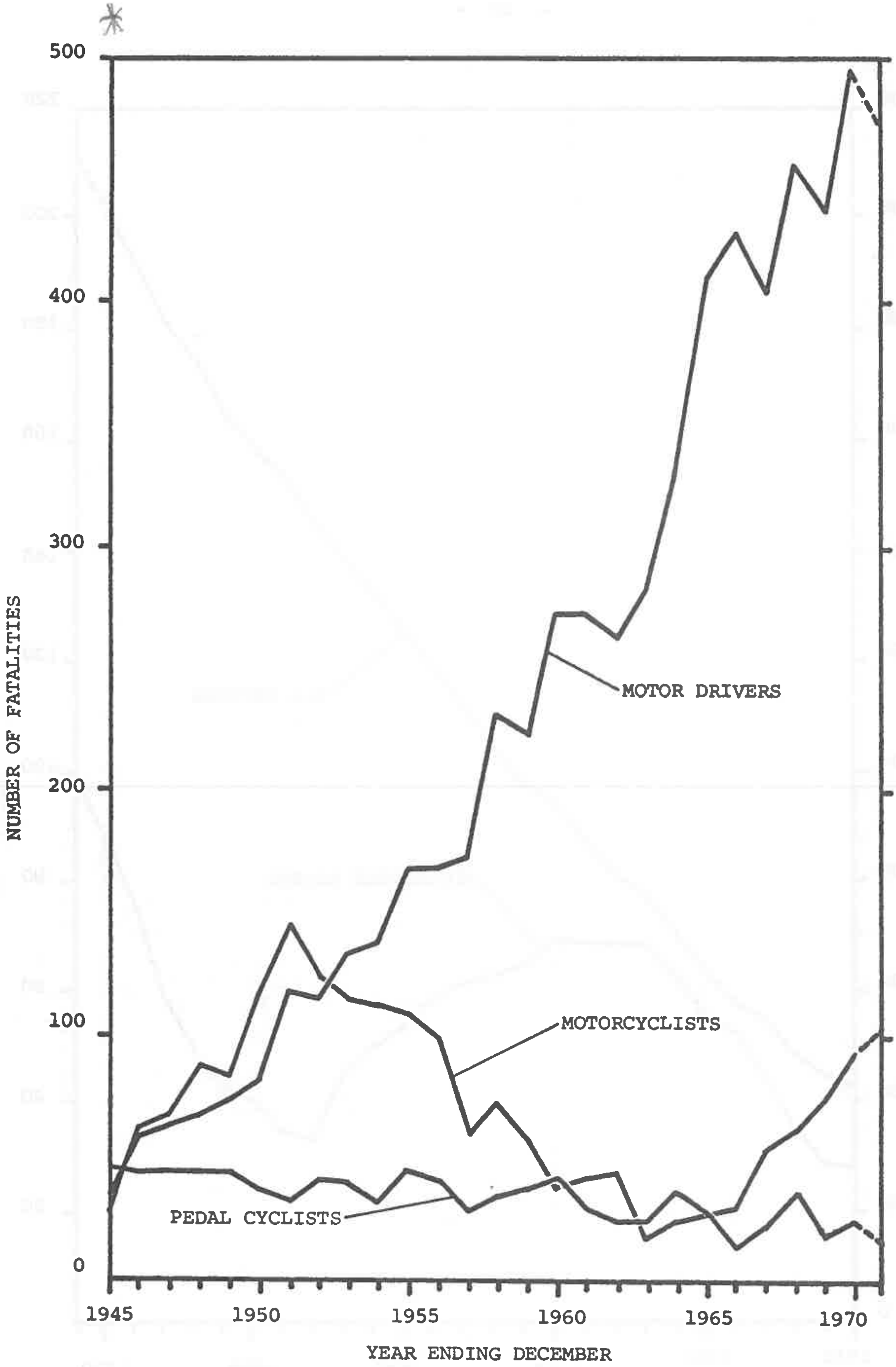


FIGURE 3

VEHICLE OPERATOR FATALITIES (NEW SOUTH WALES)

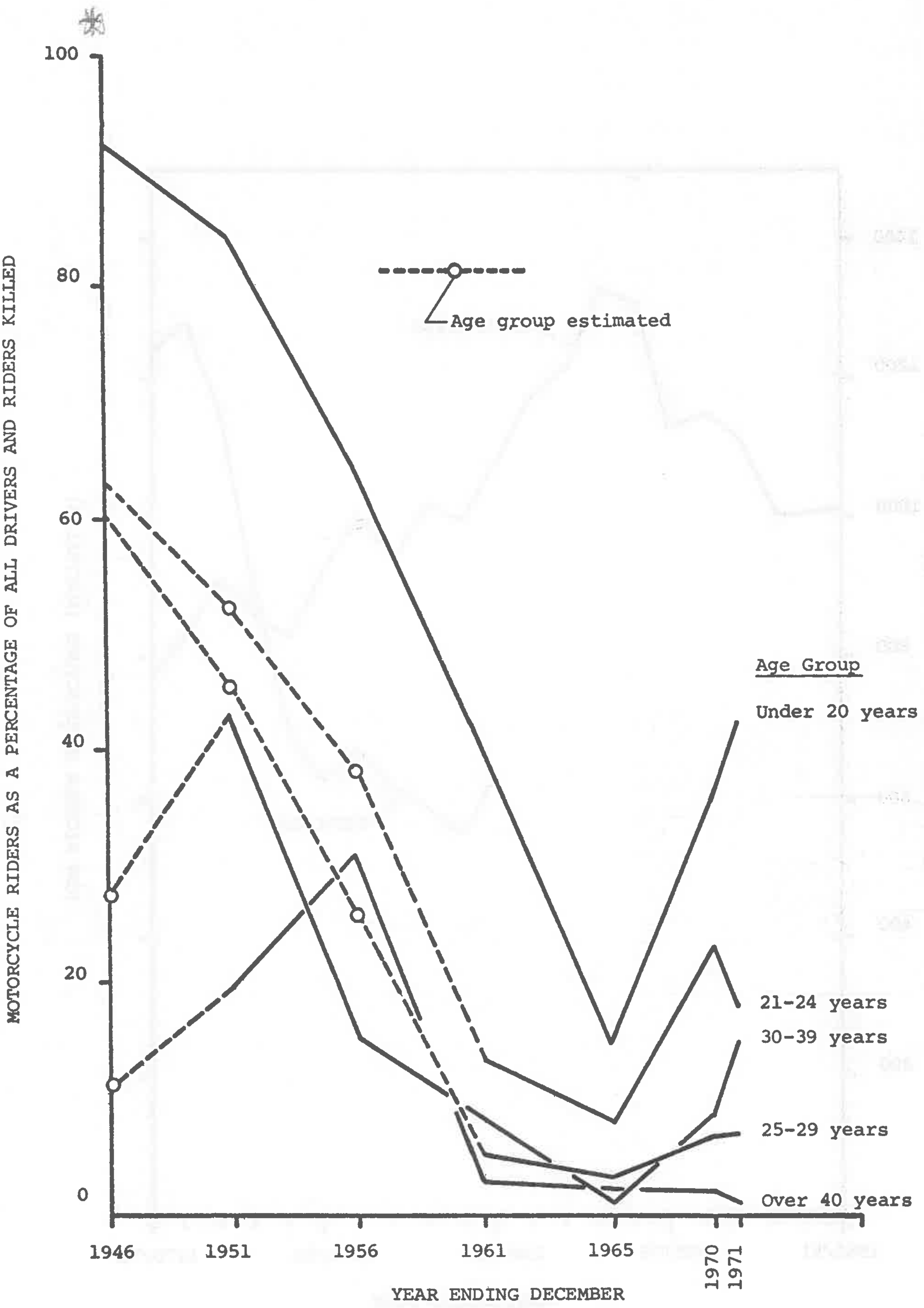


FIGURE 4

AGE GROUPS OF MOTORCYCLE RIDER FATALITIES (NEW SOUTH WALES)

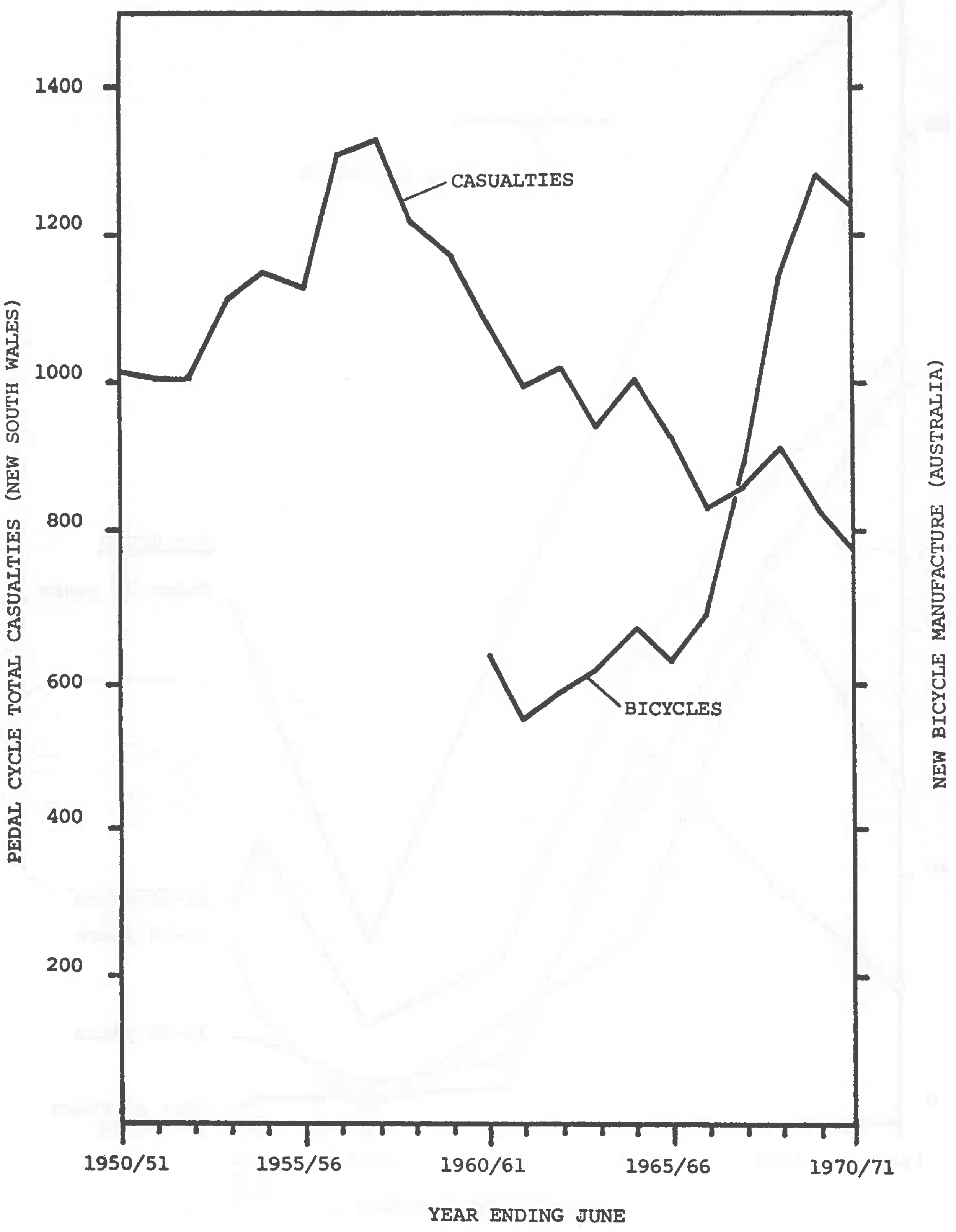


FIGURE 5

BICYCLE MANUFACTURE AND CASUALTIES

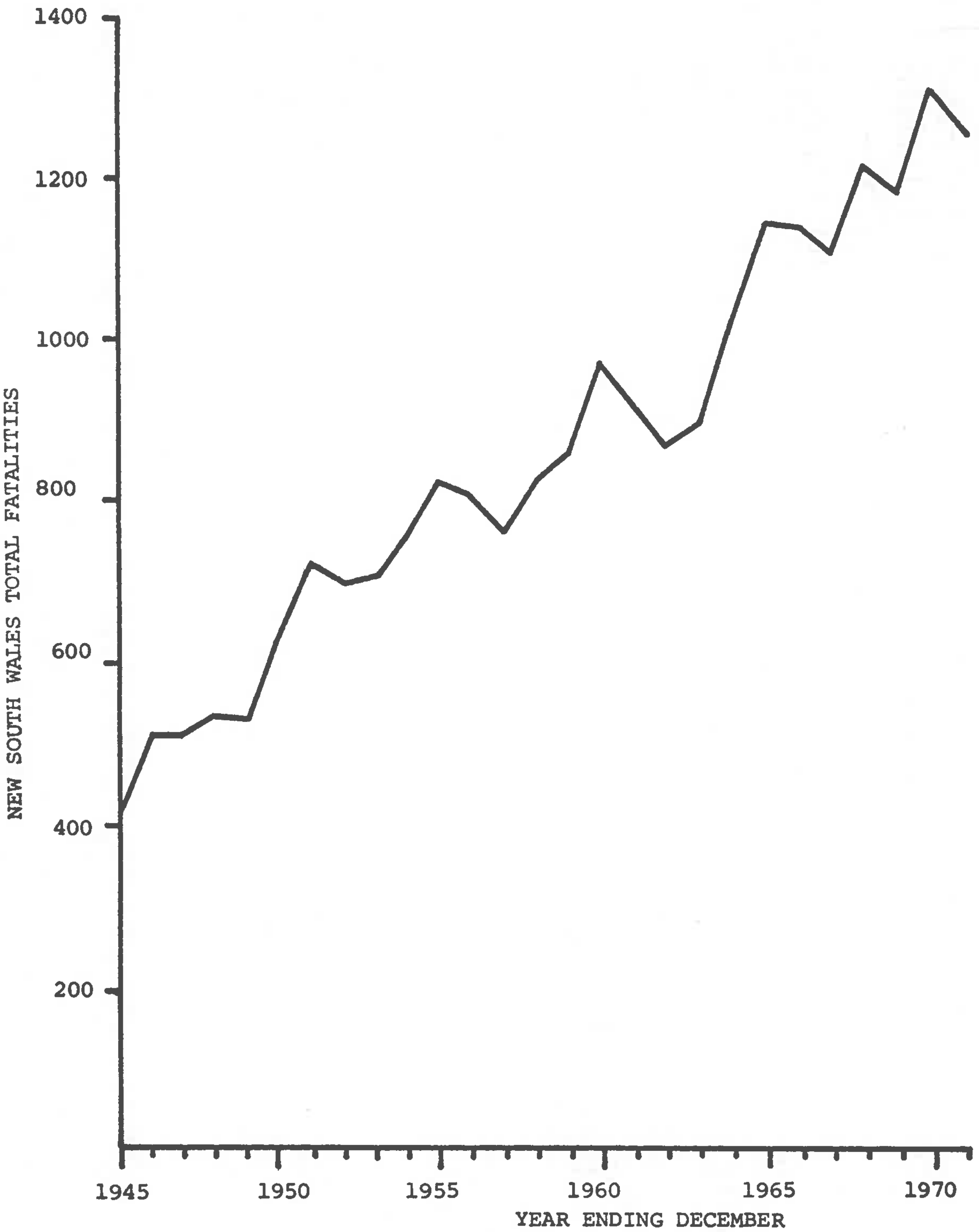


FIGURE 6

TOTAL ROAD TRAFFIC FATALITIES (NEW SOUTH WALES)