The effects of police patrolling on trunk road traffic

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THE EFFECTS OF POLICE PATROLLING ON TRUNK ROAD TRAFFIC

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ABSTRACT

Police patrols are normally allocated to traffic duties with the objective of influencing driver behaviour, and thereby reducing road accidents. When scheduling police traffic patrol resources between routes it is therefore important to know what effect they might be expected to produce, on both driver behaviour and accidents. Similarly, knowledge of these effects are important in deciding the extent of the nation's resources to be allocated to this purpose.

This thesis explores the effects of changes in the levels and tactics of police patrolling on driver behaviour, and on the accident rate. Previous published work is analysed and discussed, together with new experiements conducted in the Durham Constabulary Area. In carrying out these experiments, weaknesses in police and traffic engineering procedures became apparent. These too are discussed in detail.

No statistically significant changes were observed, in the accident rate, or in any of the measures of driver behaviour investigated, in the presence of various levels and tactics of police patrolling. This was despite quite narrow confidence limits on most of the measures of driver behaviour.

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2. INTRODUCTION

2.1 THE THEME OF THE INVESTIGATION

The Police Executive in charge of traffic supervision seeks to deploy his resources so that they achieve the greatest public benefit. The Home Office and Treasury, in fixing police traffic establishments and grants, seek to balance the cost to the public in increased rates and taxes, of extra police activity with the benefit which would be derived. It is therefore of prime importance to try to establish what benefits do derive from police traffic supervision, and how these benefits are related to the level of supervision. The study of this relationship forms the main theme of this thesis.

The cost of traffic policing is high. In Durham County, on 17 August at the start of the first of the experiments described below, the motor patrol strength was as follows:-

Cars	Motor Cycles	C/Inspectors	Inspectors	Sgt.	P.C.	P.W.
63	18	1	5	16	195	2

a total of 81 vehicles and 219 officers. This would imply a direct cost of patrolling in excess of £580,000 per year, without the overheads from such services as control room and workshops. A substantial part of this patrol strength was used in traffic supervision, though there were other duties performed by patrols, particularly crime prevention after dark. A substantial sum of public money is spent on traffic supervision, with very little evidence that patrols have any effect on the traffic they supervise.

The prime objective normally ascribed to Police traffic supervision is the prevention of accidents. The relationship between accidents and patrolling was therefore the subject of the first study described below. However, Ref. 1 has shown that if accidents are assumed to be Poisson distributed, then the percentage reduction in accidents required for significance at the 5% level is related to the original number of accidents as shown in Fig. 1. A change in accident level, therefore, will not prove statistically significant, unless the original number of accidents is very high, or the percentage change is very large.

The first series of experiments described in Section 4 below, and the work of other authors described in section 3 below, indicate that changes in patrol level do not cause large, immediate changes in the accident rate.

The second series of experiments (Section 5) therefore broadened its scope to include the effects, if any, of patrol changes on driver behaviour. If driver behaviour is unchanged by changes in Police Patrols, it is reasonable to suppose that the level of accidents will also be unchanged, and conversely any marked changes in the way people drive should be reflected to some degree in changes in their likelihood of having an accident. These two parts of the investigation are therefore very closely linked, and information on changes in driver behaviour under the influence of changes in Police Patrolling goes at least part of the way to establishing the effect and value of alternative levels and tactics for Police traffic supervision.

It has already been emphasised that patrol resources are very expensive, and that the investigation was concerned with measuring and improving the effectiveness of these resources. In the course of the investigation side-issues arose which impinged on the effective use of a Police Traffic Department's resources. They form an important part of the thesis, and have provided the most immediate, and most tangible, improvement in the use of motor patrol resources.

2.2 HISTORICAL BACKGROUND

The origin of the series of experiments described below, was a course in Operational Research Methods for Senior Police Officers, held in Durham University and attended by a number of officers of Chief Inspector rank and above from the No. 2 Police District. At the end of the course, these officers agreed that the area in which the techniques of Operational Research might be of greatest immediate benefit to them, was in determining the relationship between the manner and level of traffic patrolling and the accident rate, so that patrol allocation might be made to minimise the number of accidents in the Police Force Area. From this beginning a research proposal was drawn up (Appendix 2) which was accepted by Durham Constabulary, and by the Home Office Police Research and Development Branch. Under this contract the Home Office provided funds for the salary of a Senior Research Assistant, and the administrative expenses associated with the project. Durham Constabulary provided a Chief Inspector on secondment to the project. This nucleus of the project team, working within Durham University Business School were supported by a panel of advisers from the Mathematics Department and the Business

School. A list of the members of this team is included as Appendix 1.

The first contract was for one year, and it is convenient to refer to the experiments carried out in that year collectively as Project 1. A second contract was approved to run from the completion of the first. The experiments under this contract (Project 2) differed from those in Project 1 in that Project 1 investigated effects on accidents, while Project 2 looked instead at effects on other aspects of driver behaviour. There were also changes in the advisory panel for Project 2, with the inclusion of several senior Police Officers.

Sections 4 and 6, Figs. 2 - 20 and Documents 1, 2 and 11 - 15 all relate to Project 1. Section 5, Figs. 21 - 53 and Documents 3 - 10 relate to Project 2. At the end of Project 2 a proposal for further work (Appendix 4) was submitted to Durham Constabulary and the Home Office. It received the full support of Durham Constabulary, but has not so far been granted the financial support of the Home Office.

3. RELATED WORK BY OTHER AUTHORS

3.1 GENERAL REVIEW

A number of other studies have been made in the general field of investigation described in this thesis. This section sets out to review these, and their relevance to the research described in later sections. For convenience the review is divided into two parts. Section 3.2 deals with research into the relationship between police patrolling and accidents rates, while research into the effects of changes in police patrolling on various aspects of driver behaviour are dealt with in section 3.3.

Several pieces of research had aspects in both categories, in which case they are treated separately in each section.

The following is a list of those projects reviewed below, and the sub-sections in which the review appears:-

Research Project	Refs.	Sections
1. The Wisconsin Project (1955/59)	3,4,8 & 14	3.2.1 & 3.3.1
2. Operation 101 (1964)	5	3.2.2. & 3.3.2
3. The Swedish Experiment (1965)	6	3.2.3. & 3.3.3.
4. The No. 7 Police District Traffic Experiment (1965)	8, 9 & 15	3.2.4. & 3.3.4
5. The Seven Police Districts Experiment (1939)	10	3.2.5.
6. The Slough Experiment (1955/57)	11	3.2.5. & 3.3.8
7. The Road Research Laboratory, 30m.p.h. limit Experiment (1964/65)	12	3.2.5. & 3.3.5
8. The York and North Yorkshire Constabulary Experiment (1967/68)	13	3.2.5
9. The Metropolitan Police Experiment	16	3.3.6
10 The Indiana Project (1962)	17	3.3.7

Section 3.4 summarises the conclusions which may be drawn from an overall review of previous work.

Several common weaknesses have been encountered in a number of research projects, and there are problems of interpretation of published work in this area. These are all discussed in section 3.4

3.2 WORK RELATING POLICE PATROLLING AND ACCIDENT RATES

3.2.1 The Wisconsin Project (1955/57)

The Wisconsin Project was an extensive study conducted jointly by the Northwestern University, the Bureau of Public Roads and the Wisconsin State Highway Patrol.

It involved 96 patrol officers operating 18 hours per day on a total of 390 miles of test routes. In the only complete year of the experiment the combined accident level on all the test routes was 396.

Four test routes were selected, and each was assigned 24 patrol officers to give a continuous coverage averaging 8 men on duty at any time in the 18 hour day of the experiment. The lengths of the routes were different, resulting in there being 3 miles, 6.5 miles, 13 miles and 26 miles per patrol officer on duty for the four routes. 'Control' routes were selected corresponding to each of the experimental routes, with the exception of route 2.

The original report of this project Ref. 3 described the objectives of the study as:-

1. Verification of the hypothesis that reductions in accident frequency follow increases in amount of enforcement.
2. Preliminary investigation of quantative relationships between enforcement and accidents.
3. The effect of increased numbers of patrol units, on use by traffic of less desirable but parallel routes.
4. The effects of increased numbers of patrol units on vehicle speeds.

The part of the study dealing with the first three objectives is reviewed in this section, and the rest is dealt with in section 3.3.1 below.

In addition to a certain amount of bias suggested in the first objective, there were several other unfortunate features of the way in which the experiment was set up. The origin of the work was a decision by the Wisconsin State Legislature to set up a 250-man State Highway Patrol to check the risk in accidents. This in itself could indicate the accidents were abnormally high, with the liklihood of falling anyway from purely random causes. The State Legislature's decision would inevitably provoke publicity, which might itself have an effect, quite independent of actual police effort.

No mention is made of the 154 patrol officers not assigned to the experiment. These could have affected the control routes, especially as one comparison uses the remainder of the state as a control on the aggregated results for the four routes. It is also unfortunate that records were not kept of the actual time spent on patrol. Experience in Durham suggests that the number of officers assigned to a route may be considerably in excess of the number actually patrolling at any time. In all but one of the routes (route 1) the experiment did not start at the beginning of the year, but the accident data for that year are not separated into the period before the start of the experiment and the period after it had started.

The analysis of the results is somewhat confused. It involves the use of a trend line to predict the expected number of accidents, then comparing this with the actual number. No evidence is presented that the accidents are correlated with time, and it is apparent that on several routes this is not the case. In the absence of such a strong correlation it is difficult to justify the use of a trend line for prediction. Two conflicting methods of deriving the trend line are described. The actual predictions appear in conflict with both methods. Further the method of calculating the standard error of the estimate is also incorrect.

The conclusions drawn from this analysis were as follows:-

1. On a highway which has had no previous traffic supervision, patrolling to the extent that a driver may see four patrol units per 100 miles travelled has no significant effect on the accident rate, but patrolling to the extent that a driver may see eight or more patrol units per 100 miles travelled does result in significantly fewer fatal and personal injury accidents than would be expected from the trend of previous years.
2. Reductions in frequency of accidents tend to be more pronounced during the second year of effort indicating a possible cumulative effect.
3. Property damage accidents do not show as consistent reductions as fatal and personal injury accidents. This may be attributed to the fact that property damage accidents are more susceptable to changes

in the completeness with which they are reported.

4. Substantial increases in the number of patrol units assigned to a given stretch of highway does not cause an appreciable proportion of motorists to change their travel habits, even though there is an alternative route available.

5. One measure of patrol effectiveness is the average frequency with which motorists travelling a segment of highway will pass a patrol unit.

Leaving aside the question of the validity of the analysis, the results presented were as follows:-

Route	Year	Miles per Patrol Unit	Test		Control	
			Fatal & Injury	Property Damage	Fatal & Injury	Property Damage
1	1956	3	HS	N	N	N
1	1957	3	HS	S	N	S
2	1957	6.5	S	HS	No Control Route	
3	1957	13	HS	S	N	N
4	1957	26	N	S	N	HS

Where HS implies a highly significant reduction in accidents at the 1% level, S implies a significant reduction in accidents at the 5% level and N implies no significant change at the 5% level. The start of the experiment on routes 2 to 4 was delayed till well into 1956, so the results for that year are neglected.

These results do not support the thesis that between 3 and 6.5 miles per patrol man is critical. Even if this patrol density proved to be critical in getting significant results, this would be as much a property of the design of the experiments as a property of any relationship between patrol levels and accident rates.

For routes 2, 3 and 4 any decrease in accidents in 1957 over a decrease in 1956 might be attributable to the fact that the experiment did not start till well into 1956. On route 1 the difference in the number of accidents between 1956 and 1957 is only 20 in 250, so the second conclusion is at best speculation.

The evidence of the results do not fully support the third conclusion.

No attempt was made to test whether the reduction in Fatal and Injury Accidents were significantly different from reductions in Property damage accidents. If however such a difference were discovered the explanation put forward could explain it.

The conclusion that a significant diversion in traffic does not occur with extra police supervision is well supported. However it is still possible that a small proportion of drivers did take the alternative route, and these might have a disproportionate effect on accidents if they were drivers of defective vehicles, or driving under the influence of drink.

The last conclusion is equivalent to the assertion that the volume of police effort is a measure of its effectiveness. This is not a conclusion which may be drawn from this experiment.

A reappraisal of the data in this experiment was made by Ref. 4 who pointed out the lack of evidence of any trend in the accident data. In consequence of this observation he discarded data prior to 1955 and 1957 using a 2 x 2 chi-square test. This showed no significant change on any of the test routes. Though it is true that no individual test route shows a significant reduction in accidents if only 1955 and 1957 data is examined, it is not clear from Ref. 2 why accidents prior to 1954 are inadmissable statistical evidence, or why the accidents on Route 1 in 1956 are not of interest.

A further chi-square analysis was performed (not appearing in either ref 3 or ref 4), using the period from 1947 to 1955 as control, and 1957 as the experimental period for Routes 2, 3 and 4. Both 1956 and 1957 were used for the experimental period on Route 1. All control routes were aggregated to act as controls on each experimental route. This analysis showed the reduction in Fatal and Injury accidents on route 1 to be just significant at the 5% level while there was a highly significant increase in the Property Damage Only accidents on this route. All other changes were not significant at the 5% level.

These results support the argument that the completeness with which Property Damage accidents are reported improves with higher levels of police patrol. They also provide some basis for concluding that Injury accidents were significantly reduced on the route with the most intensive police supervision compared with the

control routes. The effect may have been the result of publicity, or some of the other experimental weeknesses pointed out earlier, but the most likely cause appears to be the extra patrol supervision.

3. 2. 2. OPERATION 101 (1964)

California State Highway patrol's Operation 101 was another attempt to solve the problem of the relationship between patrol levels and accidents. In a paper presented to IACP in October 1965, (Ref 5), Commissioner Bradford M. Crittenden said of the experiment:-

"Operation 101 ... is designed to answer this question: How much accident reduction can I expect from enforcement dollars expended?" This may be taken as the prime objective of his experiment.

In this paper he also asserts that it is not necessary to prove that enforcement works, and that they know 'from experience' that it does so. This assertion is unfortunate from two standpoints. First it indicates a certain lack of objectivity on the part of the researcher, and second the scale and design of the experiment were such that the most that could be expected of it would be a strong indication that enforcement has some effect on accidents.

The experiment was conducted on a single highway, the 36 miles of U.S. 101 in California. The whole of the route was used as a 'test' route, and there was no 'control' route. This had been patrolled before the experiment by an 18 strong unit of the California State Highway patrol, but for the whole of 1964 this was increased to 36 officers, who recorded 64,000 patrol hours on route in the course of the year. The total number of recorded accidents for the year fell by 109 (13.3%) from an implied 1963 rate of 820 accidents despite an 8% rise in traffic

volume. No significance tests were presented in Ref 5, but an analysis similar to that used to derive Fig. 1 indicates that this reduction is significant at the 5% level.

A reduction of 84 accidents (24.1%) on an implied 1963 Injury Accident rate of 347 is also significant at the 5% level. The reduction in Property Damage Accidents and Fatal accidents, 23 in 447 and 2 in 26 are not themselves significant at this level. However the application of a 2 x 2 chi-square test shows that the proportional reduction in Injury Accidents does not differ significantly (at the 5% level) from that of Property damage only accident.

In an attempt to control other factors without recourse to a control route, a number of such factors were examined and evaluated.

Weather Route U.S.101 was considered not to suffer from extremes of weather conditions. This parameter was therefore dismissed as unlikely to cause any major change in the level of accidents.

Traffic Mix This was claimed not to have changed appreciably. No statistical evidence was presented to support this.

Diversions Traffic counts on U.S. 101 and an alternative route U.S. 395 did not support any contention of a large scale switch of drivers from U.S.101 to its alternative.

Publicity The project was announced and received wide-spread publicity six weeks before it started. Thereafter no reference was made to the project in the media, particularly so in their treatment of road accidents which continued in the normal way. It is questipnable whether this tactic completely eliminated the effects of publicity.

Patrol Methods Crews were briefed to patrol normally, however a campaign against 'drowsy drivers' was intensified, but some impact on patrol tactics must inevitably follow an increase in patrol strength of this magnitude.

Engineering improvements Ref 5 states: "During the course of the year, one gate leading to the military reservation was closed, and several left hand turn channels were constructed on the study highway. The accidents which these improvements prevented have been taken into account." Unfortunately no further mention is made of how this was achieved.

It is therefore possible that the significant reduction in accidents in 1964

might have been achieved as a result of the engineering improvements rather than the enhanced Highway Patrol Activity.

Summary. This simple experiment indicates that significant reductions in accidents coincided with a substantial increase in Highway Patrol Activity. There were some defects in the way the experiment was designed, but the most likely explanation for the reduction in accidents appears to be the high level of patrolling achieved.

3. 2. 3. THE SWEDISH EXPERIMENT (1965)

The objectives of the Swedish Experiment were similar to those of the other experiments described above. Quoting from a translation of their report (ref 6) the objectives were " - to create a foundation for assessing the connection between safety and intensity of patrolling .... to attempt an estimate, with the least possible margin of error, of the difference between the true accident frequency during the time for patrolling, and a hypothetical accident frequency that would have arisen during the same period unless patrolling had been intensified", and to study "the effect of patrolling on the behaviour of road users".

The experiment was conducted using a two-month control period (May/June 1965) and a two-month experimental period (August/September 1965). The month of July was omitted, since this is the main holiday month, and roads would be subject to temporary speed restrictions.

European Highways E3 Sodertalje to Orebro and E18 Staket to Arborga were used as the experimental routes, and European Highway E4 Sodertalje to Mjolby was used as the control route. The precise length of each route is not stated in Ref. 6 but it was stipulated that the experimental section should not be longer than 250 - 300 Km because of the limited resources available for patrolling.

The level of patrolling on the control route was 9 patrol cars and 6 patrol motor cycles per 24 hour day. On the experimental routes the corresponding figures were 15 patrol cars and 10 motor cycles in the control period and 45

patrol cars and 30 patrol motor cycles in the experimental period. That is police effort was trebled for the experiment.

During the control phase a police helicopter was used for one day per week on all three routes. This practice was not continued in the experimental period, and thus tended to detract from the value and meaning of the experiment.

Two sources of accident reports were used, the National Bureau of Statistics, and a special reporting procedure for accidents coming to the notice of the police. Accident data for the preceding year was available only from the National Bureau of Statistics. A further check on accident data was provided with the aid of the Swedish Association of Auto Dealers and Service Shops. This was a record of the number of salvage operations on each route. A summary of results in included in the table below.

Swedish Experiment - Summary of Results

Routes	Control		Experimental	
Period	Control	Experimental	Control	Experimental
Patrol Cars assigned per 24 hours (1965)	9	9	15	45
Patrol motor cycles assigned per 24 hours (1965)	6	6	10	30
Aggregated accident data from two sources (1965)	87	129	112	104
Accident data from N.B.S.* only (1965)	79	104	82	82
Accident data from N.B.S.* only, corresponding period (1964)	81	90	58	63
Salvage Operations (1965)	64	91	76	85

* National Bureau of Statistics.

Reference to fig. 1 shows that only one of the changes from the control period to the experimental period was significant at the 5% level, and this was a significant increase in accidents on the control routes. This is despite a consistent decrease in traffic volume on all routes. Even so there is no significant difference between the accident pattern on the control route according to National Bureau of Statistics between 1965 and the previous year. It is suggested in Ref. 6 that this is the result of a seasonal change in the composition of traffic; but even if this is the correct explanation, there is no reason to

suppose that the affect would be repeated on the experimental route.

Despite attempts to avoid publicity several articles, containing largely erronious information did appear in the press. These were however well before the experiment started.

A further complicating feature also detracted from the experiment. Road resurfacing took place on a section of the control route in the experimental period, and on a section of the experimental route in the control period. In addition to the consequent temporary disruption, and speed limitations, it is possible that the change of surface also affected accidents.

Ref. 7 demonstrates with several examples that road surface can be an important factor in determining the accident rate.

Contrary to the claims of ref. 6 it is impossible to make any deductions about the effects of enhanced patrolling on accidents from the Swedish experiment. The different sources of accident data differ even as to whether an increase or decrease in accidents took place during the experiment, while a 'long run' decrease in accidents of as much as one third might have taken place, and still produced a sample reduction in accidents of only 8 in 112 on 5% of occasions (the reduction recorded in the aggregate accident data).

3. 2. 4. THE NO. 7 POLICE DISTRICT TRAFFIC EXPERIMENT (1965)

The Home Office Research and Development Branch carried out an experiment on patrolling of primary routes in South-West England (No. 7 Police district) between August and December 1965 (See Refs. 8 and 9). A special Regional traffic squad was formed, under the operational control of an experienced Senior Police Officer. A total of 541 miles of Primary routes in the district was selected for intensive patrolling (approximately one-third of the total primary route mileage in the district). The patrol level aimed at was one car

and one motor cycle per 20 mile sector in daylight and one patrol car per 40 mile sector at night. The level of patrolling actually reported was about 75% of the planned level. No information was given on the patrol level on the control routes. The selected primary routes covered approximately one third of the total primary route mileage, but in the control year (1964) had 44% of the accidents.

In addition to a number of objectives which amounted to studying problems of setting up a regional traffic squad on a permanent basis, the experiment had two stated objectives relevant to this thesis.

1. determination of the relationship between levels of policing and accident rates, incident rates and possibly offence rates.
2. evaluation of various patrol tactics.

The aspects of the study concerned with incidents, offences and the evaluation of tactics were performed by the Road Research Laboratory. One of their simple experiments in this connection is described below in Section 3. 3. 4.

The experimental design was such as to preclude the possibility of establishing the relationship between levels of policing and accidents. The most which might be expected from it was an indication of whether changes in police patrol levels had any appreciable effect on the accident rate.

This experiment showed the following totals of serious Injury and fatal accidents for comparable periods (2nd August to 31st December) in 1964 and 1965.

	1964	1965	Change	Percentage Change
Selected Primary Routes	530	444	-86	-16.25%
Non-Selected Primary Routes	675	707	+32	+ 4.75%
Total for Great Britain	38914	38747	-167	- 0.43%

Ref. 9 concluded from a Chi-Square Analysis that the selected primary routes showed a significant drop in fatal and serious injury accidents when compared with the national total ($X^2 = 64$; $p < 0.001$) and with other Non-Selected Primary routes in No. 7 district ($X^2 = 6.72$; $p < 0.001$). In fact a re-evaluation of the results shows in both cases $x^2 = 7.1$; $.005 < p < .01$. A significant

reduction in accidents on the selected primary routes did occur therefore between 1964 and 1965, though not as significant a reduction as was claimed by the authors of Ref. 9.

The reason for the drop in accidents in 1965 could have been a drop in traffic volume. No records were kept to detect whether this had occured. The last 5 months of 1965 were relatively wet in the South West of England which in a holiday area might have produced a drop in traffic volume on main trunk roads sufficient to cause the observed drop in accidents. The rainfall figures for the two periods were as follows:-

Monthly Mean Rainfall in Millimeters

South West England

	August	September	October	November	December
1964	59	45	82	68	112
1965	82	138	29	111	202

(Meterological Office, Bracknell, private communication)

The non-selected primary routes might not have been affected by this to the same extent, since, having just over half the accident rate per mile, they are presumably less arterial and less influenced by holiday traffic. The results might also have been influenced by engineering modification, a factor not discussed in Ref. 9. They may also have arisen from chance with a probability which is not altogether negligible, but despite these possibilities the most likely reason for the reduction would appear to be the direct result of the experiment.

Ref. 9 acknowledges that the effect of publicity in the press and on radio and television had been considerable. It is therefore impossible to assess the degree to which the reduction in accidents relates to the extra police activity alone, and the degree to which the addition of the considerable publicity affected the results.

A more detailed evaluation of the changes in accidents was attempted by 4 week period, but this proved too short a time span to add anything to the initial conclusion. Only one such period showed a significant drop in accidents on its own, and despite concern expressed in Ref. 9 about the cause of apparent variations in the accident patterns in these periods, no evidence was presented

that these were other than the random fluctuations which might have been expected.

3. 2. 5. OTHER INVESTIGATIONS

One of the earliest experiments in this field was conducted in seven selected Police districts between April 1938 and September 1939 (Ref. 10). A specially trained supplementary patrol squad performed the extra patrolling involved, and an estimated reduction in accidents of 10% was observed. This reduction would probably have been significant, though the affects of extra police effort alone may have been obscured by the attendent publicity. Road and driving conditions have also changed immensely since that time, as has police traffic patrolling, so it is questionable what bearing these results have on today's traffic conditions.

An experiment in Slough in Buckinghamshire in 1955/57 (Ref. 11) combined an investigation of several different effects, and so, though an 8% drop in accidents occurred, it would be difficult to ascribe this to a particular cause, even if it proved to be significant.

A project studying the affect of enforcing the 30 mph limit was conducted with an experimental period of one year 1st July 1964 to 30th June 1965 (Ref.12). Police coverages was recorded during that year, and for the month preceding it. It appears from a graph of reported patrol hours that a substantial increase in patrolling did occur in the period of the experiment. The roads chosen were spread over six police force areas, though data from one of these areas was abandoned as the road was up-graded from a 30 mph limit to a 40 mph limit, part way through the experiment. On the remaining five routes the accidents fell 25% from the preceding year. This was claimed to be a significant drop at the 2% level (Ref.12). At the same time, on roads in the surrounding area, reported accidents fell by 3.6%, compared with a rise of 4% for built-up areas nationally, but with very much more data this was claimed as significant at the 1% level.

Many experiments in this field are designed and carried through by the Police themselves, without reference to any outside statistical help. Typical of these is an experiment conducted by the York and North Yorkshire Constabulary for six weeks in June/July 1967 (Ref. 13) and again in 1968. In this as with others of its type the results of the experiment received little publicity outside the locality, especially when the results proved unfavourable.

For the experiment, three police mini-vans were placed at intervals along the trunk road A1, each bearing large slogans "POLICE ACCIDENT UNIT" and "FATIGUE IS DANGEROUS". One police traffic car and one police motor cycle performed traffic supervision duties in the vicinity of each mini-van. The number of reported accidents for the six weeks of the experiment in 1967 was 27 compared with 49 in the previous year. Reference to Fig. 1 shows that at first sight this appears to be significant. However the experiment was conducted in response to concern at the high level of accidents on the A1, particularly at that time of year. Accidents were therefore probably unusually high, and likely to fall anyway.

Even if a significant reduction could be proved to have occurred, it is quite possible this may have been caused by drivers believing that "POLICE ACCIDENT UNIT" was an advanced warning of an accident ahead. If motorists took extra care on this assumption it may have had an adverse effect further along the road when they discovered it to be a false alarm, and it might also be dangerous in that 'crying wolf' might lead drivers to be less cautious when given advanced warning of an accident which had in fact occurred.

A further danger is apparent in this experiment, and that is that experiments of this type receive much wider publicity when they 'succeed' than when they 'fail'? Thus when the six week experiment in 1967 coincided with a spectacular drop in accidents its results received considerable local publicity. I understand the results for 1968 were much worse, so the experiment was discontinued, and the results quietly forgotten. Such selective publication gives a very biased impression of the effects of police patrolling, and is perhaps the greatest obstacle to drawing unbiased conclusions from a combined assessment of published work in this field.

3. 3. WORK RELATING POLICE PATROL EFFORT AND SOME ASPECTS OF DRIVER BEHAVIOUR

3. 3. 1. The Wisconsin Experiment (1955/59)

The Wisconsin project examined the effect of increased patrol levels on traffic speeds and on the taking of alternative routes as well as the effect on accidents. They concluded that there was no significant diversion by road users to avoid the higher levels of patrolling operated on their experimental route. Their investigation of the effect of enforcement on speed related to a 'before' period in 1955 and an 'after' period in 1957. They found that their mean speeds showed significant decreases on three out of four experimental routes, and also on all of their four control routes during the experimental period. It is not clear from the reports to what extent measurements were kept strictly to the same time of day, or the same day of the week. If this were not done this could help to explain the difference. The large time gap between the control period and the experimental period could be a further factor as could the reliability of the assumption that vehicle speeds were random independent samples from a normal distribution. This assumption is shown to be invalid under the conditions of the Durham Experiment in section 5.7 below. In any event, it is not possible to deduce from these measurements that reductions in mean speed were in any way attributable to increased patrol levels.

In an extension of this work in 1958/59 (Ref. 14) Schumate and Crowther examined in some depth the variations of traffic speed under the influence of minimal and constant Police Supervision. Speed measurements were made from 7 a.m. till 11 p.m. on one each of the five weekdays (Monday to Friday) for each of the five months November to May excluding February. The measurements were in all cases made in good weather conditions from a concealed point on a straight country section of U.S. Highway 14 in Wisconsin. A speed limit of 65 mph in the daytime and 55 mph at night was in operation throughout the experiment; these being the maximum speeds permitted anywhere in Wisconsin.

An analysis of variance was performed on this data based on the following assumptions:-

1. "The speeds of cars observed within an hour under the circumstances of our observation techniques constitute a random sample from a normal population".
2. "While the mean of the normal population may vary between hours, days and locations, the variance of the distribution remains unchanged".
3. "The speed of any car at the observation point can be expressed as the sum of a factor depending on the time of day, a factor depending on the day of week, a factor depending on the month, and a random variable independant of hour, day and year. "

The first of these assumptions, and the implication that vehicle speeds are independent of the speeds of other vehicles passing the observer at about the same time is again the assumption seriously called into question in Section 5.7 below. If vehicle speeds were correlated with the speeds of other vehicles on the road at about the same time then sample variances would be smaller than might be expected from the variance of sample means, a fact which would tend to produce factors depending on hour, day and month which appear significantly non-zero.

The conclusions of Ref 3 are:

(a) "Hourly Mean speeds show differences greater than chance would account for even after any possible effect produced by differences between days and months is eliminated".

(b) "The differences between Monday, Tuesday, Thursday and Friday mean speeds are real and material".

(c) "The differences between monthly mean speeds are larger than can be accounted for by chance".

(d) "As sample sizes are increased without regard for the time interval involved, differences in the sample mean speeds provide estimates not only of the true changes in speed behaviour but also changes in speed arising from differences in the hours, days and months".

(e) "The quality of speed estimates can be improved by matching sampling periods by hour of day, day of week and month of the year".

All these conclusions are based on the suspect assumption 1. Their validity is therefore dubious. However some dependence of driver behaviour on

the hour, day and month is not unlikely.

3. 3. 2. Operation 101 (1964)

In Operation 101 independent observers recorded the traffic offences which they saw, and claimed a reduction when enhanced patrol levels were in operation, but with no quantitative backing for this claim in Ref. 5 it is difficult to gauge how large a reduction was obtained, and whether the reduction was statistically significant.

3. 3. 3. The Swedish Experiment (1965)

In addition to examining the effects of patrol changes on accidents, the Swedish Road Research Board Project (Ref. 6) also studied the effects on five measures of behaviour, viz:

1. The manner of overtaking
2. The manner of joining a major road
3. Speed distribution in a derestricted zone
4. Observance of halt signs
5. Observance of speed restrictions

With these measurements, as with their measurement of accident rates, much of the value of the experiments was lost by failure to provide an analysis of significance. The significance of results was often further obscured by presenting many of the results as percentages Where possible attempts have been made to add some assessment of significance, but these are not obtainable in the experimenters' report of their results.

The experimental design was similar to that used in the Northwestern Experiment, but the experiment took place over a much shorter time scale. A control phase in May and June 1965 was followed in August and September by an experimental phase. Patrol levels on one control route (E4) were left unaltered throughout, while on the two experimental routes (E3 and E18) patrol levels were trebled from the control phase to the experimental phase. No check was reported

that the designed increase in patrolling had taken place as planned. The effects observed on their five measures of driver behaviour were as follows:

1. The first measure was abandoned due to insufficient data for meaningful analysis.
2. The following facts were recorded about drivers joining the major road.
   (i) The number of such drivers (N1) in the observation period
   (ii) The number of occasions (N2) in which a driver on the main road passed the junction within 15 seconds of a vehicle joining the major road at the junction
   (iii) The number of occasions (N3) in which a driver overtook or braked to avoid a vehicle joining the major road at the junction
   (iv) The number of occasions (N4) which were recorded under both (ii) and (iii).

These data were analysed in two ways, first examining N4 as a proportion of N2 and then examining N3 as a proportion of N1. A chi-square analysis of N4/N2 showed a highly significant (at the .1% level) change in this ratio on the experimental routes, between the two phases.

For this purpose the results on the two routes were treated as independent experiments and their values of Chi square were added in the normal way (see Ref. 9). The results which would be obtained by examining N3 as a proportion of N1 would serve only to reinforce these results since they rely on essentially the same basic data. The results for the control routes are not analysed here, since most of the data is believed by the experimenters to have been influenced by road users who mistakenly thought that the experiment observers were associated with a nearby Police speed check. This suggestion must also throw some doubt on the meaning of the results obtained on the

experimental routes. If the observers were so conspicuous as to be associated with police speed checks on the control routes they were probably sufficiently conspicuous to be associated with extra police activity on the experimental routes.
In that case the effect observed might in part have been induced by the presence of the observers.
It is also possible that the same may be true of effects observed with other measures. The report on the experiment does not describe what steps were taken to ensure that the observers did not affect the behaviour they wished to measure. The Chi-Square analysis assumes the independence of driver behaviour between successive measures, but this assumption is suspect (cf . 5. 7. 1. below).
The greatest weakness of this measurement is perhaps that it takes no account of the traffic volume on the major road, yet this is likely to have a very large effect on the number of drivers on the main road inconvenienced by vehicles joining from the minor road.
3. Speed measurements were made using a device callibrated in 10 km/hr increments, which failed to record speeds over 140 km/hr. They were restricted to free flow traffic and heads of a queue, and distinction was made between heavy goods vehicles and cars. The largest category in terms of data collected was that of free-moving cars. In this the sample sizes were between 500 and 1500. cars for the four locations (two control and two experimental). The mean speeds on the two control sections rose by 4 km/hr and 3 km/hr from the control period to the experimental period. The same categories on the experimental routes in one case rose 3 km/hr and in the second fell 2 km/hr. It is doubtful if these changes were statistically significant, but no statistical analysis is made here, since it is not clear in the translation of the paper whether the presented measure

of spread of speeds is the mean deviation or standard deviation. It is also doubtful whether the standard deviation of individual car speeds would be adequate to establish significance anyway, in view of the finding of section 5. 7. 1 below. The data for other categories also show a tendency for speeds to increase on the control section, and to increase in one experimental section and decrease in the other. These changes are also of doubtful statistical significance.

4. (Observance of halt signs). From the data presented in the report on this measurement the experimental sections show a significant (at the .1% level) increase in the proportion of drivers observing the halt signs on the experimental sections, from the control to the experimental period, and no significant change on the control sections. The chi-square analysis used in 2 above was used in both cases. The results again have relied on the doubtful assumption of independence, but the value of chi-square obtained (32.8 with 2 degrees of freedom) is very high. There is also a possibility that the observers may themselves have influenced the results as discussed in 2 above.

5. (Observance of speed restrictions). As with all the other measurements, the data here was presented in total, and not analysed for significance. No statistical analysis of the data presented is possible without the dubious assumption that vehicle speeds are independent random samples from a normal distribution.

The Swedish project involved several interesting experiments with measures of driver behaviour. One failed for lack of data, the rest suffered from a lack of statistical analysis. Two of the measures were based on speeds, and because of the way in which the data is presented no analysis of the significance of the answers is possible other than one based on the highly dubious assumption that the speeds came as independent samples from a normal distribution. This assumption is shown to be invalid in the circumstances of the Durham

experiment in the analysis below. Some inconsistency in the Swedish results suggest that it is not valid for those circumstances either.

Both the remaining two experiments show evidence that driver behaviour in joining a major route improved when extra patrols were present, though it is possible that at least one of these 'improvements' may have been induced by a change in traffic volume on the major road. Again the conclusion depends on an assumption of driver behaviour being independent, and the results may have been affected by the presence of the observer.

3. 3. 4. The A38 Overtaking Experiment (1965)

As an ajunct to the Home Office No. 2 police district experiment, the Road Research Laboratory conducted an investigation of changes in drivers'overtaking behaviour in the presence of a police car (Ref. 15). The whole of the experiment was conducted in just two days in September 1965, on a half-mile straight section of the A38 at Weare in Somerset. The road was described at that point as being just wide enough for three vehicles. A police car was parked at right angles to the road with the crew standing beside it at one end of this straight section of road. The number of dangerous overtakings was assessed by the subjective judgment of a team of skilled observers. In fact the number of dangerous overtakings was assessed as 16 out of 461 when no police were present, and 19 out of 778 with the police car present. The change in proportion in the presence of a police car was not statistically significant, so that their attempt to analyse the effect further according to the distance from the police car was unjustifiable.

3. 3. 5. The R.R.L. 30 m.p.h. Limit Experiment (1964/65)

This section describes a Road Research Laboratory investigation of the

effects of enforcement of 30 m.p.h. speed limits (Ref. 12). The affect claimed on accidents is discussed briefly in section 3. 2. 5 above.

In this section the effect on vehicle speeds is examined rather more closely.

The experiment took place on six stretches of road in a built-up area, in six police forces. These roads were subjects to extra police enforcement effort, both patrol and radar speed checks, planned at three or four times the normal coverage for one year (1 July 1964 to 30 June 1965). Police coverage was reported for only one month before the experimental period, and throughout the experiment, and it appears from graphs of reported patrol hours that a substantial increase in police effort was obtained.

On each of the six routes throughout the period of extra patrolling, and for three months prior to that, speed measurements were taken by policemen in plain clothes from parked private cars, rather in the manner described for the Durham experiment in Section 5. 3. 5 below. They kept to the same day of the week, and avoided weekends and early closing days. The radar speed meters used were the same type used in Durham, and like the Durham experiment they kept to fixed times of the day. In this case three half hour periods, one mid-morning, one at lunch time, and one during the morning or evening rush hour. The results, are, unfortunately, not analysed for significance, and are in such a form that it is not possible to calculate the level of significance for the observed changes. Examination of the graphs presented leaves the impression that a reduction in mean speed and in drivers exceeding the speed limit did occur, and that the reduction built up very slowly over a matter of several months. A possible tentative conclusion might be that the public were not influenced to change behaviour by the sudden increase in apparent police activity, but by the effect of the greater volume of prosecutions which slowly built up as drivers became aware of acquaintances who had been prosecuted for motoring offences.

3. 3. 6. The Metropolitan Police Experiment

This experiment (see Ref. 16) was conducted by the Metropolitan Police on 3.4 miles of road with very heavy pedestrian accidents. They increased normal patrolling on this section of road by 4 foot patrols and 4 traffic patrols for one week.

Police investigators in plain clothes observed driver behaviour one week before the experiment, during the experiment, and for one week after it. The behavioural measures used were as follows:

(a) At automatic traffic signals

1. Failing stop at red
2. Starting on red
3. Crossing stopline on red-amber
4. Turning right from nearside lane
5. Changing lanes near or at intersection
6. Passing over stop line when stopping
7. Parking within 50 yards of intersection
8. Sounding horn
9. Proceeding on green and causing pedestrians to take evasive action

(b) At uncontrolled pedestrian crossings

1. Failing to accord precedence to pedestrians
2. Starting off early to the inconvenience of pedestrians
3. Overtaking within 15 yards of approach to crossing
4. Parking within 15 yards of approach side
5. Sounding horn
6. Failing to signal intention

With the exception of (a) 7, Parking within 50 yards of the intersection, all measures of faulty behaviour showed a decline when police were present. This would in itself have been significant, had all the measures been independent, but it is not possible to assess the level of significance of the results as all the raw data is not presented. As well as the problem of the independence of the measurements, the independence of the behaviour of different drivers is also questionable.

3.3.7. The Indiana Project (1962)

So far projects have been discussed which have examined the effect of police enforcement on accidents or on driver behaviour or both. The Indiana project (Ref.17) sets out to be a link between these approaches. It consisted of two parts, the first of which sought to link accidents with certain aspects of driver behaviour. The second part attempted to measure the effect of various Police Supervision 'symbols' on these aspects of driver behaviour. The equipment used in the project is of special interest, since such equipment is likely to provide a remedy for much of the tedious observation work encountered in research such as that described in Section 5 below, and allows several features of the behaviour of the traffic stream to be monitored simultaneously.

The equipment consisted of a radar speed meter, a very accurate clock, and a camera which pictured the speed reading, the clock, the vehicle being recorded, and a caption board showing the date and location. From the output of a number of such machines at one to two mile intervals, they were able to deduce:-

1. The mean spot speeds at measuring points
2. The mean speeds over the road segments between successive measuring points.
3. The number of head meetings in the segment (i.e. when a vehicle passes another which is travelling in the opposite direction).
4. The minimum possible number of overtakes in the segment.
5. The leader time and distance. (i.e. the interval between successive cars travelling in the same direction).
6. Traffic volume in each direction.

The equipment was contained in a box which was designed to look as nearly as possible like a mail box, and therefore it probably had little effect on the behaviour it was trying to measure.

The first part of the experiment consisted of a multiple regression/multiple correlation analysis of 4 years' fine weather, daylight accident data (1959-1962), at 72 sites, each averaging just under 2 miles long, and just under two such accidents per mile per year. The tentative conclusions were that the number

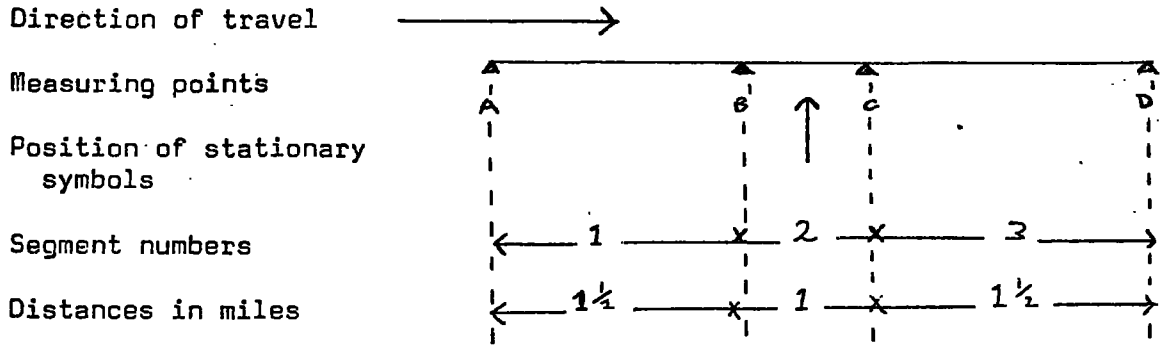
of overtakings and the proportion of vehicles with a small time headway are very closely linked to the number of accidents.

The second part of their work was designed to evaluate the effects of four police enforcement symbols on the following aspects of driver behaviour:-

1. Mean spot speeds at various positions relative to the enforcement symbol.
2. The mean speeds over the 1 mile road segment on which the symbol operated, and the one and a half mile segments on either side of that.
3. The leader times and distances
4. The number of overtakes.

On each test section of road, for vehicles travelling in a given direction the four measuring instruments were called A B C and D in the order in which they were passed.

The following is a diagramatic representation of the design at each experimental section.



The four police symbols tested were as follows:-

1. Police Car with Officer inside parked at right angle to the highway.
2. Police car with Officer standing beside vehicle parked at right angles to the highway.
3. Police car and passenger car parked parallel to the highway, officer standing beside occupied passenger car.
4. Police car patrolling segment 2.

As well as test with a police symbol in position in segment 2, there were also control samples at each site, for which the police symbol was removed.

The total numbers of such samples are shown in the table below.

	No. of Samples	
	Test	Control
Symbol 1	22	28
Symbol 2	20	24
Symbol 3	30	36
Symbol 4	16	21
Total	88	109

The data allowed no clear distinction to be drawn of the relative merits of the four symbols, though symbol 1 appeared slightly more successful than the others.

The total effects aggregated for all police symbols were as follows:-

	Expected Value - Observed mean value			
Behaviour Measure	A	B	C	D
Spot speed	-	-.36 mph	- 1.44 mph	- .80 mph
% of Headways ≤ 2 secs	-	-0.4%	- 1.1%	- 0.6%
% of Headways ≤ 5 secs	-	+0.1%	- 0.8%	- 0.9%
	Segment 1	Segment 2	Segment 3	
Average time to travel one mile (in secs)	-	+2.44	+0.51	
Passings per 100 vehicle miles	-	-2.12	+0.71	

These compare with the actual values of behaviour measures in control periods:-

	Control Data values			
Behaviour Measures	A	B	C	D
Spot Speed	49.43mph	51.30 mph	50.50mph	49.23 mph
% of Headways ≤ 2 secs	25.1%	27.5%	27.1%	29.3%
% of Headways ≤ 5 secs	39.9%	41.7%	41.5%	42.8%
	Segment 1	Segment 2	Segment 3	
Average time in secs. to travel one mile	71.20	71.42	71.08	
Passings per 100 vehicle miles	11.28	12.72	9.78	

No analysis of significance is performed on these results in Ref 17 , and the data is so presented that further analysis is not possible without further information.

3.3.8 Other Investigations

One of the early experiments which looked at the effect of enforcement on driver behaviour was conducted in Slough, Buckinghamshire in 1957(Ref.11). In this experiment a radar speed meter was placed just within the 30 mph limit zone of the A4. Vehicles were observed to slow down more when entering the speed limit zone when an attended speed meter, and warning notices, were present, but the effect was still more pronounced when only the notices were present. Vehicles leaving the built-up area accelerated less with the attended speed meter and warning notices, and least of all with just the notices. It is not clear how the changes could be detected without some speed meter present, and the presence of a concealed meter might have been detected by drivers warned of its presence. It is not known if any of these effects were statistically significant. In another early experiment, a Police Constable in uniform stood beside a pedestrian crossing. The proportion of drivers giving precedence to pedestrians rose by 25%. This change was not statistically significant.

There are a number of other investigations into the relationship between Police Patrolling and driver behaviour, many of which have received very limited publication. As with investigations of enforcement and accidents, much of the value of many such experiments is lost by failure to provide an analysis of the significance of the results, and by failure to appreciate the implications of the stochastic nature of the variables being examined.

3.4 THE 'STATE OF THE ART'

In Section 3.2 above, eight projects are reviewed which studied the relationship between police effort and accidents. Only one of these projects was correctly analysed for significance in the original reports. In two cases, those of the 7 police districts experiment and the Slough Experiment, it has not been possible to determine whether the results were significant from the information available. Of the results where an analysis of significance is possible, the Wisconsin Experiment, Operation 101, the No. 7 Police District Experiment, and the R.R.L.30 mph Limit Experiment all experienced a drop in accidents coincidental with extra police supervision, which in some sense could be regarded as significant at the 5% level. In every case there were aspects of the experiment which could have allowed alternative explanations to have accounted for the changes. The most consistent of these is presence of publicity in three of the cases and perhaps in all four. In several instances too, there is a deficiency in records of traffic volume and road engineering changes, while the Wisconsin Experiment requires the inclusion of a great deal of historical data going back 10 years for significant results to be obtainable. However the combination of the four results amount to a very strong case that very large increases in police activity, coupled with publicity of the increase, does lead to a significant decrease in the number of accidents. The two experiments not so far referred to are the Swedish Experiment, which proved too small to allow any significant results to be obtained, and the York and North Riding Experiment the results of which it would be safest to ignore. It is doubtful if the results of the experiment would have received the publicity they did, had they not shown a large decrease in accidents when extra police effort was in operation. Further the experiment was repeated one year later with very different results.

There were rather more experiments dealing with the effect of enforcement on some aspect of driver behaviour, and the most common aspect of behaviour examined was vehicle speed. Five experiments are reviewed in section 3.3 above. Only one of these attempted any analysis of the significance of their results, though all observed reduced speeds when the extra police activity was in operation. The experiment which did analyse the results for significance found a similar decrease in speeds on the control routes, which rendered the changes not significant.

The analysis was done on the assumption that vehicle speeds are independent. This assumption is shown to be invalid for the Durham Experiment in Section 5.7 below.

The other behavioural measures also suffer from a lack of analysis for significance. The effects on overtaking were examined in three different experiments. In two, the amount of data was inadequate to give significant results while the third showed a decrease in overtaking in the locality of police supervision, but this decrease could not be analysed for significance. One experiment showed improved driver behaviour at pedestrian crossings and traffic signals, but again it is not possible to determine whether this effect was significant. The only result in this area which could be demonstrated to be significant was a significant (0.1% level) increase in the proportion of drivers halting at a halt sign when extra police were in operation in the Swedish experiment. Even here however, the analysis of significance was not included in the original report, and the result is subject to the reservations that the observers may have affected the result by their presence, drivers' actions were assumed independent of those of others and no information is given on changes in traffic volume on the major road.

In both sections 3.2 and 3.3. information on results of previous work was very difficult to obtain. Most experimental results are published only privately by the experimenters, and not in a recognised journal and there is no proper clearing house for information on experiments of this type. The haphazard way in which experiments are recorded and their results publicised contributes to the difficulties of evaluating those experiments for which information is eventually obtained. This is because positive results are much more likely to receive a wide circulation than results which show no significant change. Other experimenters in the area suffer from the deficiencies in publication of results in that information about previous experiments is not available at the proper time, before the design of a new experiment.

Results published with no analysis for significance are very common in this field. Such reports are often of little use and may be misleading.

4. THE INVESTIGATION OF THE EFFECTS OF POLICE PATROLS ON ACCIDENT RATES

4. 1 BACKGROUND

4.1.1 Introduction

This section describes research into the relationship between Police Patrolling and accident rates on trunk roads. The objective of the research was to establish whether changes in Police Patrolling had an appreciable effect on accidents, and if so to make some estimate of the way expected accidents vary with patrol levels and a change in patrol tactics. The research proposal for this is included as Appendix 1. This proposal was submitted to the Home Office Police and Development Branch, and was accepted as the basis for the research to proceed, financed by the Home Office. In the event it became necessary to modify these initial plans, and the experimental design actually implemented is described in Section 4.2 below.

From the outset the experiment was a co-operative effort between Durham Constabulary and Durham University. It was expedient therefore in selecting routes, and planning the police effort for those routes, to confine attention to the roads in the Durham Constabulary area, and the patrol systems operating on them. These roads and the police patrol systems, are the subjects of the next two sub-sections, while section 4.1 is concluded with a sub-section describing what relevant information systems were in operation before the experiment started.

4.1.2 The Road Situation.

The network of classified roads in the Durham Constabulary Area is shown in Fig. 2. The area lies between the large conurbations of Teeside in the South and Tyneside in the North, with large towns also at Sunderland and at Hartlepool.

The Western half of the county is sparsly populated and has therefore less traffic and a relatively low accident rate. The Geography of the area is such that, outside the towns, the greatest traffic travels north/south along either the A1 or the A19. The A1 with an average daily traffic flow of just over 20,000 vehicles per day has roughly twice the traffic volume of the A19 (just over 10,000 vehicles per day), but it is a better quality road, and in consequence both roads have a similar accident rate of about 600 accidents per year on a 24 mile stretch of each. (For detailed accident history see figs 13 to 20). These two roads have normally a high traffic volume, high accident rate, and high police coverage and are insulated from each other by ten miles of other road thus minimising any carry-over effect. They were therefore considered ideal for the purpose of the experiment.

4.1.3 The Organisation of Durham Constabulary

At the start of the experiment in August 1967, the responsibility for motor patrol activities was divided as shown in the following organisation chart:-

- Chief Constable
  - Assistant Chief Constable (Traffic and Communications)
    - Chief Superintendent (H.Q. Traffic and Communications)
      - Chief Inspector (Motor Patrols)
        - Inspector (Section A)
          - Motor Patrol Sergeants
            - Patrol Crews
    - Divisions (A, B, C, D, E, F, G & H)
      - Superintendent (For each Division)
        - Motor Patrol Inspector or Sergeant
          - Divisional Motor Patrol Crews
  - Assistant Chief Constable (CID)
    - Detective Chief Superintendent
      - Detective Superintendent (Technical Aids)
        - Chief Inspector (Serious Incident Squad)
          - Sergeants
            - Serious Incident Squad Crews

These are referred to as patrol cars, not traffic cars, since they were intended to fulfil a dual role of traffic and crime duties. Headquarters patrol units, by virtue of the fact that they were normally detailed onto trunk roads, tended to lay greater emphasis on traffic work, while Divisional patrols, with a higher proportion of town roads, laid greater emphasis on crime work.

There was also a tendency for the emphasis of patrol work to move from traffic towards crime in the hours of darkness.

The patrol strength allocated to each Division, and the strength of the Headquarters patrol unit on 17th August, 1967, (the day the experiment started) were as follows:-

Patrol Strengths (Nominally) available on 17th August, 1967

Divisions	Patrol Cars	Personnel			
		Above Sergeant	Sergeant	P/Constable	P/Women
A	5		2	17	
B	5		1	21	
C	7		2	25	
D	4		1	11	
E	6	1	1	17	
F	8	1	2	25	
G	4		1	14	
H	8	1	2	23	
H.Q. Cars	10	3	4	42	2
Total	57	6	16	195	2

In addition to these 57 patrol cars there were 6 Supervision cars and 16 motor cycles distributed between headquarters and the Divisions.

During the experimental period (August 1967/September 1968) Durham Constabulary was responsible for policing all of County Durham with the exception of Gateshead and South Shields and (from 31st March 1968) the Stockton Area. (See the map: Fig. 2).

4.1.4. Sources of Data

Before setting up data collection systems for any of the parameters which required measurement, it was necessary to examine existing information systems.

Accident data is collected regularly for analysis by the Road Research Laboratory and others. The Police Force is required to file details of every injury and 'dog' accident in their area, which comes to their attention. In addition to this Durham Constabulary record all 'property damage only' accidents in a similar manner for their own internal use, to assist the County Surveyor to identify blackspots, and for local publication. The accident details which have to be forwarded to the Home Office are requested to be stored on punched cards for ease of data handling, and it has proved convenient for all accident data stored by Durham Constabulary to be stored in that manner. This source of data appeared to be the most reliable source of accident information available, and superior to any temporary system which might have been brought in for the experiment. It had the additional advantage of providing ample historical data in a format which could be handled with reasonable ease.

At the start of the experiment, the Durham County Surveyor's Department was asked what information they were able to supply on traffic volume on the A1 and A19. In reply it was stated that measurements of traffic flow were taken regularly at intervals along both roads, that these records were made using automatic counters and that they would gladly extract whatever information was required when the results were ready for analysis.

This source of data was assumed to be adequate; there was also a further source of traffic flow data on either road as it entered the Tyneside Conurbation. These measurements though restricted to just one point on each road, were virtually continuous day and night throughout the year, and only stopped in the event of a breakdown or a covering of snow.

The actual amount of patrolling on any road was not recorded before the experiment, only the duty assignment, but it was later found (Section 6.1) that an average of only just over half the time assigned to patrolling aroute was devoted to doing so. The remainder being taken up with Court Duties, Clerical Work, Sickness, Breakdowns and such duties. It was therefore decided

to set up an information system on times spent patrolling the experimental routes, specially for the experiment. This is discussed in more detail in Section 4.2.3. below.

4.2. THE DESIGN OF THE EXPERIMENT

4.2.1. The Routes and Phases

The project was concerned with examining the effects of police patrolling on the accident rate. In order to do this it is necessary to be able to discount the effects of as many other variables as possible, which are beyond physical control.

Such things as weather conditions, changes in the design of vehicles using the road and changes in traffic law are variables of this type. They cannot be controlled physically, so the experiment was designed to control them as far as possible statistica ly. To do this a control route is used which will experience the changes in other variable to a similar extent to the experimental route, while experiencing no change in the experimental variable, police patrolling.

In fact the roads selected for the experiment, 24 miles each of the trunk roads A1 and A19, were divided into four, 12 mile routes, only one of which was used in an experiment at any one time. This allowed a high concentration of police effort on an experimental route when this was required without placing any undue strain on the police resources available. It also allowed for different Phases of the Project to use an experimental route where there was risk of a carry-over effect from the experiment of the previous Phase. In the event, the two southern routes provided impractical as experimental routes, when one was severely affected by the opening of an alternative section of motorway, and Durham Constabulary's responsibility for policing a large section of the other ceased with a change of police force boundaries.

The four routes were designated as follows:- (see map, Fig.2)

Route 1 A1 from Aycliffe interchange to Cock O' The North roundabout. The Southern part of this route, Rushyford roundabout to Aycliffe interchange was redesignated A167 on the opening of a further section of A1(M) on 15.10.67.

Route 2 Cock O' The North to Gateshead boundary. (Large scale engineering and extensive diversions occurred on this route after 14.8.68). Phase 4 of the experiment (see below for Phases) was terminated on this route on 13.8.68.

Route 3 County Boundary at Yarm (on A19) to the intersection of the A19 with A179. The southern part of this route became the responsibility of the new Teeside Constabulary from 1.4.68, but the new force continued to collaborate with the project and supplied reports on motor patrols.

Route 4 A179 junction with A19, north to Monkwearmouth bridge, Sunderland. Accident rate was recorded for this route, excluding the section Sunderland Art College to Monkwearmouth bridge, owing to the urban character of this section, and the introudction of one-way systems, thus preventing comparison with earlier accident data.

The experiment started with a control phase, in which normal police practice continued on all routes. During this phase the amount of police patrolling was recorded for each route. The second and third phases were used to test the effect of, first two extra patrol cars and then seven extra patrol motor cycles on Routes 2 and 4 respectively.

For the last phase, Phase 4, a change in tactics was tested, in which a system of "Pulsed Patrolling" was used to patrol routes 2 and 4. In this system, a force of 4 motor cycles was used alternately on routes 2 and 4 for successive 10 day periods. It was suggested that an effect might be built up during the period a 'pulse' was in operation, and that drivers, remembering the recent heavy patrol levels might continue to exercise greater care during the period the pulse was "off" and on the other route.

The four phases were thus defined as follows:-

Phase 1 — The period 9.8.67 to 19.11.67, a total of 103 days, of which 61 were prior to the introudction of the 1967 Road Safety Act ("The Breathalyser Law") and 42 subsequent to this. No modification to existing police practice were introduced on any of the four routes.

Phase 2 — Phase 2 ran from 20.11.67 to 11.2.68, a total of 84 days. In this period routes 1, 3 and 4 were continued as controls, but an additional two patrol cars were allocated to route 2.

Phase 3 — Phase 3 ran from 12.2.68 to 19.5.68, a total of 98 days. Routes 1 and 3 were used as controls, and seven additional motor cycle patrols were allocated to Route 4. Motor cycle patrols were preferred for Route 4 because of the road conditions (narrow, undulating road).

Phase 4 — Phase 4 ran from 27.5.68 to 14.8.68 on route 2 but to 30.9.68 on routes 1, 3 and 4. Except for route 2 the duration of this phase was 127 days, (79 days on route 2). In this phase routes 1 and 3 were controls, while an additional force of 4 motor cycles was used, in alternating fashion, in successive 10 day periods on routes 2 and 4 in the hope for some evidence of the "carryover" of the sharp pulses of patrolling.

The experimental design, in terms of Routes and phases is summarised in Table 4.2.1. below.

TABLE 4.2.1

SPECIFICATION OF ROUTES, PHASES AND EXPERIMENT PERIODS

	Phase 1* 9.8.67 to 19.11.67	Phase 2 20.11.67 to 11.2.68	Phase 3 12.2.68 to 19.5.68	Phase 4+ 27.5.68 to 30.9.68
Route 1. Trunk Road. A.1 from Cock O' The North Roundabout to Aycliffe Interchange.	Control	Control	Control	Control
Route 2. Trunk Road A.1. from Gateshead Borough Boundary to Cock O' The North Roundabout.	Control	First Experiment	Control	Third Experiment
Route 3. Trunk Road A.19 from Junction with A.179 Road to North Riding County Boundary.	Control	Control	Control	Control
Route 4. Trunk Road A.19 from Monkwearmouth Bridge, Sunderland to Junction with A.179 Road.	Control	Control	Second Experiment	Third Experiment

* Phase 1 was sub-divided at midnight 8/9.10.67 to allow analysis of introduction of breathalyser.

+ Except Route 2 which terminated on 13.8.68 due to extensive road improvements commencing.

4.2.2. External Influences and Corrective Action

In the previous section a number of these external influences have already been mentioned briefly. The introduction of the controvercial breathalizer law on 9.10.67 was the first such influence to affect the experiment. As a result of this the control phase was extended beyond the length which had originally been intended, to allow some assesment of its effect on all the routes, before that influence was distorted by the additional effect of the extra patrols on Phase 2. Soon after this on the 15.10.67 a further section of the A1(M) motorway was opened, and the section of Route 1 from Aycliffe Interchange to the Rushyford roundabout was re-designated A167. This change was anticipated from the start of the experiment, and it was envisaged that some time would be needed on this route to assess the effect of this change before it could be used as an experimental route. In the event, it was thought safest to keep Route 1 for control use only, throughout the experiment.

on 1st April, 1968, the Teeside Constabulary was formed, incorporating the Stockton Division of Durham Constabulary, which took with it responsibility for policing route 3 from Wolviston South to the old county boundary. The new Force agreed to co-operate with the experiment, and continued to furnish information about both patrol levels and accidents coming to the notice of the police. However, Teeside had rather less patrol strength from which to draw any enhanced patrol levels, so it was decided from the date of the formation of the new force, to try to maintain patrol levels as nearly as possible to the patrol levels formerly operating on that part of the route. As a result of this Route 3 also was retained as a control route throughout the experiment.

On 14th August, 1968 extensive diversions and road works started on the north end of Route 2. Some road works had been anticipated, in order to bring the road from dual carriageway standard up to two lane motorway standard, but the disruption of traffic which actually took place was far in excess of what had been anticipated, and the experiment was drawn to an early end at that date on Route 2.

All other external influences were deemed sufficiently minor to be controlable statistically, or to be negligible.

4.2.3. Design of Data Collecting Systems

Patrol Levels The allocation of patrols to routes, and the releasing of patrol officers for other duties, throughout the experiment were at the discretion of the Operational Commanders, and outside the control of the experiment team. Changes in patrol level were agreed by the experiment team. They were then discussed with the operational commanders who were responsible for implementing the changes. The actual patrolling achieved was measured directly by a Motor Patrol Form (see Documents 1 and 2).

The purpose of this form was to give an unbiased record of the actual patrolling taking place. For this reason it was decided that this document should not be incorporated into the management and control system for police patrols, but should be forwarded directly and anonymously by patrol officers.

On 10th August, 1967, one week before the experiment started, copies of Document 1 were distributed among the patrol officers likely to be involved in the experiment. At a meeting of all such officers they were briefed by members of the experiment team, about the experiment and its aims, and the patrol form, its purpose and its relation to the project. Special stress was laid on the anonymity of the form and the fact that it would not be used to assess an individual's performance. Document 2 was issued in place of Document 1 part way through Phase 1, the extra information requested on that form was used as a basis for anciliary investigations discussed in Section 6 below.

On two selected days per month identifiable police vehicles other than patrol cars were also required to fill in motor patrol forms whenever they travelled along any of the four routes. An initial assumption that these returns could be easily distinguished from returns by patrol crews proved incorrect in the respect of patrol cars driven by civilian drivers. Therefore at the start of Phase 4, when the patrol form was slightly modified to include

the routes on which offences were detected, it was reissued in red for use by patrol crews, and in green for use by other identifiable police vehicles on the selected days. The analysis of patrol time on routes contained in figures 7 to 11 is based solely on returns by patrol cars. Patrol data for the first three phases has been cleaned of returns by other identifiable police vehicles, in so far as this was possible from an examination of call signs. Analysis of the Green form returned indicates that the returns which could not be extracted in this way are likely to be negligible.

The patrol forms were so designed that they could be used directly as punching documents. The information contained in them was transferred to punched cards and then analysed by computer. Greater accuracy could thereby be achieved, while the volume of data was such that manual analysis would have been impossible without an additional member of the research team. Unfortunately there were delays in obtaining a satisfactory working programm occasioned in part by the late commissioning of computer system used (the Northern Universities Multiple Access Computer, "NUMAC", an IBM 360 model 67). This resulted in planning decisions for later phases being made, with only the overall phase totals of patrol time being available for each route, from earlier phases.

Accident Rates The system for collecting accident data was grafted onto the existing system. It was agreed that whenever a punched card was prepared at police headquarters for an accident on the A1, the A167, or the A19, then a duplicate card should be cut and this should be forwarded to the research project team. The precise location of the accident was written on the card, and so when this card was received by the project team it was coded more precisely for route and location, and this code was punched into a field on the card, which would otherwise have been blank.

The data was again analysed by computer, and again the late commissioning of "NUMAC" caused full information on accident data to be delayed until near the end of the project.

In the interim period before computer results were obtainable, the monthly tabulation of accidents statistics by the police for internal use, was monitored

as a possible indication of the progress of the experiment. By June 1968 the apparent decrease in accident figures on both A1 and A19 were so pronounced as to lead to suspicion of their accuracy.

A spot check revealed discrepancies in these statistics. The extent of the discrepancies is apparent from table 4. 2. 2 below in which the abstracts from the Monthly Accident statistics relating to A1 and A19 are compared for June 1968 before the mistake was corrected, and August 1968, after correction. These are clearly inconsistent.

Table 4.2.2. EXTRACTS FROM MONTHLY ANALYSIS OF ACCIDENTS

June 1968 (before correction)

	Fatal	Ser.	Slt.	Dam.	Monthly Total	Prog. Total Fat.	Ser.	Slt.	Dam.	Total for end of June 1968
A.1 (M)	-	-	2	4	6	-	3	22	49	74
A.1 Trunk	2	1	4	19	26	5	8	42	106	161
A.19	-	-	2	2	4	2	3	28	16	68

August 1968 (after correction)

	Fatal	Ser.	Slt.	Dam.	Monthly Total	Fat.	Ser.	Slt.	Dam.	Total for end of August 1968
A.1 (M)	-	-	-	2	2	-	-	3	3	6
A.1 Trunk	1	1	14	17	33	6	14	88	203	311
A19 Trunk	-	2	5	6	13	4	22	89	142	257

At the end of the project, an analysis of Durham Constabulary Headquarters accident cards and the duplicates received by the project team revealed a number of accidents for which duplicates had not been received. These ommisions were then corrected.

Much of the earlier accident data was stored on an early type of punched card, which used holes in the shape of a figure 8. It was only after extensive enquiries that equipment was found which could sort these cards, at the Ministry of Social Security in Longbenton, Newcastle-on-Tyne. When cards relating to the A1 and A19 had been sorted from the much larger volume for all accidents in the Durham Constabulary area, these cards had to be repunched onto conventional punched cards. Some cards for accidents on part of the A19 also had to be punched from manuscript sources. These were the part of route 4 in the Sunderland Police Force Area prior to its amalgamation with Durham Constabulary in April 1967, and the part of route 3 in the Teeside Constabulary area, after its formation in April 1968.

Traffic Volume It has already been stated that the project team was led to believe that Durham County Surveyor's Department kept extensive records of traffic volume at intervals along both routes. When it was too late to have traffic counts made specially for the projects, it was discovered that the County Surveyor's Department's records were made on different parts of the road, at different times of the year, and in different years without any of these parameters being kept constant. Thus any real changes in traffic volume might have been the result of seasonal variation, a long term trend, or different levels of useage on different parts of the route. Further, this data was modified by multiplication by a scaling factor derived from national data. Thus data taken in January was multiplied by 2.33 to convert to 'August traffic flow'. Comparison with local traffic courts (see figs.3, 4, 5 and 6) indicates that this figure is totally unrealistic under local conditions.

It was therefore concluded that the Surveyor's Department's data was unsuitable for purposes of the experiment, and so the alternative source of data provided by the Tyneside Conurbation Traffic Survey was used instead.

This survey had two fixed survey points, one at the very northern end of Route 2 and one a few miles north of the northern end of route 4. Data was extracted for one week in each month from December 1966 to September 1968, and from this average daily traffic flows were calculated (see Figs. 3, 4, 5 and 6).

4.3 ANALYSIS OF RESULTS

4. 3. 1 The Traffic Flow

It has already been pointed out in the previous section that the traffic flow information available from the County Surveyor's department was inadequate for the purpose of the experiment. The data supplied by the Tyneside Conurbation Traffic survey is the only alternative traffic flow information. The traffic volume past each measuring point in a sample week for every month between December 1966 and September 1968 are presented graphically for the A1 in Fig. 3 and for the A19 in Fig. 4. As may be seen by reference to these graphs there is no indication of any appreciable trend or seasonal variation. A similar conclusion is reached if traffic volume between 8 a.m. and 6 p.m. is examined (Figs. 5 and 6).

It was assumed that no appreciable changes in traffic volume had occurred throughout the two routes, and the remaining analysis neglects traffic volume as an uncontrolled variable, and assumes it to have a controlled, constant value.

There is no proof that the full lengths of the A1 and A19 used in the experiment, experienced the same constant traffic volumes observed at their northern ends.

4. 3. 2. The Patrol Levels

The patrol forms completed by Motor Patrol Officers were analysed by computer to produce the histograms of average daily patrol hours performed on each route, shown in Figs. 7, 8, 9 and 10. When plans were being laid for Phase 3, the average patrol hours produced in Phase 2 on the experimental route (route 2) were compared with the average patrol hour on the same route in the control phase.

At that time these two figures appeared very much the same, and the

reason suggested was the dissipation of the extra police effort by travelling time to their assigned routes, and by police duties other than patrolling. It was then concluded that two cars was too small an increase to make any appreciable difference. That was why an additional seven motor cycles were requested for the third phase.

Though there was no marked rise in the overall reported patrol hours on route 2 between Phase 1, and the first part of Phase 2, it would appear from Fig. 6 that a more likely explanation for this is that a substantial increase in patrol hours performed did occur, but that this occurred simultaneously with a near exponential decay in the proportion of patrol hours performed which were recorded on a motor patrol form. An even more pronounced decline in recorded patrol time was experienced on Route 1 which was a control route throughout, and should therefore have experienced near constant patrol levels. The effect is discernable on Route 4, though slightly less marked, but there is very little evidence of it on Route 3, though there is a very pronounced drop in the reported patrol levels after the formation of Teeside Constabulary in April 1968. Further evidence that the fall in reported patrolling was caused by a fall in reporting rather than a fall in patrolling, is apparent from the changes in the level of reported patrol activity in May 1968 when a red modified motor patrol form was brought in to replace the white original.

This minor modification, coupled with a limited amount of rebriefing created what appears to be an astonishing renewal of interest in completing the patrol forms. This renewal of interest appears to have been short-lived, and reported patrol hours again begin to decline rapidly.

It is of course possible that the above speculation is incorrect and that the data presented in Figs. 7, 8, 9 and 10 are substantially the true record of the patrolling which took place. This possibility has been discounted by all the senior police officers consulted, and by the project team.

Reverting to the assumption that the proportion of patrol hours which were recorded declined steadily over the first three phases, it is possible to estimate the increases in actual patrolling which took place in phase 2 on Route 2 and in Phase 3 on Route 4. This may be achieved using the trends in reported patrolling.

In this way it is estimated that patrol levels were very nearly doubled for the second phase on Route 2, and that patrol levels were very nearly trebled for phase 3 on Route 4. A similar assessment was not attempted for Phase 4 because of the effect of an apparent widespread renewal of interest accompanying the introduction of the red version of the motor patrol form.

Reference to Fig. 11, in which reported patrol time in Phase 4 is analysed by the ten day pulse periods shows that, at least in the early stages the designed alternation between high and low patrol levels did in fact occur. The mean level of patrolling on either route when a pulse was "off" was approximately half the level of patrolling when the pulse was "on".

The results of the use of the Motor Patrol form were very different than had been expected at the start of the experiment. The experiment team had been led to believe, as several senior police officers appeared to believe, that if patrol officers were explained the purpose of the form, and left in no doubt how to fill it in, and if the Chief Constable issued a force order that the form should be filled in, then in a disciplined force the proportion of patrol officers who would ignore this order would be negligible. Most senior police officers in Durham Constabulary now concede that this did not occur. From the point of view of Police Force organisation and control, this in itself seems to have been a worthwhile discovery.

In view of the foregoing discussion of the response of patrol officers who should have returned motor patrol forms regularly, and who had been carefully briefed, it was felt that little emphasis should be placed on the results of the occasional returns by other identifiable police vehicles. Those returns received for routes 1, 2 and 4 were relatively negligible. However on Route 3 the levels reported by Panda Cars were considerably in excess of the patrol hours reported by motor patrol vehicles.

4. 3. 3 The Accident Levels

In Section 13 at the back of this thesis there are two sets of graphs which show the accident rates on the four routes. Figs. 13, 14, 15 and 16 show the historical accident rates over the 24 hour day for each phase on each roote, while Figs. 17, 18, 19 and 20 show the corresponding information for the ten hour daytime period 8 a.m. to 6 p.m. over which all patrol changes were concentrated. In all cases these data have been normalised to 100 day periods, to facilitate easy comparison between phases. A comparison of Phases for each route reveals no pronounced seasonal variation in accidents. This tends to support the assumption in Section 4. 3. 1 above, that traffic volume has no appreciable seasonal variation on any of the routes.

Another feature, very apparent from these graphs is the consistent large drop in accidents on route 1 in the last three phases, following the opening of the Bradbury section of the A1 (M). For this reason, the analysis of the next section only uses data from the period after this length of Motorway was opened.

The next feature apparent from these graphs is the lack of any major depression in accidents when any of experiments were in progress, compared with the fluctuation in accident rate experienced in the normal accident history of the routes. This comparison is not the basis of the statistical analysis in the next section since historical accidents are subject to influences of which the experiment team had no control and no record. Such influences would include the level of policing and engineering modifications. Only accident data for the period of the experiment when all such factors were carefully monitored, are therefore used for the statistical analysis which follows.

4. 3. 4 Statistical Analysis

The statistical analysis of the accident data has been restricted to the period 6 a.m. to 6 p.m. when a patrol car would be visible. The period eliminates most of the effect in the introduction of the "Breathalyser" Law (Road Traffic Act 1967). Phase 1 on Route 1 was restricted to the 35 days subsequent to the opening of the motorway, on 15 October 1967, to eliminate the resultant effects of changes in traffic volume. Similarly, Phase 4 on Route 2 was curtailed to 79 days by major road works on a large section of the route which started on 14 August 1968. The number of days in phase j on route i, m (i, j) are therefore as shown in the following table:

Table 4. 3. 1 Number of days in Phase j on Route i (M(i,j))

	j = 1	j = 2	j = 3	j = 4
i = 1	35	84	98	127
i = 2	103	84	98	79
i = 3	103	84	98	127
i = 4	103	84	98	127

If the experiments carried out have no statistically significant effect, we would expect the number of accidents in any phase j, on any route i, to be approximately equal to t(i) s(j) m(i, j), where Σ t(i) = 1 and where t(i) is a factor depending only on the route, and s(j) is a seasonal factor, depending only on the phase. In this case the difference between the estimate of the accidents in phase j on route i, e (i,j) and the actual number of accidents n(i,j) would be explicable as random variations. In order to derive values of e(i,j) = t(i) s(j) m(i,j) it is necessary to obtain values of t(i) and s(j) which make the estimate e(i,j) 'nearest' the number of accidents n(i,j). This is done by the method of maximum likelihood (Ref.18). This method indicates that the required values of t(i) and s(j) must satisfy the equations:-

$$t(i) \sum_j m(i,j)\, s(j) = \sum_j n(i,j) \text{ for } i = 1 \text{ to } 4,$$

$$s(j) \sum_i m(i,j)\, t(i) = \sum_i n(i,j) \text{ for } j = 1 \text{ to } 4$$

and $\sum_i t(i) = 1$

Ref. 18 also shows that with values e(i,j) so derived, and for large values of n(i,j), the statistic $X^2 = \sum_i \sum_j \left(\frac{(n(i,j) - e(i,j))^2}{e(i,j)} \right)$ has a chi-squared distribution with nine degrees of freedom. The size of X^2 is indicative of the degree to which e(i,j) is a good estimator of n(i,j). If X^2 is small then differences of this magnitude are likely to arise from purely random variations, and there is no justification for claiming that the experiments had any significant effect on accidents. Reference to a standard table of values of X^2 indicates the probability that a value of X^2 as large as the one encountered could have arisen from random causes.

For Injury and Fatal accidents in the period 8 a.m. to 6 p.m. the number of accidents in phase j on route i, n(i,j) is given in the following table:-

Table 4. 3. 2 Values of n(i,j) for Injury and Fatal accidents (8 a.m. to 6 p.m.)

	j = 1	j = 2	j = 3	j = 4
i = 1	3	8	7	22
i = 2	20	22	10	14
i = 3	22	17	17	25
i = 4	12	13	14	14

This produces the following values of s(j) and t(i):-

s(1) = .6311 s(2) = .7143 s(3) = .4898 s(4) = .6640

t(1) = .1866 t(2) = .2927 t(3) = .3148 t(4) = .2060

Hence e(i,j) is given by table 4. 3. 3

Table 4. 3. 3 Values of e(i,j) for Injury and Fatal accidents (8 a.m. to 6 p.m.)

	j = 1	j = 2	j = 3	j = 4
i = 1	4.1	11.2	9.0	15.7
i = 2	19.0	17.6	14.0	15.4
i = 3	20.5	18.9	15.1	26.5
i = 4	13.4	12.4	9.9	17.4

From tables 4. 3. 2 and 4. 3. 3, we may tabulate values of $\frac{(n(i,j) - e(i,j))^2}{e(i,j)}$ which is done in Table 4. 3. 4.

Table 4, 3, 4. Note all values are positive, (+) following an element indicates that the corresponding element of n(i,j) was larger than that of e(i,j) and (-) indicates the converse.

	j = 1	j = 2	j = 3	j = 4
i = 1	0.3(-)	0.9(-)	0.4(-)	2.5(+)
i = 2	0.1(+)	1.1(+)	1.1(-)	0.1(-)
i = 3	0.1(+)	0.2(-)	0.2(+)	0.1(-)
i = 4	0.1(-)	0.0(+)	1.7(+)	0.7(-)

This gives a value for X^2 of 9.6 which is exceeded by random fluctuations, with a probability of a little more than .3 (1 in 3). Any effect on Injury accidents that might have been achieved in the experiments are therefore not distinguishable from random fluctuations in Injury accident levels. Reference to the signs in brackets in table 4. 3. 4 for i = 2 and j = 2 and for i = 4 and j = 3 shows that the actual number of reported accidents was in fact higher than expected when extra patrols were on, though the increase was not statistically significant. This suggests that a higher proportion of accidents were reported when extra police were readily available.

Consider in the same way, all the reported accidents in the period 8 a.m. to 6 p.m. These are given in table 4. 3. 5.

Table 4.3.5 Values of n(i.j) for all reported accidents (8 a.m. to 6 p.m.)

	j = 1	j = 2	j = 3	j = 4
i = 1	14	24	19	45
i = 2	82	82	51	51
i = 3	62	53	64	73
i = 4	36	29	38	43

This produces the following values of s(j) and t(i):-

s(1) = 2.098 s(2) = 2.2381 s(3) = 1.7551 s(4) = 1.9366

t(1) = 0. 1502 t(2) = 0.3652 t(3) = 0.3068 t(4) = 0.1778

and hence the following values of e(i,j):-

Table 4.3.6 Values of e(i,j) for all reported accidents (8 a.m. to 6 p.m.)

	j = 1	j = 2	j = 3	j = 4
i = 1	11.0	28.2	25.8	36.9
i = 2	78.6	68.7	62.8	55.9
i = 3	66.1	57.7	52.8	75.5
i = 4	38.3	33.4	30.6	43.7

From tables 4.3.5 and 4.3.6 the following table of values of

$\frac{(n(i,j) - e(i,j))^2}{e(i,j)}$ is derived.

Table 4.3.7 Values of $\frac{(n(i,j) - e(i,j))^2}{e(i,j)}$ (All these values are positive but are marked by (+) to indicate that n(i,j) is greater than e(i,j) or by (-) to indicate the converse.)

	j = 1	j = 2	j = 3	j = 4
i = 1	0.8(+)	0.6(-)	1.8(-)	1.8(+)
i = 2	0.1(+)	2.6(+)	2.2(-)	0.4(-)
i = 3	0.3(-)	0.4(-)	2.4(+)	0.1(-)
i = 4	0.1(-)	0.6(-)	1.8(+)	0.0(-)

From table 4.3.7 a value of X^2 of 16.0 is derived, and consulting chi-squared tables, the probability of obtaining a value of X^2 as high as this or higher from random causes is found to be a little over .05. That is on a little over 1 in 20 occasions differences between actual and expected numbers of accidents might have been as large if the experiment had no effect at all. The changes

in accidents observed are therefore not statistically significant at the 5% level.

There are, however, strong indications that a change in the accident rate might have taken place, and the elements corresponding to Phase 2 on Route 2 and Phase 3 on Route 4 both make large contributions towards X^2 and in both cases the number of accidents reported are larger than expected. This tends to indicate that the proportion of accidents reported increases more than sufficiently to compensate for any deterrent effect of extra patrols on accidents. Another large element in Table 4.3.7 corresponds to Phase 3 on Route 2, supporting to some extent the proposition that there might be quite a long memory effect from a higher level of patrolling. It should, however, be noted that a high element occurs for Phase 3 on Route 3 with no apparent cause except perhaps that there may have been an increase in the actual amount of patrolling which was not designed.(see Fig. 9).

4.4 CONCLUSIONS

From the first project, there was no clear, detectable relationship between the levels of police patrolling and of reported accidents on trunk roads, within the limitations of the experiments. For significant results to have been obtained, a large percentage change in the accident rate would have been required (see Fig.1). The experimental design also precluded the detection of very long term effects of police enforcements, and the detection of any deterioration in the accident position with very low levels of patrolling. If this latter effect is the case, it could only be detected by operating patrols on some routes at very low levels for a considerable period of time. If the effect were thereby detected, it might be achieved at the cost of considerable loss of life and serious injury. This was not a risk which the Police who co-operated with this experiment were prepared to take.

There is some evidence from the project of a rise in reported non-injury accidents in the presence of increased patrolling. This could be indicative of a rise in the proportion of such accidents coming to the attention of the police. Further experiments to relate the cost of patrolling with the benefit which might result in reduced accidents, should therefore ideally derive a source of accident data independent of the police. One possible source of such data would be the combined records of the insurance companies. The effort required to obtain and collate such data would be well beyond the resources of the Durham team.

From experience of trying to use Durham Surveyor's Department's traffic flow data, it has become apparent that a number of modifications in their procedure would benefit all who use their data. It is clear that adjustment figures which are based on assumed seasonal differences in traffic flow of as much as 230% are totally inappropriate for these routes. More appropriate seasonal factor should therefore be found, or the practice of seasonal correction should be abandoned.

Traffic counts would be of greater use if they were made simultaneously along a section of road, or at a single point at various times throughout the year, or at a single point at the same season in successive years. I understand that the Durham practice for organising traffic counting is by no means unique. These conclusions would therefore have much wider application than to Durham County alone.

The project experienced serious weaknesses in the control of the police activity for the experiment, and particularly in the control of information received about police activity related to the project. It was therefore concluded that in an experiment of this type it is essential to restrict the police officers concerned with the project to as small a team as possible, and to integrate the command structure of this team, with the experimental team conducting the project, in so far as this is feasible. This conclusion had a great influence on the organisation of the second project (see Section 5.3 below).

5. THE EFFECTS ON DRIVER BEHAVIOUR OF CHANGES IN POLICE PATROLLING

5.1 GENERAL

In the previous section it was shown that any further experiments into the relationship between police patrols and accidents would require:-

1. A more suitable source of accident data, not available to the Durham team.
2. A tightly controlled team of police officers performing the patrolling.
3. So large a volume of accidents for a moderate change to show as significant, that an extensive network of roads would be required. Considerable Major Road works would have prevented such a scale of experiment within the confines of the Durham Constabulary Area, while extension to another police force area would have made tight control of the police effort quite impossible.

Further use of accidents for assessing police effectiveness had therefore to be ruled out. The question then arose whether an examination of police effect on various aspects of driver behaviour could serve any useful purpose. It seemed clear that if the police are to affect accident levels they must do so by inducing drivers to improve their driving behaviour. Conversely if driver behaviour is improved then this should inevitably have some effect on the probability of an accident occuring.

Without knowing how much various changes in driver behaviour affects the accident rates, it is not possible to assess th value of different levels of policing, merely by examining their effect on driver behaviour. It is therefore not possible to use changes in driver behaviour to determine optimal patrol levels. However, assuming that is is possible to evaluate whether one set of driver behaviour is better than another, then it is possible to use driver behaviour to evaluate the relative merits of two equally expensive patrol tactics.

In phase 4 of the first project a system of patrolling, referred to as pulsed patrolling was tested experimentally. No conclusion could be drawn from the effect on accidents, however some reasonably favourable reports were received from some of the patrol officers operating the scheme. It was therefore decided to test a pulsed patrol scheme against a conventional uniform patrol scheme, using the same police resources, by examining their respective effects on driver behaviour. Before this could happen it was necessary to experiment with a number of possible measures of various aspects of driver behaviour, and these pilot experiments are described in the next section.

After the completion and evaluation of the pilot experiments a project was devised for the testing of pulsed patrolling against uniform patrolling using various measures of driver behaviour. A proposal along these lines (Appendix 3) was submitted to the Home Office Police Research and Development Branch and to Durham Constabulary, and received the support of both bodies.

5.1 THE PILOT EXPERIMENTS

5.2.1 The Purpose of the Pilot Work

In order for a measure of driver behaviour to be acceptable for experimental purposes, it should be objective. For measures depending on the subjectiveeassessment of the observers it would be very difficult to maintain a consistant standard of aesessment throughout a long experiment. Judgements made on the basis of such measurements might well be influenced by the bias of the observer in favour of one method of patrolling rather than another. Further,

subjective assessments could give rise to problems in the statistical analysis of the significance of results.

Another requirement of an acceptable measure of driver behaviour is that, with a reasonable observation period, sufficiently tight confidence limits can be placed on observed mean results, for a reasonably small change in the measure to be detectable as statistically significant. If this criterion is not fulfilled then material changes observed under two different patrolling systems will be indistinguishable from random fluctuations.

A third requirement for a measurement of driver behaviour is that a suitable site should exist for the observation of this aspect of driver behaviour, without the observers causing danger to themselves, or other road users, without their influencing the behaviour they set out to observe, and without their being too exposed to the elements. These requirements usually amounted to there being a place where the observers could observe the aspect of driver behaviour from a vehicle which was safely and inconspicuously parked.

It was envisaged that the second project would take place on the major roads in the North East corner of the County, and so pilot experiments were conducted in that area. Prospective measures were assessed by the three criteria above. Where a measure proved unsatisfactory, reasons for this are given. The assessments of possible measures of driver behaviour follow in sections 5.2.2. to 5.2.6.

5.2.2. Left and Right hand turns

Left and right hand turn accidents is the largest category of reported accidents in the Durham Constabulary Area. These accounted for 8% of all reported accidents in 1968. The Highway Code describes three stages in the correct execution of a left or right hand turn. These are:-

1. Check the mirror.
2. Signal intention.
3. Take up the correct position and turn.

It is not possible for an observer, not in a vehicle, to determine whether the driver checks his mirror before executing a turn. No suitable measure was therefore possibly related to this aspect of turning behaviour.

Two properties of the signal were considered as possible measures of driver behaviour. The proportion of drivers who made a signal before turning was examined at a test site, but it was found that the proportion was so high, that a considerable amount of data would have been required in order to have detected a significant improvement. This measure was therefore abandoned as unsuitable. The distribution of the time and distance between the signal and the turn is another possible measure. No field trials were used to test this in practice.

It is difficult to conceive of a measure of the execution of the actual turn which is not highly subjective. Any concept of correct positioning would inevitably be ruled out for this reason. One possibility would be the distribution of the time between a vehicle turning right across a main road, and an oncoming vehicle passing the junction. This however would be influenced considerably by the speed of the traffic stream, which might itself be influenced by changes in police patrolling. Further this parrameter might bear little relationship to the risk involved in the manoeuver. An oncoming vehicle which had been forced to brake sharply, might take a relatively long time to actually pass the junction, while an oncoming car which had signalled by flashing its headlights might pass the junction quite safely a very short time after the turning vehicle had crossed its path.

Similar objections might be raised to a measure based on the position of the oncoming car when the manoeuver was performed.

Another similar measure is the proportion of turns in which the oncoming car brakes as a result of a turn in front of it. Here again difficulty would be encountered with drivers who braked first to allow traffic to turn in front of them. This event could also indicate a deterioration in turning behaviour or an improvement in the driving performance of oncoming vehicles. With all measurements based on the interaction of turning and oncoming vehicles difficulty would be experienced in obtaining sufficient data to provide the

the desired narrow confidence interval.

No satisfactory measure was found for any aspect of drivers' performance of right or left hand turns.

5.2.3. Overtaking

Improper overtaking is another common cause of accidents. In 1968, 6% of the reported accidents in the Durham Constabulary Area were believed to have been caused this way.

There are many situations in which the highway code recommends that drivers should not overtake. Road markings also often indicate where overtaking would be hazardous. In these situations the number of overtakings which may be observed in a reasonable observation period appear from test observations to be quite small. It would therefore be very difficult to establish the required narrow confidence interval.

Over a longer stretch of winding road, the number of overtakings may be sufficiently large to provide the required accuracy. On such a road it is normally not possible to find a vantage point where all overtaking may be observed simultaneously. However it is possible to record the order in which vehicles enter a long section of winding road, and the order in which they leave it. The degree to which the second sequence differs from the first is strongly related to the minimum number of overtakings which can take place. A number of pilot experiments were conducted on this principle using the South-bound stream of traffic between Cold Hesledon Railway Bridge and Eagle Hall Bank on the A19 trunk road. The sequence of vehicles past each observer was recorded using as the main identification the registration number. Where this was obscure, or difficult to read, and time permitted, other salient features were also recorded.

Recording was performed onto portable tape recorders for the pilot experiments, but considerably mechanical problems were encountered with these

instruments. When this measurement was modified for Project 2, portable dictating machines were used instead, and these proved much easier to use and more reliable.

The recordings were transcribed and then compared. Because vehicles joined and left the route between the two observers, not all vehicles in one list were in the other. The measurement concentrated on those vehicles in common between the two lists. The number of vehicles in this common list was computed together with the minimum number of these which had to be deleted before the remainder passed both observers in the same order. In the pilot experiment buses and police patrol vehicles were both ignored since both were very likely to stop en route.

Four pilot measurements were made, and are presented in table 5. 2. 1 below. The first point referred to is at Cold Hesledon Railway bridge, the first observer passed by the Southbound stream of traffic. The second point is the observer at Eagle Hall Bank, passed by the stream of traffic as they leave the winding overtaking section of road.

Measurements 1 and 2 took place between 11.15 hours and 12.15 hours. Measurements 3 and 4 both started at 14.45 hours, but Measurement 3 lasted 2 hours while measurement 4 had to stop after only one hour. For measurements 2 and 4 there was intensive local police supervision, while for measurements 1 and 3 police supervision was normal.

All measurements suffered to some extent from the poor performance of the recording equipment, but measurement 1 was particularly badly affected by intermitent breakdown.

Table 5. 2. 1

Measurement Number	No. past 1st point	No. past 2nd point	No. in common	Min. No. to be deleted	% of No. in common
1	168	243	132	18	14
2	251	242	204	28	14
3	399	463	319	39	12
4	373	299	218	16	7

There is clearly no significant difference between the % of the list in common which had to be deleted for measurements 1 and 2. The chi-square test is obviously not strictly applicable in this case since a vehicle's deletion from the list depends on the presence of other vehicles on the road. However, for a rough approximation, to be used for the pilot experiment only, a 2 x 2 chi-square test was performed on the data from measurements 3 and 4. The result just failed to be significant at the 5% level. In spite of this the pilot experience with this measure was still felt to be sufficiently encouraging for the measurement to be included in a modified form in project 2.

5. 2. 4 Speed

Excessive speed is the accepted cause of many accidents and must be the main contributory factor in many more. In 1968 3% of reported accidents in the Durham Constabulary Area were ascribed to excessive speed, and a further 3% were ascribed to "losing control". The distribution of speeds of vehicles in a traffic stream therefore deserves consideration. The chief advantages of measurements based on the speed distribution is that they are completely objective, are naturally quantitative and produce relatively large samples in a short period, since all vehicles passing a point have a speed. The implications of speed distributions, change with the position of the point at which the speeds are measured.

Speed measurements were considered under three main categories.

1. in a 30 m.p.h. limit zone
2. in a 40 m.p.h. limit zone
3. in a derestricted area

Speed is especially important at the approach to a recognised road hazard. A fourth category was considered as an example of this, viz.

4. at the approach to a pedestrian crossing

Pilot speed measurements were all made using a radar speed meter, masked by the observers car, which was parked well off the road to avoid influencing the speeds being measured. As with the measurement of overtaking, pilot measurements were made in the presence of intensive local police supervision, and again with normal police supervision levels. Pilot experiments were conducted at one site in each category with the exception of category 3. A sudden deterioration in weather conditions prevented this measurement going ahead as planned.

The results of the other pilot speed experiments are presented in tables 5.2.2, 5.2.3 and 5.2.4. below.

An initial appraisal of this data was performed based on the assumption that vehicle speeds were independent random samples from a normal distribution. While it was realised that both the assumptions of normality and of independence were slightly suspect, this was the standard method recommended in Traffic Engineering Handbook (ref. 19). On these assumptions the reductions in mean speed in each category experienced in the presence of intensive local police patrolling were significant at the 1% level. However, later experience in Project 2 indicates that the assumption of independence is totally wrong. It may well be that a real reduction in mean traffic speed did occur in the presence of intense local police supervision, but without the assumption of independence, it is impossible to analyse the significance of the changes in mean speed. If it were possible to assume that the variance of mean speeds were those experienced at the 30 m.p.h. limit speed measurement of Project 2, then the changes could be assessed just significant at the 5% level, but the points at which the measurements were taken were entirely different so there is no basis for making that assumption.

Table 5. 2. 2

Site - just inside a 30 m.p.h. zone

1. Date 26. 9. 68. Time 14.25 hours. Weather fine.
Normal police activity.

Class	No. recorded	Mean Speed	Variance	Standard Deviation
Heavy goods	64	32.9 m.p.h.	25.5	5.0 m.p.h.
Light goods	66	35.1 m.p.h.	23.8	4.9 m.p.h.
Cars	175	36.3 m.p.h.	39.4	6.3 m.p.h.

2. Date 27.9.68. Time 14.25 hours. Weather - heavy rain.
Normal police activity.

Class	No. recorded	Mean Speed	Variance	Standard Deviation
Heavy goods	86	32.5 m.p.h.	20.8	4.6 m.p.h.
Light Goods	47	34.2 m.p.h.	17.4	4.2 m.p.h.
Cars	179	35.6 m.p.h.	31.3	5.6 m.p.h.

3. Date 30.9.68. Time 14.25 hours. Weather fine.
One additional Police Motor Cycle.

Class	No. recorded	Mean Speed	Variance	Standard Deviation
Heavy goods	76	30.6 m.p.h.	18.0	4.2 m.p.h.
Light goods	59	31.9 m.p.h.	28.4	5.3 m.p.h.
Cars	192	32.8 m.p.h.	40.5	6.4 m.p.h.

Table 5. 2. 3.

Site - just inside 40 m.p.h. zone

1. Date 24. 9. 68. Time 14.54 hours. Weather fine.
Normal police activity.

Class	No. Recorded	Mean Speed	Variance	Standard Deviation
Heavy Goods	55	37.3 m.p.h.	35.2	5.9 m.p.h.
Light Goods	45	39.7 m.p.h.	65.2	8.1 m.p.h.
Cars	202	38.3 m.p.h.	44.6	6.7 m.p.h.

2. Date 25.9.68. Time 14.52 hours. Weather fine.
One additional Police Motor Cycle.

Class	No. Recorded	Mean Speed	Variance	Standard Deviation
Heavy Goods	34	33.5 m.p.h.	17.3	4.2 m.p.h.
Light Goods	38	34.2 m.p.h.	12.4	3.5 m.p.h.
Cars	210	35.4 m.p.h.	28.1	5.3 m.p.h.

Table 5. 2. 4.

Site in 30 m.p.h. zone. 80 yards on the approach side of a pedestrian crossing

1. Date 2.10.68. Time 10.15 hours. Weather fine.
Normal police activity.

Class	No. Recorded	Mean Speed	Variance	Standard Deviation
Heavy goods	88	31.3 m.p.h.	14.1	3.8 m.p.h.
Light goods	72	33.1 m.p.h.	11.9	3.5 m.p.h.
Cars	249	33.1 m.p.h.	18.6	4.3 m.p.h.

2. Date 3.10.68. Time 10.42 hours. Weather fine.
One additional Police Motor Cycle.

Class	No. Recorded	Mean Speed	Variance	Standard Deviation
Heavy goods	107	28.2 m.p.h.	16.5	4.1 m.p.h.
Light goods	67	29.2 m.p.h.	31.8	5.6 m.p.h.
Cars	228	29.5 m.p.h.	32.0	5.7 m.p.h.

5.2.5. Using a Roundabout

The following advisory rule in the Highway Code relates to the proper use of a roundabout:- "Give way to traffic coming from your immediate right, unless road markings indicate otherwise, but keep moving if the way is clear."

A measure of behaviour was devised using the proportion of drivers approaching a roundabout who gave precedence to a vehicle already on the roundabout, in the section to his immediate right.

Pilot experiments were conducted with this measure, but it was found that, though objective in pricinple, it required a number of quite subjective assessments. There was no difficulty when a driver accelerated to cut in just in front of a vehicle on the roundabout, or when the driver stopped to let a driver through from his immediate right. However some drivers gave precedence by slowing, but just because a driver slowed for a roundabout it did not imply that he did so in order to allow precedence to vehicles on the roundabout. In fact slowing is good normal driving practise when approaching any road hazard. There was also the assessment of when the approaching driver committed himself to going on, and whether at that point a vehicle already on the roundabout was on that part to his immediate right.

Further difficulties related to the great variability in the levels of risk involved in situations acceptable for use in the measurement. They ranged from the situation where the approaching driver would certainly have been involved in an accident had he not given way, to the situation when for instance the vehicle on the roundabout was a slow moving heavy vehicle, well back round the roundabout, when the approaching vehicle could join the roundabout with complete safety. All drivers gave precedence in events of the first type while very few gave precedence in events of the second type. Since the risk involved varies with the speed of both vehicles, it is likely that this measurement would not be independent of any effects induced by changes in police supervision on traffic speeds.

The test site for the pilot experiment used a roundabout on the B1289 road in Sunderland. One approach road only was used, the B1289 Westbound. Observations were made between 15.55 hours and 16.55 hours from a car parked well away from the roundabout. Table 5.2.5 below sets out the results of these observations. The 'stopped but restarted' column indicates occasions when a driver stopped to give

precedence to one vehicle, but restarted before the part of the roundabout to his immediate right was completely clear of traffic. Measurements 1 and 3 were made with normal police supervision, but measurements 2 and 4 were made in the presence of intensive local police activity. Measurement 2 was also unusual in that it was made on a Wednesday afternoon, Sunderland's early closing day. Traffic for that measurement was therefore rather lighter than normal.

Table 5.2.5

Measurement Number	Observations	Stopped and Waited	Did not Stop	Stopped but Restarted	Increased Police Supervision
1	90	58(64%)	24 (27%)	8 (9%)	No
2	83	59(71%)	16 (19%)	8 (10%)	Yes
3	107	66(62%)	31 (29%)	10 (9%)	No
4	100	61 (61%)	29 (29%)	10 (10%)	Yes

A 4 x 3 chi-square analysis of these results indicates that any apparent changes in the proportions in each category are not statistically significant. They could therefore have arisen from purely random fluctuations.

5.2.6 Courtesy

As well as examining some of the aspects of driver behaviour most closely associated with accidents, some experiments were also carried out into changes in drivers' courtesy under changing levels of police supervision.

The particular aspect of courtesy examined in some depth was drivers' attitudes to pedestrians waiting at the side of a pedestrian crossing. Early experience showed that pedestrians very rarely claimed their right of precedence by placing a foot on the crossing, but on the few occasions they did so, in every case the driver stopped to give precedence. This observation was based on a very small sample. In project 2, with more data, this was found to be far from universally true.

Because of the small number of pedestrians who claimed their right of precedence, they were ignored in the pilot experiment.

The position chosen for pilot observations was the same as that used in Project 2. The observers' car was parked in a lay-by outside some shops. Observation was kept on the pedestrian crossing outside the Sunderland Orthopaedic and Accident Hospital. (See fig. 24). This crossing had a central island, but for the pilot experiment only, no distinction was made between pedestrians waiting on the central island, and those waiting at the roadside. The results of these observations are presented in table 5. 2. 6 below.

Table 5. 2. 6

Motorist behaviour at a Pedestrian Crossing in a 30 m.p.h. zone

Date 16. 9. 68. Weather fine. Normal Police Activity.

Time	No. Recorded	Gave Way	Did Not	% who gave way
10 - 11 a.m.	152	31	121	20%
11 - 12 noon	108	28	80	26%
3 - 4 p.m.	141	23	118	16%
4 - 5 p.m.	158	31	127	20%
	559	113	446	20%

Date 19.9.68. Weather Fine. 1 additional Police Motor Cycle

Time	No. Recorded	Gave Way	Did Not	% who gave way
10 - 11 a.m.	109	27	82	25%
11 - 12 noon	99	29	70	29%
3 - 4 p.m.	123	45	78	37%
4 - 5 p.m.	164	42	122	26%
	495	143	352	29%

A 2 x 2 chi-square test on the proportions who gave precedence with and without intensive local police supervision, indicates that the increase in the proportion giving precededce in the presence of intense local police supervision, is highly significant at the 0.5 % level. Such results might thus be expected from random fluctuation only once in two hundred occasions. This is a clear indication that driver behaviour did improve in respect to courtesy to pedestrians waiting at a pedestrian crossing, when intensive police supervision was in operation.

In the course of carrying out the pilot experiments it was noticed that there was a clear difference in driver behaviour towards pedestrians at the roadside and pedestrians in the central reservation. For project 2, the measurement was therefore modified to recognise this difference.

5. 2. 7. The Value of the Pilot Experiments

In section 5. 2. 1 it was pointed out that the pilot experiments were designed to test likely measures of driver behaviour to see if they would be suitable for inclusion in Project 2. It is apparent from the sections following this that many such measures were tested and found to be quite unsuitable. The pilot work therefore went a long way towards ensuring that the project which followed, which was difficult and expensive to mount, was not spoilt by using unsatisfactory measures of driver behaviour. Even for those measures judged to be suitable, some changes were made in the light of pilot experiment experience. In the overtaking experiment, a change of equipment for recording from portable tape recorders to portable dictating machines, was the direct result of mechanical failures in the pilot experiments. This prevented loss of valuable data in the project itself.

In the case of the pedestrian crossing experiment, the measure was modified to separate the driver response to pedestrians on the side of the road from that to pedestrians in the central reservation, as a direct result of experience in the pilot experiment. In all measures the pilot experiments enabled suitable forms to

be developed for the recording of the experimental data, while suitable computer programmes to analyse speed test results were also developed at that stage.

Only one result from the pilot experiment can be regarded as at all significant. This result is that driver behaviour towards pedestrians waiting at a pedestrian crossing significantly improves in the presence of intensive local police supervision. Even the basis for this however is shown to be rather suspect, by the main experiment. (See Section 5. 5. 3.below).

5. 3. DESIGN OF THE MAIN EXPERIMENT

5. 3. 1 Broad Outline

It was generally agreed after the first project that any subsequent projects investigating the effects of police patrolling should be carried out using a special team of police patrol officers, whose command structure should be integrated into the team controlling the experiment. For this reason Project 2 was allocated a special team of 12 patrol officers, and an Inspector in charge of their operational control. This Inspector was responsible direct to the University Liaison Officer. He was also a member of the Project Advisory team, as was the University Liaison Officer. The Chief Superintendent in charge of Motor Patrols, the Assistant Chief Constable in charge of traffic, the Chief Superintendent in Stategic Command of the Northern half of the County, and the former University Liaison Officer also joined the Project Advisory Panel, in order to strengthen the links between the Police Force and the Project.

Because the project would be using a small team of specially assigned officers, and a single operational commander, it was necessary to select experiment routes within a relatively compact area of the county. In this way the team could operate efficiently from a single team headquarters. A further extension of the A1 (M) and other extensive road works in the County, dictated that the North East corner of the County was the best area in which to operate. The natural barriers

of the sea to the East, and the Tyne Estuary to the North ensured that outside influences were minimal.

The Project was divided into two phases. In the first phase the project routes were patrolled in the normal way, with patrol levels kept as even as possible. In the second phase the same project team was used to patrol the same routes, but in a pulsed manner. The bulk of the patrol strength at any time was concentrated on one or other of the routes, and the route to be pulsed was changed round randomly.

Throughout both phases regular measures of four aspects of driver behaviour were maintained. This then was the broad outline of the design of the experiment. Detailed descriptions of various aspects of the experimental design follow in sections 5. 3. 2 to 5. 3. 7.

5. 3. 2 Routes

The roads selected for use in Project 2 were the busiest in the North East corner of the County, excluding those sections of road due for major engineering changes during the period of the experiment. These roads were grouped into four routes as follows (See fig. 21):

Route 1 Beginning of the A183 road, South Shields to its junction with the A182 road at Shiney Row.

Route 2 A184 from the roadworks south of White Mare Pool to the A19, A19 from the end of the dual carriageway, at South Shields to Ryhope Green.

Route 3 B1289 Washington Town Centre to Sunderland, joining the A690 at Barnes Hotel via the Queen Alexandra ring road, and the A690 from Barnes Hotel to the top of Houghton Cut.

Route 4 A19, Ryhope Green to its junction with the A179.

For each shift each patrol officer was given one route to patrol, and he was expected to confine his patrolling to that route for the whole of his shift. The Durham Constabulary Communications and control room agreed to co-operate in this, and University Motor Patrol Group patrols were not called off route to attend an incident except in extreme emergency.

5. 3. 3 Phases

The experiment was first planned to start on 1 March, but was postponed until 17 March due to inclement weather. The team of twelve men and an Inspector started on that date to patrol the routes, and measurements were taken on the Tuesday and Thursday of that week. However, in view of a snow storm on the Tuesday, that week was regarded for analysis purposes as a dummy run. The driver behaviour would have been grossly affected by the adverse conditions, and the two motor cyclists were taken off the road when conditions were at their worst. The eventual starting date for the experiment was thus Monday 24 March. Phase 1 ran for nine weeks from then until Sunday 25 May.

The official start of Phase 2 would have been the Spring Bank Holiday, Monday 26 May, but operational conditions at the time led the Inspector to abandon the pulsing for this first day. No record of patrols were made for that day, and the planned patrol schedule was resumed the next day, 27 May. As Monday was not a day on which driver behaviour was measured this change had very little effect on the experiment. The second phase lasted a further nine weeks, and ended on Sunday 27 July.

In the first phase the patrol effort was distributed as evenly as possible over the four routes in the ratio 1:1:1:2. At the outset of the experiment, examination of some traffic counts supplied by the County Surveyor's department indicated that this was the ratio of traffic density on the four routes. Further study of traffic volumes shows that these are probably not the ratios of vehicle miles driven on these routes. Vehicle densities also vary greatly from place to place on the same route, but neither consideration is critical to the findings of the experiment.

In the second stage of the experiment the main part of the force was concentrated on one route at any one time. The concentration on one route lasted for a three-day pulse. After this, the pulse for the next three days was re-allocated at random to one of the four routes. The probability of the pulse being allocated to a route were kept in the ratio 1:1:1:2 so that, had the experiment run for a very long time the average levels of patrolling would have been the same

as in the first phase. The random selection of routes for pulsing was performed using a table of random numbers, before the experiment started. This programme of pulses appears in the original research proposal, approved by the Home Office Police Research and Development Branch (included as Appendix 3 below).

5. 3. 4 Policing

The University Motor Patrol Group team consisted of two motor cyclists, ten patrol car drivers, and a supervisory Inspector. They had at their disposal two motor cycles, seven cars (a mixture of Westminster 1800's and Hunters) and a supervision car (a BMC Mini Cooper).

The patrolling of the experimental routes between 8.00 hrs. and 18.00 hrs. was the sole responsibility of this team, and other identifiable police vehicles were instructed to avoid using these routes where possible. Despite this, there was quite a heavy background of other identifiable police vehicles. This was unavoidable, because it was not possible to travel from Sunderland to Durham ramp without using one of the experimental routes, and several Panda cars needed to use the experimental route to get from the Police Station to the Panda beat, or from one part of the beat to another. The amount of patrolling performed by the patrol officers was recorded using Document 3 (see section 14 below). Reference to that document will show that on it officers were expected to fill in the number of other identifiable police vehicles soon, split down into the categories Patrol Cars, Panda Cars and Others. This, together with the number of other cars observed by the experimental observers on Tuesdays and Thursdays were the only methods used to assess the level of background patrolling. This assessment is made below in Section 5. 4. 1. It was decided not to ask men who were not directly concerned in the experiment to provide information on their patrol activity on the experimental routes, inview of experience in the previous project (See section 4. 3. 2 above).

The patrol team was organised into two shifts, the first of which operated

from 08.00 hours to 16.00 hours with lunch to be taken during the period 12.00 hours to 1300 hours, and the second shift operated from 1000 hours to 1800 hours with lunch to be taken between 1300 hours and 1400 hours. Document 4 shows a typical duty sheet for the first phase, and document 5 shows one for a typical week in the second phase. Note that the scheme for obtaining uniform patrolling was not that originally suggested in table 1 of Appendix 3 below. This change was made on the recommendation of the Operational Inspector in charge of the team. The job of the man on office duties was to man the mobile office while the inspector was out in his supervisory role, to catch up with his own outstanding paperwork and to be available to take over another officer's patrol car while he came in to write reports or attend Court.

No-one was detailed for office duties unless there were insufficient cars for him to be patrolling, and no cars were double-crewed unless there was already one man doing office duties.

The men seconded to the experiment team lived over quite a wide area of the Northern part of the county, and it has been the custom recently for patrol drivers to be allowed to go home for lunch. To have allowed this practice would in most cases have been impractical, and would have dissipated the useful patrol effort. All officers were required to be on their designated routes by 30 minutes after they came on duty; they were allowed away from their designated routes for at most one hour for lunch, and they were required to stay on their designated route until 30 minutes before they came off duty. Special financial arrangements were made so that members of the project team were compensated for the extra cost of having lunch away from home.

A check against the patrol forms (document 3) was possible because Control Room allocated special call signs to vehicles involved in the project (K10 to K18) and a special code for the routes (K1, K2, K3 and K4 to routes, 1, 2, 3 and 4 respectively). The mobile police station was allocated the call sign K20. The radio messages involving all vehicles with a K call-sign were transcribed for each day by the following night shift in Control Room on to document 6 (see section 14). The operational inspector then compared the document 3 submitted by each man with the corresponding document 6, and followed up any anomalies. Unlike the

1967/68 project, no patrol officers failed to return a form, since the inspector ensured that he had a form from each man, or an adequate reason for his not being on patrol that day.

5. 3. 5. Measurements of Driver Behaviour

The measurements of driver behaviour were conducted on Tuesdays and Thursdays. This avoided the Sunderland area's early closing day (Wednesday) and the effects of weekend traffic. Consistent repetition of measurements on these two days of the week effectively controlled any differences in driver behaviour between different days of the week, and the fact that measurements were always taken at the same time of day controlled any such differences at different times of the day. The use of two days of the week enabled the collection of a considerable amount of data. More measurement would have required so much time from the full-time members of the team that there would have been a danger of their being unable to keep the summaries of incoming data up to date, and to exercise proper direction and control of the experiment.

The measurements taken were as follows :

Measurement 1 : The speed distribution of vehicles in a derestricted zone..

This measurement was taken between 1000 hours and 1100 hours at a point shown on the map of the experiment area (Fig. 21), and in more detail in the sketch plan (Fig. 12). This location is between Vardy's garage and Houghton Cut, on a dual carriageway section of the A690 (part of route 3), just east of Houghton-le-Spring. Vehicles in the carriageway travelling towards Houghton-le-Spring only were monitored. Those were travelling up a very slight incline as they passed the observers. The speed measurements were made using a Marconi Peta radar speed meter which ran off a 12-volt battery. Both the meter and the battery were placed at the side of a parked car remote from approaching traffic, and were normally covered by polythene bags or an old coat. This afforded quite good concealment, and it is believed that few users

of the road were aware that the radar speed meter was there. The observers were both seated in the front seat of the car, which was parked in the gateway to a field at right angles to the traffic, facing towards the road. There was at least two feet between the front of the car and the edge of the road. The dial which showed the speeds of approaching vehicles was connected to the radar speed meter by a cable which ran inconspicuously through the passenger side quarter light window. The makers of the speed meter claim that it is accurate to within one m.p.h. but the observers recorded speeds only in 2 m.p.h. intervals, on document 7 (see section 14 below). Records were kept for three groups of vehicles: Heavy goods - light goods and cars, motor cycles etc. Bicycles, agricultural tractors and mopeds were ignored.

Measurement 2: The speed distribution of vehicles in a 30 m.p.h. limit zone.

This measurement was taken between 11.30 hours and 12.30 hours allowing half an hour for the observers to drive from their first measuring point. The location of the second measuring point is shown on the map (Fig.21) and in more detail in the sketch plan (Fig.23). This is outside Fawcett's Bakery, and opposite Grindon Post Office in Chester Road, Sunderland, part of the A183 (Route 1). Vehicles' speeds were measured using the radar speed meter for vehicles travelling in one direction only along this undivided carriageway, this direction being towards the centre of Sunderland. The vehicles measured had passed into the built-up area 700 yards before the measuring point, and had a further 300 yards to travel before having to negotiate a roundabout. They were travelling down a slight gradient. Local road hazards included a bus stop used by a frequent bus service, pedestrian and vehicular traffic associated with a small shopping centre, and during term-time school children returning to lunch from a nearby school.

For this measurement the observers again sat in the front seat of their car, which this time was parked in a lay-by in front of the bakery, facing the same direction as the traffic being observed. The radar speed meter was therefore placed in front of the car, and concealed as before. The cable to the meter unit again ran back inconspicuously to the passenger side quarter-light window.

The same speed intervals, vehicle groupings and recording form were used as in the first measurement. Mopeds and bicycles were ignored and all vehicles which had pulled away from rest within the 30 m.p.h. zone, or which stopped before the roundabout were recorded as missed.

Measurement 3: The behaviour of drivers towards pedestrians waiting to cross a pedestrian crossing.

This measurement was taken between 1330 hours and 1500 hours, the hour between this and the previous measurement being used by the observers to move from the second location, and to take lunch. The location of this observation point, outside the Sunderland Accident and Orthopaedic hospital, is shown on the map (Fig. 21) and in the sketch plan (Fig.24).

This is on the A19 road, well inside the Sunderland 30 m.p.h. zone, on the north side of the borough (Route 2). The crossing concerned is a busy one, serving the hospital, shops, bus stops and housing estate. It is a divided crossing with a central island refuge. In observation of the crossing in the pilot experiments, it became apparent that drivers were more ready to stop for pedestrians waiting at the central refuge than for those waiting at the roadside, so the incidents recorded were divided into three categories according to whether the pedestrian had his foot on the crossing, was in the central refuge, or was waiting at the roadside. With more than one pedestrian waiting, if any had a foot on the crossing then the incident was recorded as in the first category, if not, and any of the pedestrians was in the central refuge, then it was classified as of the second category. Incidents were recorded for vehicles travelling in either direction and pedestrians crossing from either side. The form used for this purpose is included at the end of this thesis as document 8.

The observations for this measurement were made mostly with the two observers sitting in the front seat of a car parked in the lay-by outside the shops on the approach side of the pedestrian crossing. Double parking of vehicles, which thus blocked the view, occasionally made it necessary to leave the vehicle and observe from the pavement.

It was sometimes difficult to distinguish when an incident had occurred and when it had not. For this purpose a number of fairly arbitrary rules were developed.

1. At either side of the crossing there were concreted areas sloping down to the crossing. Pedestrians who had no part of their foot (or pram or push chair) on this concrete area were ignored.

2. Horses and carts, cycles and mopeds were not ignored.

3. If a pedestrian signalled to a driver, this fact was ignored.

4. Pedestrians gossiping on the roadside who were not facing the crossing were ignored.

5. Drivers who checked but did not stop in order to allow precedence to pedestrians were deemed to have stopped.

6. Drivers who stopped for pedestrians well on the crossing were ignored.

7. Where a stream of traffic was obliged to stop because the first vehicle had stopped for a pedestrian only the first driver was counted.

8. Drivers who stopped to allow pedestrians who were on the off-side crossing, not having reached the central refuge, or pedestrians standing too far back at the roadside to be counted were ignored.

Measurement 4: The level of overtaking on a tortuous section of road.

This measurement was first scheduled to run from 1530 hours to 1700 hours, but after three weeks it was changed as 30 minutes was insufficient to get from the third measurement. The revised starting time was 15.40 hours. Only in one case in the first three weeks was it possible to start before 15.35 hours, so the change should have no important effect. In any case, the measurement lasted exactly one and a half hours. The section of road concerned is shown on the map (Fig.21) and in the more detailed sketch map (Fig.25). It is part of the southern portion of the A19, designated route 4. Only the northbound stream was monitored, between a first observer next to Harrop's Garage in Castle Eden, and a second observer near the junction of the A19 and the B1320. In both cases observations were made from parked cars. The first observer's car was parked immediately north of the Castle Eden sign, in a parking area belonging to Harrop's Garage, some 20 yards beyond the end of a section of dual carriageway, and as far before the start of the 40 m.p.h. zone for Castle Eden. The second observer's car was parked on the grass verge, at the end of the Peterlee slip road and just before northbound vehicles reached another section of dual carriageway. Neither car could possibly impair any other road user's vision of the road.

At the start of the measurement, both observers dictated the car numbers of all northbound vehicles as they passed, on to a Phillips 83 portable dictating machine. They also recorded any other salient features (e.g. type, if with roof rack, etc.) which might aid identification. This continued until the measurement had run for an hour and a half when the first observer stopped recording and drove to the position of the second observer, ensuring that he did not overtake anyone in doing so. Then the second observer stopped recording. Thus all vehicles passing the first observer are allowed time to pass the second observer.

The tapes produced by both observers were then transcribed. Document 9 shows part of a typical transcription for the first observer, and Document 10 shows the corresponding part of the transcription for the second observer. The numbers on the left-hand side of Document 9 are the numbers in sequence assigned to the vehicles passing the first observer. Those on the left hand side of Document 10 are the assigned numbers from Document 9 of vehicles which have been matched in both lists. The * against vehicle 140 indicates that it must be deleted from the list in common to restore the original sequence.

Two measurements were lost due to malfunctioning of a dictating machine (one in each phase), one was lost because of an accident, and one was lost owing to the operation of a Stop/Go man at some GPO roadworks (both the latter in the second phase).

5. 3. 6 Traffic Volume

Traffic volumes were measured near each of the measuring points towards the end of the experiment, using a Sykes Automatic Traffic Counter. At the location of the fourth measurement, traffic volumes were measured near both observers. The pneumatic tubes used by the counters were well away from the observers for the speed measurements and were passed by the observed stream of traffic after it had been through the radar beam. In all cases the pneumatic tube was far enough away from the observers for the motoring public not to associate one with the other, and was positioned in such a way that their effect on the measurement could only

have been minimal. Considerable difficulty was experienced in getting the counters to operate accurately and consistently. This is reflected in the many gaps in the traffic count data presented below. The poor quality of the measurements for this part of the experiments in unfortunate, but it in no way affects the validity of the experiment. This information was only intended as background information of the environment in which the experiment was conducted.

The meters were set out for one continuous period, but only those days for which a correct reading was obtained are listed in the tables 5.3.1. to 5.3.6 below.

Table 5.3.1.

Traffic volumes at a point adjacent to measuring point 1 of vehicles travelling towards Houghton-le-Spring. Readings taken at 1100 hours.

Day	Date	Vehicles passed in 24 hours
Friday	20.6.69	4955
Saturday	21.6.69	4482
Sunday	22.6.69	4405
Wednesday	25.6.69	5121
Thursday	26.6.69	5208
Friday	27.6.69	5866
Saturday	28.6.69	5536
Tuesday	1.7.69	4860
Wednesday	2.7.69	5082
Thursday	3.7.69	4841
Monday	7.7.69	6224
Tuesday	8.7. 69	5697
Wednesday	9.7.69	6240
Thursday	10.7.69	6073
Friday	11.7.69	5862
Saturday	12.7.69	5958

Table 5.3.2.

Traffic volumes at a point adjacent to measuring point 1 for vehicles travelling towards Sunderland. Readings taken at 1100 hrs.

Day	Date	Vehicles passed in 24 hours
Monday	16.6.69	5206
Wednesday	18.6.69	5398
Thursday	19.6.69	6290
Friday	20.6.69	5672
Saturday	28.6.69	5352
Tuesday	1.7.69	4610
Wednesday	2.7.69	4717
Thursday	3. 7.69	4759
Monday	7.7.69	6497
Tuesday	8.7.69	4695
Wednesday	9.7.69	5081
Thursday	10.7.69	4996
Friday	11.7.69	4683
Saturday	12.7.69	4594

Table 5.3.3.

Traffic volumes at a point adjacent to measuring point 2. Readings taken at 1230 hours.

Day	Date	Vehicles passed in 24 hours
Monday	16.6.69	12488
Monday	7.7.69	12884
Tuesday	8.7.69	14926
Wednesday	9.7.69	14646
Thursday	10.7.69	14620
Friday	11.7.69	14498

Table 5. 3. 4.

Traffic volumes at a point adjacent to measuring point 3. Readings taken at 1500 hours.

Day	Date	Vehicles passed in 24 hours
Sunday	6.7.69	8060
Monday	7.7.69	12880
Tuesday	8.7.69	10410
Wednesday	10.7.69	9833

Table 5. 3. 5.

Traffic volumes at a point adjacent to the first observer at measuring point 4. Readings taken at 1710 hours.

Day	Date	Vehicles passed in 24 hours
Friday	18.7.69	8604
Saturday	19.7.69	7997
Sunday	20.7.69	6940
Monday	21.7.69	10172
Tuesday	22.7.69	8853
Wednesday	23.7.69	9600

Table 5. 3. 6.

Traffic volumes at a point adjacent to the second observer at measuring point 4. Readings taken at 1720 hours.

Day	Date	Vehicles passed in 24 hours
Friday	18.7.69	9759
Saturday	19.7.69	8546
Sunday	20.7.69	9979
Monday	21.7.69	10021
Tuesday	22.7.69	8489
Wednesday	23.7.69	9334

5.3.7 Publicity

As with Project 1, publicity was stringently avoided. No publicity of any sort was given to either project until well after both projects had been completed.

5.4. POLICE ACTIVITY DURING THE EXPERIMENT

5.4.1. Patrol Levels Achieved

The levels of patrolling achieved were very much the sort of levels which the experimental design required. These levels are set out in Figs. 14 to 17 that the average coverage in the two phases is not always the same. The chief reason for this difference is the fact that pulses in Phase 2 were allocated at random. Though the expected amount of patrolling before this allocation was made was the same as that of Phase 1, when the pulses were allocated, the actual planned patrolling was higher or lower than in the first phase, depending on the number of pulses allocated to the respective routes. The total number of hours of patrolling performed on all four routes was 2488 in the 63 days of Phase 1 and 2343 in the 62 days of Phase 2.

The diurnal distribution of patrol time had two main levels. Between 1030 hours and 1200 hours and between 1400 hours and 1530 hours the level was approximately twice that achieved at other times, since both shifts were on duty together.

Background Patrolling

The officers patrolling the routes were required to make a record of any other identifiable police vehicle (not belonging to the University Patrol Group) that they saw on their patrol.

The results of these observations are set out in tables 5.4.1 and 5.4.2 below.

Table 5.4.1 Results of observations by Patrol Car Drivers in Phase 1

Phase 1	Route			
	1	2	3	4
Hours patrolled	521	505	508	954
Patrol cars seen	172	179	130	280
Panda cars seen	293	263	318	370
Others	78	80	94	173
Cars seen per patrol hour				
Patrol cars	.33	.35	.26	.29
Panda cars	.56	.52	.63	.39
Others	.15	.16	.19	.18

Table 5.4.2 Results of observations by Patrol Car Drivers in Phase 2 .

Phase 2	Route			
	1	2	3	4
Hours patrolled	412	559	708	664
Patrol cars seen	130	149	235	198
Panda cars seen	233	303	423	312
Others	75	82	140	119
Cars seen per patrol hour				
Patrol Cars	.32	.27	.33	.30
Panda Cars	.57	.54	.60	.47
Others	.18	.15	.20	.18

It is apparent from these tables that background patrolling did not alter greatly between the two phases.

It is estimated that background patrolling was to the extent of one tenth, one fifth and one twentieth of the patrol group's effort for other identifiable police vehicles respectively. These figures are only a very rough approximation, but this is all the data allows.

5.4.2. Police Work Performed

There is no evidence of any substantial falling off in the number of cautions or process which would have occurred either if driver behaviour improved appreciably or if the patrol group lost any of its initial interest. Figs. 26 - 33 show the combined caution and process rate for the four routes, and both phases, superimposed on the patrol hour in which the work arose.

5.5. THE COMPARISON OF EFFECTS ON DRIVER BEHAVIOUR

5.5.1 Measurements During Pulses

The following table 5.5.1 shows which measurements took place during a pulse for each of the measuring days in Phase 2. The measurement numbers 1 to 4 refer respectively to speed in a derestricted zone, speed in a 30 m.p.h. zone, pedestrian crossing behaviour and overtaking behaviour.

Table 5.5.1: Measurements taken du ing a Pulse (Phase 2)

Week No.	1	2	3	4	5	6	7	8	9
Tuesday	2	3	3	1	4	3	3	4	2
Thursday	1	4	3	4	1	3	2	4	2

5.5.2 The Effect on Speed

5.5.2.1 The Properties of Speed Distributions

Before examining the results of the speed measurements to find what changes have occurred it is important to see the way in which the speed distributions behave without such a change. For this purpose the speed measurements for the first phase were examined, when no changes in patrol level were attempted. The null hypothesis was tested that traffic speeds in this phase, and for any given category of vehicle, were random, independent samples from a normal distribution. If this were so then the variance of sample means would be less than $\frac{V}{n}$ where V is the population variance, and n is the size of the smallest sample.

Table 5.5.2 below shows how the variance of mean speeds of one hour samples compare with the variance of vehicle speeds for all vehicles in each class and phase. Classes 1, 2 and 3 refer to heavy goods, light goods and cars, motor cycles, etc., respectively. Location 1 is in a derestricted zone, location 2 in a 30 m.p.h. limit zone.

Table 5.5.2

Location	Phase	Class of Vehicle	Mean Speed (m.p.h.)	Variance V	Size of Smallest Sample n	Variance of Sample Means	$\frac{V}{n}$
1	1	1	40.03	29.65	28	1.463	1.059
		2	44.20	53.17	32	3.451	1.662
		3	52.51	85.62	118	3.500	.726
	2	1	40.24	31.89	41	2.109	.778
		2	44.13	50.27	34	2.497	1.479
		3	51.77	84.08	130	2.157	.647
2	1	1	31.29	22.85	13	2.351	1.756
		2	32.70	25.98	24	1.507	1.083
		3	32.81	23.72	99	1.110	.240
	2	1	31.68	21.03	16	3.550	1.314
		2	33.35	25.96	17	1.308	1.528
		3	33.04	19.36	88	1.405	.220

The fact that for Phase 1, $\frac{V}{n}$ is less than the variance of the sample means in all six cases is itself significant at the 5% level. Application of the F test to these two estimates of the variance of sample means shows that the observed variance of sample means is significantly larger (at the 1% level) than would be expected from the null hypothesis, for cars at both locations and for light goods vehicles at Location 1.

The results for phase 2 also show a similar effect, but this effect would be expected if the presence or absence of a pulse changed the mean of the speed distribution for each class.

The need to reject the null hypothesis is further underlined if mean vehicle speeds in the first half hour of a measurement are compared with those in the second half hour. This comparison shows that in Phase 1, the mean speeds for a particular location and class of vehicle were positively correlated in successive half hour periods, and that these correlations were significant at the 5% level with two exceptions. These were Location 2, Class 3, and Location 1, Class 1, where the significance levels were 6% and 14% respectively. These findings are of importance to all who may be contemplating before and after studies of speed. They indicate that the method of evaluating such studies recommended in Traffic Engineering Handbook (Ref. 19) is inadequate and misleading. It also meant that an initial evaluation of the pilot speed measurements had to be completely revised. As a result of this re-assessment it is not possible to claim significant effect based on the pilot work.

In order to decide if an observed change in mean speeds is significant, it is necessary to ascertain the variation in mean speeds when no change in environment has occurred. The above findings show that the only reliable way of doing this is to use the observed variations in mean speeds within a phase.

5.5.2.2. Speed in a Derestricted Zone

The first null hypothesis tested, is that for each category of vehicle the mean speeds for one-hour observation periods in the first and second phases are random independent samples from the same distribution. This distribution need not be assumed normal, since sample means with sample sizes 16 will be distributed approximately normally with any parent distribution. If this hypothesis cannot be rejected, then there is no reason to suppose that the effects on driver behaviour of the one tactic is any different from that of the other.

Table 5.5.3 sets out the difference in the means of sample means between the two phases, and the standard error of that difference. As in section 5.5.2.1 above, Classes 1, 2 and 3 refer respectively to heavy goods vehicles, light goods vehicles and cars.

Table 5.5.3: Speeds in a Derestricted Zone in M.P.H.

Class	Phase 1		Phase 2		Difference in means of sample means	Standard error of difference in means of sample means
	Mean of sample means	Standard deviation of sample means	Mean of sample means	Standard deviation of sample means		
1	39.96	1.21	40.26	1.45	.30	.44
2	44.22	1.86	44.11	1.54	.11	.57
3	52.54	1.87	51.85	1.47	.69	.56

A Student test using the last two columns of the above table reveals that no significant changes in mean speed have taken place between the two phases for any of the classes of vehicles, despite the fact that a 1.2 m.p.h. change would have been sufficient to show as significant. There is no sign either of any change in variance.

In fact with both mean and variance, the change for two groups of vehicles was in one direction, and for the other group it was in the opposite direction. There is therefore no justification for rejecting the null hypothesis.

Inspection of Figs.38, 39 and 40, and of Figs. 44, 45 and 46, which compare the distribution of speeds, between phases, confirms visually the results obtained above statistically. There is no apparent difference in mean speeds between a Tuesday and a Thursday, or any major effect related to the weather.

The mean number of vehicles measured in Phase 1 and Phase 2 were respectively 264 and 295 per hour measuring period. This difference is unlikely to have affected the speed distributions.

Consider now a second null hypothesis that the mean speeds in the hour measuring periods when a pulse was on and the mean speeds in the periods in

Phase 2 when a pulse was not in operation are all independent random samples from a normal population. There were five measurements during a pulse on Route 3 in Phase 2. The means of mean speeds for measuring periods occurring during a pulse, and for measuring periods in Phase 2 not in a pulse, are set out in Table 5.5.4 below.

Table 5.5.4: Speeds in a Derestricted Zone (Phase 2) in M.P.H.

Class	Mean of mean speeds		Standard deviation for Phase 2	Standard error of difference in means	Difference in means
	Pulse on	Pulse not on			
1	41.35	39.84	1.45	.76	1.51
2	44.33	44.02	1.54	.81	.31
3	51.37	52.03	1.47	.77	.66

The Student test shows that the only change of any significance is an increase in mean speed of heavy goods vehicles when the pulse is on, and this is not quite significant at the 5% level. My own belief is that the presence of pulses had no effect on vehicle speeds, and that this result occurred as a result of purely random fluctuation. In the other two classes of vehicle, the mean speed of one increased, and of the other it decreased when pulses were present, neither significantly.

5.5.2.3 Speed in a 30 M.P.H. Limit Zone

The procedure adopted for analysis of speed results in this section is precisely the same as used in the preceding section. The same null hypothesis is used, that for each category of vehicle the mean speeds for one-hour observation periods in the first and second phases are random independent samples from the same distribution.

Table 5.5.5: Speeds in a Built-up Area in M.P.H.

Class	Phase 1		Phase 2		Difference in means of sample means	Standard error of difference in means of sample means
	Mean of Sample means	Standard deviation of sample means	Mean of sample means	Standard deviation of sample means		
1	31.36	1.53	31.61	1.43	.25	.49
2	32.69	1.23	33.31	1.14	.62	.40
3	32.81	1.05	33.03	1.19	.22	.37

Again no evidence of a significant change either in mean or variance may be found from the analysis, despite a 5% confidence interval on the difference in means of $\pm$ 1 m.p.h. Figs. 41, 42, 43, 47, 48 and 49 illustrate the distribution of speed in two phases,

The mean number of vehicles measured in the phases are not significantly different, being 251 and 254 per hour respectively in Phase 1 and Phase 2.

The second null hypothesis is now examined, that is that the mean speeds in the hour measuring periods when a pulse was on, and the mean speeds in the hour measuring periods in Phase 2 when a pulse was not on, were both random independent samples from the same normal distribution. There were two measurements during pulses for speeds in a built-up area. Table 5.5.6 shows the mean speeds in Phase 2 when a pulse was on, and when no pulse was on.

Table 5.5.6 Speeds in a Built-up Area (Phase 2) in M.P.H.

Class	Mean of mean speeds		Standard deviation for Phase 2	Standard error of difference in means	Difference in means
	Pulse on	Pulse not on			
1	30.70	31.72	1.43	1.08	1.02
2	32.90	33.36	1.14	.84	.46
3	32.91	33.04	1.19	.89	.13

Though all three classes show a decrease in mean speed when a pulse

is on, none of the decreases is statistically significant.

5.5.3 The Effect on Pedestrian Crossing Behaviour

Before proceeding with the analysis of the changes in pedestrian crossing behaviour under changed police supervision, the fluctuation in this behaviour in Phase 1, when no such changes had taken place are first examined. The null hypothesis is tested, that the number of drivers approaching a pedestrian crossing with a pedestrian on the roadside who stopped and the number of those who did not stop were random samples from an unchanging binomial distribution. This was accomplished using a 18 x 2 Chi-square test, which yielded a value of X^2 of 12.1. This value would have been exceeded on 75% of occasions if the null hypothesis were true, and so it is not significant.

This contrasts with the corresponding results for drivers' behaviour towards pedestrians waiting on the central refuge in that a value of X^2 of 37.9 was obtained. This value is significant at the 5% level of significance. In view of these findings, the Chi-square test was considered suspect for all categories (pedestrian on the roadside, pedestrian in the central refuge, and pedestrian with a foot on the crossing).

Application of the Wilcoxon Rank Sum Test* to data for Phase 1 indicates that driver behaviour towards pedestrians waiting in the central reservation is different from driver behaviour towards pedestrians waiting at the roadside, and this difference is highly significant at the .1% level. Reference to Figs. 50 and 51 shows that this difference in driver attitude is very substantial with an average of 12% of drivers stopping for pedestrians at the roadside, compared with 55% stopping for pedestrians waiting in the central reservation.

The difference in behaviour of drivers towards pedestrians in the central reservation, and those on the roadside need not in itself negate the results of the pilot experiment (Section 5.2.5), where no distinction was made between these two classes of events, provided that the number of

*Foot Note The Wilcoxon Rank Sum test uses the rank of a variable rather than its actual value. The highest valued reading is ranked 1 and the next 2 and so on. The test indicates whether there is a significant tendency for the high ranking readings to occur within one class of results.

events in each class are themselves random samples from an unchanging distribution. The above Chi-square test results for pedestrians waiting in the central reservation does, however, call these results into question. A third 2 x 18 Chi-square test on Phase 1 data, in which no distinction was made between pedestrians waiting at the roadside and pedestrians waiting on the central reservation produced a value of X^2 of 28.8 which is significant at the 5% level of significance. This result contradicts one of the assumptions made for the analysis of the results of the pilot experiment by a 2 x 2 Chi-square test. However, the change observed in the pilot experiments were larger than that observed in Phase 1 of the main experiment. The fact that increases in the percentage of drivers giving precedence to pedestrians were observed in each of four time categories when intensive patrols were in operation is itself almost significant at the 5% level.

It was shown above that the Chi-square test is suspect for use on this measurement. Differences between Phase 1 and Phase 2 were therefore examined by the Student t test, except for the category of pedestrians with a foot on the crossing. In that case the restricted amount of data, and the bimodal distribution (with peaks at 100% and 0%) made the Wilcoxon Rank sum test the more appropriate. In the case of pedestrians waiting at the kerb side, at the crossing, a value of t of .76 was obtained, and in the case of pedestrians waiting in the central reservation the value of t was .81. Neither value is significant.

The changes in the percentage of drivers who stopped, which would have been required for significance at the 5% level were respectively 1.9% and 5.7% The Wilcoxon Rank sum test showed no significant change between phases, of driver behaviour towards pedestrians with a foot on the crossing.

The distribution of the percentage of drivers who give precedence to pedestrians is unknown, and only six of the measurements in Phase 2 took place during a pulse. The analysis of differences in driver behaviour in Phase 2 between when a pulse was in operation, and when a pulse was not in operation, was therefore performed using the Wilcoxon Rank sum test.

No significant differences were obtained in any of the three classes considered.

5. 5. 4. The Effect on Overtaking

The basic measure used for determining the level of overtaking was the percentage (P, say) of the list in common to the two measuring points, which had to be deleted before the order of the remainder was the same in both lists. The values of P obtained are set out in Fig. 52. As is indicated on this figure, two measures were lost in Phase 1, one through a dictating machine malfunction, and one through the influence of thick fog. Three measures were lost in Phase 2, one as a result of machine malfunction, one through the influence of a stop/go man at minor GPO roadworks, and the third as a result of a serious road accident on A19 at Green Bank, on the overtaking section.

In the data for Phase 1, P, is positively correlated with the size of the list in common (N, say). The value of the correlation coefficient of .49 is significant at the 7% level. A least squares regression line was fitted which was found to have the equation :-

$$P = 4.88 + .0165\ N$$

This relationship was further investigated by re-examining each of the values of P to see the average change if one of the vehicles in common were to be ignored. One would expect this average change to be approximately equal to the rate of change of P with N $(\frac{dP}{dN})$. The values in fact obtained were of the same order as the slope of the regression line, and their mean value for Phase 1 was .0175. The regression line was therefore assumed to be a reasonable representation of the functional relationship between P and N for the range of values of N encountered in the experiment.

A new statistic M was therefore defined as $M = P - .0165\ N$ which should be independent of N. The values of this statistic for Phase 1 and for Phase 2 are set out in Fig. 53. These were compared, using the Student t test, and gave a value of t of 1.96 which was not quite significant. A 1.36 difference in the

two mean values of M would have been required for significance at the 5% level. The mean value of N in Phase 1 was 387 and in Phase 2, 381. It is therefore unlikely that changes in the value of N have masked real changes in overtaking level.

Only four overtaking measurements were made during a pulse, so the comparison of values of M during a pulse with the other values of M in Phase 2 was made using the Wilcoxon Rank Sum test. This showed no significant difference between the two groups of measurement.

5. 6 ACCIDENTS

The total number of reported accidents (other than 'dog' accidents) during the experiment were as follows:

Route	Phase 1	Phase 2
1	39	33
2	68	44
3	25	50
4	19	14
TOTAL	151	141

No significance is attached to these results, which are only presented here to demonstrate that accident numbers were so small that they add nothing to the value of the experiment.

5.7 THE IMPLICATIONS OF THE RESULTS

None of the measures of behaviour give any indication that the two tactics, pulsed patrolling and uniform patrolling differ in their effect on driver behaviour. Since uniform patrolling has definite advantages in producing uniformly good response times to incidents, there is no justification for

changing to a system of pulsed patrolling.

In addition to there being no indication of any difference in driver behaviour between phases, there is no indication either of any difference in driver behaviour between when a pulse is 'on' and when it is 'off'. This would indicate that heavy police coverage of a route in the short term has no large effect on driver behaviour, except possibly in the very immediate vicinity of the police car. Since such an effect is often assumed by the police when allocation of traffic patrol effort is contemplated, these findings required some reconsideration of objectives by those who plan traffic policing. The lack of a short term effect does not necessarily mean that police may be withdrawn indefinitely with no consequent deterioration, but Ref. 12 indicates that the time scale of the effect is months rather than days. The combination of the findings of Ref. 12 and of this experiment suggests that the effect which they detect derives from the cumulative effect of higher levels of prosecution, transmitted slowly by drivers becoming aware of acquaintances who have been prosecuted for driving offences, and not from the visual impact of the police activity. This speculation, if accepted, will also have profound implications on the objectives of traffic policing.

This approach of measuring driver behaviour has provided an adequate way of comparing alternative tactics which cost the same. It would be difficult to evaluate changes in behaviour if observed, and to use this method for a cost benefit approach to evaluate methods of patrolling having a different cost. It also seems unlikely that changes in tactics will change driver behaviour in the short term.

The patrolling which occurred during the project was believed to be, on average, higher than that normally obtained. If a further nine weeks of measurement were undertaken using the same measures, when patrol levels have been maintained at a very much reduced level, then this would give a further indication of the extent to which police patrol levels affect driver behaviour. The project team suggested that such a small experiment might be run by the Durham Constabulary, with some help in the analysis of the results by members of Durham University.

The other main implication of Project 2 is that the standard method of before and after speed comparisons is unreliable and misleading. Such comparisons ought to rely on the distribution of the means of a number of speed checks, both in before state and after state, these checks being made on different days.

6. OFFSHOOTS FROM THE MAIN THEME

6.1 PERSPECTIVE

The object of this section is to put section 6 into perspective in relation to the rest of the thesis. It is true that the topics discussed below do not help to elucidate the effects of the police on the traffic environment. Yet if police do have a worthwhile effect when patrolling, then any measure which improves police efficiency, and allows greater time to be spent patrolling, will be of benefit to the travelling public. The topics discussed below all arose quite naturally out of information required for the first project.

An examination of the diurnal distribution of the main variables was undertaken in the first place for the evaluation of the project. The implications of these comparisons on police strategy then became apparent.

In the course of preparing computer programmes for the analysis of accident data required for the experiments, it was realised that the whole of the routine accident analysis work of Durham Constabulary could be performed more efficiently by computer.

The patrol forms included information on police work performed, as well as stating whether the vehicle was single or double crewed. This data was analysed at the request of the Home Office who were then examining the relative merits of single and double crewing.

In the early stages of the experiments, the team was concerned that the patrol times being reported were rather lower than had been expected from the resources nominally deployed to patrol the routes. It was therefore decided to examine how police patrol duties were divided between patrolling and other tasks, and to identify what other tasks were chiefly responsible for keeping patrol men from their assigned duties. This analysis was of great interest to the senior police officers responsible for traffic work, as well as to the project team. The analysis revealed a considerable amount of a patrolman's time to be taken up with paperwork, and so in an effort to reduce this and thereby increase operational time, several clerical procedures were re-examined.

The net effect of all these side-issues is a deepening understanding by the senior police officers of the police system they control, and an increase

in the operational efficiency of the police force. Not all these benefits are easy to evaluate in financial terms, but the benefit in Durham County from the improved clerical systems alone is estimated to be worth £25,000 per year. This more than pays for both projects several times over, every year.

Reports of the benefits achieved in Durham have been circulated with reports of the other aspects of the projects, to other police forces and it is hoped by this and by personal contact between officers of different forces, that improvements achieved in Durham may also be utilised in other forces.

6.2 DIURNAL PATROL TIME DISTRIBUTION

One of the benefits of handling large volumes of data by computer is that it is then relatively easy to analyse in any number of different ways. One way in which the main experimental variables of Project 1 were examined was by time of day. The diurnal distributions of patrolling, traffic volume and accidents are discussed here for Phase 1 on Route 2. These are shown in histogram form in Fig. 12 (Section 13). Phase 1 was chosen for two reasons. First it was the control phase, and these patrol levels should be entirely normal, and not influenced in any way by the experiment. Secondly if a decrease did occur in the proportion of actual patrolling which was recorded, then the data for Phase 1 is the most complete patrol data collected in the experiment. The choice of Route 2 was because this was the route on which one of the Tyneside Conurbation Traffic Survey's traffic counters was in permanent operation. Their counting point on the A19 was a little north of the northern end of Route 4. The Accident data was aggregated for the same time of year for the years 1963 - 1967 in order to give sufficient data for the comparison to be worthwhile.

Reference to Fig. 12 reveals several interesting features. In the period between 2000 hours and 0100 hours traffic volume steadily decreases. The number of accidents in contrast stays at a fairly consistent level, though dropping for the last hour. The number of accidents per million vehicle miles therefore rises steadily over this period. This is the period normally con-

sidered to be influenced most severely by the affects of alcohol. This rise in risk is matched by a rise in patrol levels to combat it. The period between 0100 hours and 0700 hours is the least heavily patrolled, yet relative to other variables, it is then when patrolling is highest. It is normally considered necessary to maintain a certain minimum police response potential at all times so this early morning level is perhaps justifiable on that basis. The apparent mismatch between police patrolling and the other variables is perhaps greatest, and least explicable in the early evening, from 1700 hours. Traffic volume and accidents are clearly at the maximum level between 1700 hours and 1800, yet at that time of day police patrol levels are in the middle of a steady decline which lasts from 0900 hours to 2100 hours.

Senior Police Officers were concerned at this mismatch, and stated that they would try to increase patrol levels in this period. Further action to modify diurnal patrol distribution was delayed while a more complete survey was carried out of all incidents requiring police attention. Members of the project team were also concerned with that investigation, but its scope extended so far from the theme of this thesis that further discussion of it is not included here.

6.3 COMPUTERISED ACCIDENT RECORDS

Durham County Constabulary's accident records were stored in two ways. There were large binders containing accident report forms similar to document 12, and there were punched card records which could be sorted on a card sorting machine. The cards did not contain information about the exact location of the accident. From these records Durham Constabulary normally produce a monthly summary of accident statistics, which is in such broad outline as to be of very limited use for police purposes.

This summary takes about 24 man hours per month to produce. As was illustrated in our experiment (See section 4. 2. 3.) the system is liable to break down in the event of sickness or a change in sorting machine operator.

Ad hoc investigations are also required from time to time, ranging from a half day job on the sorting machine up to one man week of checking from the accident report binders, as was often the case with accidents requiring more precise location. Further, a record of all injury accidents is passed by Durham Constabulary to the County Surveyor's Department who plot these on an accident map for all the trunk roads in the county.

It was pointed out to the Chief Constable and the Clerk of the County Council that all these functions could be performed more efficiently by computer, and at the same time the monthly information sheet might be developed to provide information more in line with the operational requirements. It was also pointed out that such systems were already being used successfully in a number of other counties. The Chief Constable and Clerk of the County Council both agreed in principle to accident statistics being processed on the County Council's IBM system 360/4 computer, and staff from the County Council's Data Processing Department started a detailed evaluation of the systems used in other counties. At this point the project team withdrew.

6.4 SINGLE AND DOUBLE CREWING

At the request of the Home Office, a survey of the activities of single and double-manned patrols was carried out. The survey was based on the reports of patrols operating on the A1 and A19 only, during the first project.

Table 6.4.1 gives a broad summary of activities reported for the period 9th August, 1967 to 1st February, 1968, and indicates that roughly equal numbers of single and double crewed patrols were operating.

Table 6. 4. 1

INCIDENTS	Crew 1	Crew 2
Number of Patrols Reporting	1,758	1,780
Accidents Reported	120	140
Traffic Offences Reported	560	652
Traffic Offenders Reported	354	439
Verbal Cautions (Traffic Offences)	886	1,031
Defective Vehicles Checked	264	270
Criminal Record Office Checks	276	440

These crews were not necessarily a representative sample of all crews, and the data in this section cannot be regarded as conclusive.

6.5 DISTRIBUTION OF PATROL TIME BETWEEN TASKS

Even in the early stages of Phase 1 of the first project, the reported patrol levels fell well short of the level which had been expected from a knowledge of the number of vehicles detailed to patrol each route.

In an effort to discover the cause of this, the form which had been used for recording patrol time (document 1) was modified to include a record of the distribution of duty hours between a number of different tasks (see document 2).

For a period of six weeks, all patrol crews, irrespective of whether they had spent any time on one of the designated routes, were required to complete one of these forms. This was not a man-hours survey (except in the case of Serious Incidents Squad personnel, where greater variations of crew and of duties made this necessary) but was a survey of patrol units. No account was taken of single or double crewing. The results of the survey are shown in Table 6.5.1 below.

It will be noted that only 61% of patrol crews' available time was in fact spent patrolling, while fully 9.5% of that time was spent in clerical duties. The full details of where patrol time was lost to other duties has been passed on to senior police officers in Durham Constabulary who will try to make improvements where possible.

After examining some of the clerical procedures, the Project Team were able to make some recommendations, whose implementation will help to reduce the very high proportion of time spent on clerical duties. Further details of the examination of two of these clerical procedures, and the improvements effected are included in the next two sections.

Table 6. 5. 1

DISTRIBUTION OF PATROL TIME AMONG VARIOUS DUTIES

PATROL TIME	TIME SPENT		% OF TOTAL TIME	
Patrol time	7082 hours	15 mins.	61.2	
Scene of accident	303	15	2.6	
Scene of crime	84	15	.7	
Attention to complaints	67	15	.6	
Escort duties	332	30	2.9	
Static check	37	15	.3	
Attention to 999 calls	193	00	1.7	
Taking statements	153	00	1.3	
Making Enquiries	371	00	3.2	
Interviews	122	45	1.1	
Court attendance	180	00	1.6	
Clerical duty	692	45	6.0	
Typing	317	45	2.8	9.5
Dictating	86	00	.7	
Miscellaneous	1075	15	9.3	
Car duty	473	30	4.1	
TOTAL TIME	11553	45	100.1	

6.6 ACCIDENT REPORTING PROCEDURES

6.6.1 Previous Method

This section describes the method of reporting an accident in use in Durham Constabulary until 31st March 1968. Thereafter, following the recommendation of the project team, a new procedure was adopted, which is described in the next section. Under the old system, the first Police Officer to whom an accident was reported was required by Durham Constabulary Standing Orders to observe the following procedure:

Either A. If he was able to complete his enquiries with 48 hours, then he was required to submit a completed Accident Report Book (see document 11) with typed witness statements, a sketch of the scene of the accident, and his recommendation, through his Superior officers, to Divisional Office.

or B. If enquiries were not completed within 48 hours, then he was required to submit the incomplete Accident Report Book to Divisonal Office, where the accident was recorded, and a serial number allocated to it. The Accident Report Book was then returned to the reporting officer, who was then required to complete it, and then resubmit it in a file, with a separate note sheet, on which his recommendations were entered, with a separate scale plan of the scene of the accident, and with typed witness statements.

Any Report Book submitted under A above, but bearing recommendations for court action, had also to be made up as a file, complete with note sheet and a separate scale plan of the scene of the accident. Where a file was made up, the recommendation of superivisory officers, and the decision of the Divisional Chief Superintendent, were entered on the note sheet, as was the result of any court action. After the completion of court action, or on the Chief Superintendent's Decision to caution or take no further action, the file was forwarded to Force Headquarters for storage.

When the Accident Report Book was first submitted to Divisional Office, details from it were typed in duplicate onto Accident Report Forms (see document 12).

This was a full-time job for one typist at each divisional office. One copy of the form was retained at Divisional Office, while the other was forwarded to Force Headquarters for use in punching accident cards, and for the headquarters accident file. Both copies of the Accident Report Form were endorsed with a note on the final action taken and its result, when the accident file was closed.

6.6.2 Revised Method

After some pilot experience, the following accident reporting procedure was adopted in Durham Constabulary from 1st April 1968.

An officer reporting an accident completes a Revised Accident Report Form (see document 13), in black ball-point pen, and submits it to his supervisory officers, together with handwritten statements and his recommendations. A decision is made on further action based on these documents. If no further action is to be taken, the Report Form is minuted to this effect, and forwarded to Force Headquarters.

If court action is required, the typist who formerly typed the old Accident Report Forms (Document 12), types the court file. This is then returned to the reporting officer with his original report form, to be checked, and completed by the addition of a scale plan.

The old Accident Report Forms (Document 12) are replaced by photocopies of the new Report Form (Document 13). When a file has been closed, any authorised person requiring information from it, is supplied with a photo-copy of the appropriate part of the Report Form.

6.6.3. Comparison

Before changing the system, a sample was taken of the time taken to complete the reporting of an accident under the old system. Similar measure-

ments were then made for a sample of accidents reported under the pilot new system. The following table summarises this comparison.

Table 6.6.1 Comparison of Accident Reporting Procedures

	Old System	New System
Number of Accidents in Sample	128	83
Mean time in minutes for completely reporting an accident	255	145
95% Confidence Interval	230 to 280	128 to 162

The new system therefore saves a highly significant 1 hour 50 minutes per accident, i.e. 43% of the average time taken to report an accident. This saving alone would be enough to cover the cost of both projects many times over every year.

The reasons for the savings with the new system are obvious:

1. Policemen no longer type statements, this is done by civilian typists, and then only when necessary for court procedings.
2. Civilian typists no longer type Accident Report Forms. The equivalent information is photocopied from the original.
3. Detailed plans of the scene of an accident are only prepared when required for court action.
4. Civilian typists no longer type extracts from 'closed' accident files, when such information is requested by authorised persons. This information is instead photocopied from the original document.

6.7 PROCESS REPORTING PROCEDURES

6.7.1 Previous System

The following procedure was that laid down for use in Durham Constabulary until 31st December 1968, for all offences (traffic, crime, and other) in which proceedings were initiated by summons.

1. The officer dealing with the offences, entered full details in his pocket book as the investigation proceeded.
2. When his investigations were complete, he dictated particulars of offenders and evidence of offences.
3. A civilian typist types these details in duplicate from the dictating machine onto a Summons Report Form (See Document 14).
4. The Summons Report Form was then checked by the reporting officer. If any error was found, the form was retyped and rechecked unit correct.
5. The Report Form was submitted with recommendations, through supervisor officers, to the Divisional Chief Superintendent for a decision.
6. If it was decided to apply for a summons, the Summons Report Form was sent to the Magistrates' Clerk with a request for a summons to be issued.

Dictating was not done in a patrol vehicle, but in a convenient police station, thus involving travelling time to and from the assigned duty. Young and inexperienced police officers usually preceeded dictation with a long hand draft, further increasing the time lost. Shortage of available typists often caused queues of work awaiting typing, especially at weekends. On occasions, these queues became so long as to cause serious delays in the issue of summonses.

6.7.2 Revised System

From 1st January 1969 the following procedure for initiating proceedings by summons was adopted by Durham Constabulary:

1. The officer dealing with the offences makes a brief entry in his pocket book, to record the time and sequence of events.
2. He completes details of offenders and evidence of offences on a Process Report Card (See document 15) as these become available.
3. He submits this card with recommendations, through his supervisory officers, to the Divisional Chief Superintendent for a decision.
4. If court proceedings are authorised, the card is sent to the Magistrates' Clerk, with a request for a summons to be issued.

All Magistrates' Clerks in the Durham Constabulary area have agreed to accept this card as a "written information" and to issue summonses based on their use. The reporting officer need not go to a police station at any time in the course of his reporting a simple offence. His process report card may be handed to his supervising officer at a rondez vous in the course of normal duty. Otherwise it is handed in at a police station at the end of a shift.

6.7.3 Comparison

Before the new system of Process Reporting was introduced, it was tested experimentally against the old system in Sunderland Division. Table 6.7.1 sets out the result of this Comparison.

Table 6.7.1: Comparison of Process Reporting Procedures

	"OLD"		"NEW"	
Number of process reports in sample	118		110	
	hrs.	mins.	hrs.	mins.
Total Police time	59	0	44	16
Mean Police time	0	30	0	24
Total Civilian time	29	0	5	12
Mean Civilian time	0	15	0	3
Total time	88	0	49	28
Mean total time	0	45	0	27
Standard deviation	0	19	0	6
Standard error	0	1.8	0	0.6
95% confidence limits	(45 ± 4) mins		(27 ± 1) mins	

The new Process Reporting procedure thus saves an average of 18 minutes (40%) for every summons issued. These savings are accomplished by the elimina-

tion of typing and the checking of typing, and by savings in time through making shorter entries in pocket books.

There are other advantages to the new system not appart from Table 6.7.1. Since it is not necessary to make a special journey to the police station for dictating, 'dead' travelling time is also saved. Since officers will not be spending as much time in police stations, less time will be lost in conversation with police friends, not strictly in the course of duty. Because of the elimination of queues for typing, the time between commission and trial will be reduced. Further because of the simplicity of the new system there is a tendency for more offences to be reported. Against these advantages must be set the disadvantage that there is no other record if a Summons Report Card is lost. This appears to be a risk well worth taking.

7. CONCLUSIONS

Tha main objective, normally ascri bed to Police Traffic patrolling, is to induce drivers to improve their driving standard, and thereby to reduce the accident rate. In the course of investigating the relationshipd between patrolling and driver behaviour and accidents, several facets of current practice in traffic engineering, in Police administration, and in operational police work, were shown to be unsatisfactory. These and other ancilliary conclusions are presented before proceeding to the central theme of the thesis.

One of the leading authorities in traffic engineering practice, Ref. 19, recommends a method of testing for a change in mean traffic speed, based on an assumption which is shown to be incorrect. As a result of this incorrect assumption, such a test would be grossly inaccurate.

It is common practice among British Traffic Engineers, to collect traffic data at different times of the year, and to collate these data by means of a seasonal factor, derived from a continuous census at 50 selected points throughout the country. The effect of this is to produce a correction factor, for conversion to mean August traffic flows, which, at its highest, exceeds two. These factors are completely different to the seasonal variations observed on the main trunk routes in the North East, and are wholly inappropriate for that area.

The Police administrative systems which formerly dealt with the recording of accidents and offences, were shown to be wasteful in their use of civilian and police manpower. Improved systems were devised and implemented in Durham Constabulary with considerable savings.

Anomolies were observed between the diurnal allocation of patrol strength, and the diurnal distribution of both accidents and traffic volumes. The anomolies, and the lack of any evidence that police have a short term effect on driver behaviour, has led Durham Constabulary to re-examine their objective, and their control and information systems, within the traffic area. This was the subject of the third research proposal (Appendix 4), which did not

receive the financial support of the Home Office. Work along similar lines is however proceeding, using mostly Durham Constabulary personnel, with some Business School support.

The survey of other related research, showed that much of the work in this area suffered from a lack of statistical analysis. Where possible, some evaluation of the significance of results was performed for these projects. In other cases, errors in statistical analysis were found, and corrected. The close scrutiny of the significance of results enabled the conclusions of other researchers to be put in their proper perspective.

Some other larger scale experiments do show some indication that police levels affect reported accidents, but in these cases there is a strong possibility that publicity might have had a considerable effect on the outcome of the experiments. Both Durham projects avoided publicity completely.

There was no clear evidence from the first project, that changes in the level of police patrolling had any effect on the accident level. The design of these experiments was however, such that a considerable change in the accident rate would have been required for its significance to become apparent.

From the results of the second project it is clear that changes in the level and tactics of police patrolling, to the extent described above, have little or no influence on several key aspects of the driving behaviour of the vast majority of drivers. In particular, in a change from uniform patrolling to pulsed patrolling the following changes are the maximum which could occur within the 95% confidence intervals of the experimental results.

1. The mean speed of cars in a derestricted zone changes by no more than 1.81 m.p.h.
2. The mean speed of light goods vehicles in a derestricted zone changes by no more than 1.25 m.p.h.
3. The mean speed of heavy goods vehicles in a derestricted zone changes by no more than 1.18 m.p.h.

4. The mean speed of cars in a built up area changes by no more than .96 m.p.h.
5. The mean speed of light goods vehicles in a built up area changes by no more than 1.42 m.p.h.
6. The mean speed of heavy goods vehicles in a built up area changes by no more than 1.23 m.p.h.
7. The percentage of drivers according precedence to pedestrians waiting on the pavement to cross a pedestrian crossing changes by no more than 2.6% from a value of 12%.
8. The percentage of drivers giving precedence to pedestrians waiting on the central island of a pedestrian crossing changes by no more than 8.0% from a value of 55%.
9. The changes in a specifically designed measure of overtaking levels was no more than 2.7

These are the maximum changes which might be expected at similar road positions, on similar roads to those of the Durham experiment. There is no reason to suppose that comparable changes in patrolling would have any markedly greater effects on other roads, and on other features of driver behaviour.

Driver behaviour was not appreciably different when pulses were in operation, and when they were not in operation. Thus the short term effects of changes in levels of policing are at most very small.

As a direct result of the experiments performed, the idea of pulsed patrolling was dropped. It showed no advantages in the effect on driver behaviour, and it would produce an inferior distribution of response times compared with the same force distributed uniformly.

In examining the implications of the Durham results a number of explanations are apparent. It is possible that driver behaviour and accidents are largely unaffected by police presence, and that earlier experiments which produced positive results, did so as a result of experimental defects, or the effects of publicity.

An alternative explanation, and perhaps the most likely one, is that drivers modify their behaviour only when they perceive an appreciable change in the level of policing, and that the reason for the effect observed in Durham, was the failure of the majority of motorists to notice any difference in police levels or tactics. This could explain the more dramatic changes where publicity was used, which would help the perception of changes. This hypothesis might be tested by incorporating a public awareness survey into experiments, similar to those conducted in project 2.

It is also possible that the mere presence of extra police might not have much effect on driver behaviour, while greater fear of prosecution would cause an appreciable improvement in driving standards. If this were so, then the effect might be more related to the number of prosecutions than to the level of patrolling, and this effect would tend to build up over a much longer period of time than was examined in any of the phases of the Durham experiment. This explanation is supported by the 30 m.p.h. limit enforcement project, but further experiments, with much more careful statistical design, would be required to test this theory properly.

Much further work is still required on the effect of the police on the traffic environment. The evaluation of a functional relationship between patrol levels and accident rates is likely to remain an illusion unless the scale of experiment can be increased to a different order of magnitude from anything attempted so far. This would require the implementation of detailed, accurate information systems for Police Patrolling, traffic volume, road engineering, and accidents on a National Scale. Such an investigation would prove extremely expensive, and difficult to control, but if it were able to lead to the better allocation of police, and road engineering resources, then this expenditure might easily be justified.

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9. APPENDIX 1

THE PROJECT TEAMS FOR THE TWO PROJECTS

9.1. PROJECT 1

The project team for the first project was as follows:

FULL TIME POLICE LIAISON OFFICER

Chief Superintendent H. A. Taylor, Durham Constabulary (then Chief Inspector).

FULL TIME RESEARCH ASSISTANT

Mr. T. H. Biss, Durham University Business School.

PART TIME ADVISORY PANEL

Prof. M. R. C. McDowell, Durham University Mathematics Dept.

Dr. R. F. Tuckett, Durham University Business School

Dr. D. M. Greig, Durham University Mathematics Dept.

Mr. J. R. Poston, Durham University Mathematics Dept.

This team was also responsible for the initial development of the second project.

9.2. PROJECT 2

The project team for the second project was as follows:

FULL TIME POLICE LIAISON OFFICER

Chief Inspector J. Passmoor, Durham Constabulary

FULL TIME RESEARCH ASSISTANT

Mr. T. H. Biss, Durham University Business School

PART TIME ADVISORY PANEL

Mr. J. Hallett, Assistant Chief Constable, Durham Constabulary

Chief Superintendent W. H. Harper, Durham Constabulary

Chief Superintendent J. G. Young, Durham Constabulary

Chief Superintendent H. A. Taylor, Durham Constabulary

Inspector J. Fidiam, Durham Constabulary (Operational Commander)

Prof. M. R. C. McDowell, Durham University Mathematics Department

Dr. A. G. Hawkes, Durham University Mathematics Department

Dr. D. M. Greig, Durham University Mathematics Department

Mr. C. J. Constable, Durham University Business School

Mr. P. M. Jenkins, Durham University Business School

 APPENDIX 2

UNIVERSITY OF DURHAM

Research project on trunk road patrolling

1. Introduction

It is proposed that the Durham group investigate the effect, if any, of police motor car patrols (hereafter called patrols) on the accident rate on certain primary routes in County Durham.

The investigation will be limited to the lengths of the A1 and A19 in the County Police area. These routes will be considered in two stretches each:

	Stretch a_1	Stretch a_2
A1	Darlington - Durham (Sunderland Bridge)	Durham - Gateshead

	Stretch b_1	Stretch b_2
A19	Sunderland - Castle Eden	Castle Eden - Egglescliffe

Each stretch is approximately 12 miles in length. The gross accident rate for the first three months of 1967 is approximately 30 ± 3 per stretch per month. However previous experience with this type of experiment indicates that the reported incidence of accidents involving only damage and/or slight injury may not be reliable, and that it is preferable to work only with the figures for accidents which are fatal or cause serious injury. There are about 3 of these per stretch per month at present.

Traffic flow measurements carried out by the County Surveyor's office on each stretch for August 1966 indicate that the accident rate/vehicle mile is about one accident/2×10^5 vehicle miles on the A1 and about three times this figure on the A19. Major improvements in hand on the A19 are expected to greatly reduce this latter figure. During 1967-68 hourly flow levels at two points on each of the a_1 and a_2 stretches (mean over one week in general) will be available.

Present levels of patrolling are minimal, the responsibility being largely a divisional one so that cars are very frequently diverted from patrolling to other functions.

2. Preliminary Studies

(a) Using police punched card records for 1963-1966 of serious and fatal accidents on the A1, A19 (about 600) an analysis of diurnal and seasonal variations, and of the corresponding changes in traffic flow, will be carried out to indicate the present pattern and assist in scheduling additional patrol activity to give maximum effectiveness.

(b) The first important step is to establish present patrol levels and tactics. To do this it is proposed that on selected days during the two months August - September 1967 the crews of all police vehicles using the A1 or A19 will be asked to record the times at which they were on any of the four experimental stretches. Further care specifically assigned to patrol would be asked to record in addition

1. the number of men in the crew,
2. weather and road conditions,
3. the time and location of any accident attended,
4. the number of warnings of possible process issued, other than accidents,
5. the number of verbal cautions given,
6. the number of defective vehicles checked,
7. the number of CRO checks,
8. assistance to motorists,
9. escorts provided.

Information under the headings 4 - 9 above will be returned on the normal incident form, but filled in daily instead of monthly. The times of entry and exit to the experimental stretches of road, and details 1 - 3 above, will be entered on a record pad designed to simplify recording and to act as a punch card transfer.

This information will be analysed to give present levels of overall police activity and of specific patrol activity on the experimental stretches.

3. First experiment October - December 1967

(a) Two additional patrol cars (subject to availability) will be assigned to each of stretches a_1, b_1, for the shift 4 p.m. - midnight: this period appears to include the peak incidence of accidents.

(b) No changes in tactics or recording will be introduced.

(c) Recording as in the preliminary study will be carried out on random days on all four stretches to monitor other police activity.

With the information on these two levels of patrol activity, and on traffic flow, the accident rate on the stretches, a_1 , b_1 , (and also on other roads near these) will be compared with that on the control stretches for the periods covered by 2 and 3.

4. Testing of model, influence of change of tactics

A. During January - March 1968 two experiments will be carried out -

(a) on stretch a_1 patrolling will be carried out without change of tactics, at an altered level suggested by the previous results (i.e. at either one or three additional cars depending on whether the effects in the first experiment were large or small).

(b) on stretch b_1 where the level of patrolling should not be altered a tactics experiment is suggested, not involving either highly decorated cars or widespread publicity. It might however involve,(subject to further discussion)

(i) increased verbal cautions

(ii) two cars connected by radio and working together

(iii) restriction of each car to a six-mile stretch to avoid over-lapping

(iv) replacement of cars by motorcyclists working in pairs

B. During April - June 1968 further tactical modifications will be investigated.

A patrol level will be adopted as in the first experiment, or as suggested by the results in order to have a perceptible effect. The modifications which could then be introduced would include

(i) highly decorated police cars (white stripe on black or some easily recognisable colour scheme)

(ii) widespread local publicity in press and T.V.

(iii) labelling of some roads 'Police Patrol Experiment in progress'

Recording will continue as in the first experiment for the whole of this period.

These proposals require 4 or 5 additional police cars for one shift per day during the period September 1967 to June 1968, preferably each with a crew of two. The patrol level in the experiment will vary from the present figure, (estimated as $\frac{1}{3}$ car/stretch) to a maximum of 3 cars/stretch, i.e. a factor of nine.

5. Analysis of Results

The preliminary model will be reassessed and modified to incorporate the effect of tactical changes. The group will attempt to deduce optimal patrol levels and tactics and suggest further research.

D. M. Greig

17th July, 1967.

11. APPENDIX 3

Proposed investigation of the effects of different methods of use of Police Motor Patrols on driver behaviour

Durham University/Durham Constabulary

February 1969

1, Design of Experiment

It is proposed that a special Motor Patrol unit is formed on a short term basis for this project. This unit will be used to patrol selected routes in the Sunderland area

(a) uniformly

(b) in a pulsed manner

and measurements made of certain aspects of driver behaviour during both types of patrolling.

2. Selected Routes

The total route mileage to be studied is approximately 48 miles, comprising of four stretches of approximately 12 miles each:

Route 1

Commencement of the A183 road, South Shields to its junction with the A182 at Shiney Row.

Route 2

A184 from the roadworks south of White Mare Pool to the A19, A19 from end of Dual Carriageway, South Shields to Ryhope Green.

Route 3

B1289 Washington Town Centre to Wheatsheaf Roundabout, Sunderland.

A690 Centre of Houghton-le-Spring to Park Lane Island.

Route 4

A19, Ryhope Green to junction of A179. The traffic density on these routes is very nearly in the ratio 1:1:1:2.

For that reason route 4 will be treated as a double route, by introducing "route 5", a dummy route equivalent to route 4, and thus giving an effective route mileage of 60 miles.

3. First Period, Uniform Patrolling

For a nine week period, from 17 March, the force will be used to patrol the five routes as uniformly as possible from 8.30 a.m. to 5.30 p.m.

Two shifts will be used:

Shift A: 8.00 a.m. - 4.00 p.m.

Effective patrol 8.30 a.m. - 3.30 p.m., lunch 12 noon - 1.00 p.m.

Shift B: 10.00 a.m. - 6.00 p.m.

Effective patrol 10.30 a.m. - 5.30 p.m., lunch 1.00 p.m. - 2.00 p.m.

Double strength will be available 10.30 a.m. - 12 noon and 2.00 p.m. - 3.30 p.m.

4. Force Required

Men: 12 P.C's and supervisor (Sergeant or Inspector) giving 6 men per shift, allowing for sickness and administrative and clerical duties should give four drivers per shift.

Vehicles: 6 motor cars and 2 motor cycles (giving 3 motor cars and 1 motor cycle per shift).

Base: Sunderland, Mobile Police Station

5. Patrol of Routes by Other Police Patrol Units

These routes should be patrolled by normal Divisional patrols during the period 5.30 p.m. - 8.30 a.m. No Police vehicles other than the University Patrol Group should patrol the routes except to respond to an emergency.

6. Effective Patrol Intensity, First Period

At four vehicles per shift, six hours patrol per vehicle per shift gives 48 patrol hours a day, giving approximately 9.6 patrol hours per route per day, or very closely one vehicle in each of the five stretches at any time. (Distribution as Table 1). Officers will be allowed one hour away from their route for lunch, and if possible personnel should receive an allowance for meals out.

7. Second Period: Pulse Patrolling (nine weeks)

The same force, at the same intensity, would be used to give very in-

tensive coverage of one of the five routes, selected on a random basis, in three day bursts (see Table 2). Three out of four vehicles per shift would be used on this basis, the remaining strength giving low level uniform background cover. This allows for 36 patrol hours per nine-hour day on the selected 12 mile route, or four vehicles on the route at any time. The pulse selection (Table 2) has been carried out using a table of random numbers.

8. Instructions to Crews, re R.T.A.

Each man will submit a daily report on distribution of time between various duties, and a special incident form for each incident dealt with.

Crews will be instructed to use cautions and reports for process for all cases of excessive speed, reckless, careless or dangerous driving, offences with respect to pedestrian crossings, etc.

9. Measurements of Driver Behaviour

The following parameters will be measured.

1. Route 3, A690

   Mean and variance of speed distribution in a derestricted zone (Heavy, light commercial and private motor cars separately).

2. Route 1, A163

   The same, in a 30 m.p.h. restricted zone.

3. Routes 4/5, A19

   Percentage of drivers overtaking in a narrow undulating stretch of road.

4. Route 2, A19

   Percentage of drivers giving precedence to pedestrians at a designated crossing.

Measurements will be made on eight occasions per week, each measurement comprising a 1½ hour sample, so that each parameter will be measured twice per week. Sites have been chosen so that in as far as possible those carrying out the measurements will not be very noticeable.

The parameters will be analysed in terms of

(a) Uniform patrolling

(b) Pulsed patrolling

and

b_1) Pulse on b_2) Pulse off

Accident statistics will be kept, but are not expected to provide a statistically significant sample.

TABLE 1

Uniform patrol: assignment to routes (week 1)

Time	8.30/9.30	9.30/10.30	10.30/12	12/1	1/2	2/3.30	3.30/4.30	4.30/5.30	TOTAL (hours)
Route									
1	1	1	2	1	1	1	1	0	9½
2	1	1	1	0	1	2	1	1	9½
3	1	0	2	1	1	1	1	1	9½
4	0	1	1	1	0	2	1	1	9½
5	1	1	2	1	1	2	0	1	10
No. m. patrol	4	4	8	4	4	8	4	4	48

Week 2: permute routes 2, 3, 4, 5, 1

Week 3: " " 3, 4, 5, 1, 2

Week 4: " " 4, 5, 1, 2, 3

Week 5: " " 5, 1, 2, 3, 4

Week 6: " " 1. 2. 3. 4. 5

8.30	9.30	10.30	12	1	2	
-	-	-	-	-	-	
9.30	10.30	12	1	2	3.30	

TABLE 2

Pulse Pattern, Phase 2

Pulse No.	Route No.				
1	1	2	3	4	5
1	ON				
2			ON		
3		ON			
4					ON
5		ON			
6		ON			
7			ON		
8			ON		
9					ON
10					ON
11			ON		
12				ON	
13		ON			
14					ON
15		ON			
16	ON				
17				ON	
18				ON	
19			ON		
20			ON		
21			ON		

12. APPENDIX 4

DURHAM UNIVERSITY BUSINESS SCHOOL

A PROPOSAL FOR RESEARCH INTO GOALS AND CONTROL AND INFORMATION SYSTEMS IN POLICE TRAFFIC DIVISIONS

29th July 1969

ABSTRACT

This proposal is for a detailed research programme into the setting of Goals* for a Police Traffic Division, and the establishment of Control and Information Systems* necessary to achieve these goals.

The research programme is designed to cover a period of two years, involving five and a half man-years of full-time research staff effort, together with the full-time support of a seconded senior police officer and the part-time advice of a panel of five staff from the Business School. The proposal covers two stages of investigation.

Stage I will cover a period of six months and involve a national sample to establish the goals. Stage II will investigate control and information systems in detail in three selected police traffic divisions over a period of eighteen months. A possible third stage involving the implementation of suggested improvements would be the subject of further negotiation with the Home Office, when the extent of the work is more apparent.

*See Glossary on Page XIX

2. INTRODUCTION

This proposal outlines the previous work done for the Home Office by the Durham Team. It shows how the proposed project developed out of the previous work. It argues that it would be wasteful to continue with research of the type previously conducted, before police goals have been clearly established, individual objectives set, and the control and information system examined in detail. Relationships such as those investigated in the first two years of work in Durham are usually distorted by the influence of other factors which are difficult to exclude. A common way of excluding such a factor is to run an experiment in which the factor is kept constant throughout. This leaves results which are strictly only applicable when the factor has this fixed value. A clear picture of the relationships is therefore difficult and expensive to obtain. Before such an investigation is undertaken the relationship should, therefore, be central to the function of a traffic division.

The proposal also shows how the Business School is well qualified to carry out the research programme, which is described in detail and consists of two stages. In the first stage two full-time research scientists and one police officer on secondment will examine the goals of police traffic divisions in a nation-wide investigation. In the second stage, a further scientist will join the team, which will investigate control and information systems* in three selected traffic divisions.

Possible further developments of this line of research are also outlined.

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*See glossary on Page XIX

3.1 Past Research

.1 A joint Durham Constabulary/Durham University Methematics Department/Durham University Business School team has been working on the effects of Police Traffic Patrols on traffic behaviour and accidents, for the past two years.

.2 The first project this team undertook was to look at the effect an increased patrol level had on accidents. The effects of a change in tactics on accidents was also investigated. Neither change showed any significant effect.[1] In retrospect, perhaps this is not surprising in view of the fairly considerable decrease which would have been required for a significant result to have been established.

.3 As a spin-off from this experiment certain simple changes were made in information handling procedures, which were shown[2] to have led to considerable savings in Durham County alone.

.4 The second project examined changes in police patrolling in respect of their effect on various aspects of driver behaviour. Pilot experiments for this project showed[3] that the presence of a police car in the immediate vicinity had a small but significant effect on drivers' speed in a built-up area and on their willingness to give precedence to pedestrians waiting at a pedestrian crossing.

.5 The second project is now almost at an end, but it has already become apparent that the changes made in patrolling have no appreciable effect on any of four measured aspects of driver behaviour.

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1. The joint University of Durham/Durham Constabulary Research Project on Trunk Road Patrolling 1967-68, Second Report, Part 1.
2. Part II of the above report.
3. Part III of the above report.

These aspects of driver behaviour were :

speed in a derestricted zone,

speed in a 30 m.p.h. limit zone,

action at a pedestrian crossing, and

overtaking behaviour.

The changes in patrolling were from a uniform level to the same overall effort, but distributed mostly in pulses, or bursts of three-day duration. The small local effect of a patrol unit noted in .4 seems to be lost when observing a traffic stream under any practical level of patrol supervision.

3.2 The Need for a Change in the Theme of the Research

The results of both previous experiments, especially the 1968-69 experiment, have profound implications on the use of patrol cars. They call into question accepted objectives for patrol car allocation. This, together with large savings obtained by simple changes in information handling procedures, leads not unnaturally to the investigation we now recommend.

Further work could entail a waste of research effort if it is not contributing directly to the central function or goals of police traffic divisions. Such investigations make most sense when conducted into problems that are central to the effectiveness of traffic divisions. This would include an examination of the sources and types of information used for control purposes.

It would therefore be most sensible to precede any resumption of experiments such as those of our first two years of operation by the investigation proposed. It is also clear that without a knowledge of the cause-effect relationship between police and their environment, cost benefit analysis in the field of traffic supervision is not a viable proposition. The proposed investigation will not only give a

return in providing a framework for research, it will also indicate how the organisation and information handling can be revised for greater operational effectiveness.

3.3 The Research Proposal

The first stage of the proposed investigation would consist of a nationwide survey of the goals of police traffic divisions. These would be established firstly by using the results of a questionnaire, and secondly by a series of structured interviews. The questionnaire will go to all senior police officers in traffic divisions throughout the country. For the follow-up interviews a sample will be selected from those who have completed the questionnaire. This first stage will last for six months.

In the second stage of the proposal the control and information systems of three selected police traffic divisions will be examined in detail. This will entail carefully structured interviews with officers, at all levels of each traffic division, to establish the following:

1. His objectives*
2. How he is assessed on those objectives
3. What information he requires
4. What information he received
5. The sources of his information
6. What information he provides for others
7. His subordinates' objectives
8. What he thinks his objectives should be
9. How he thinks he should be assessed
10. What he thinks his subordinates' objectives should be

The results of the interviews will be examined to determine the following :

1. Is the police officer contributing effectively to the attainment of the traffic division's goals?

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*See Glossary

2. Does the method of assessing him reflect the degree to which he has achieved his objectives?

3. Is the information a man receives the information necessary for him to make his decisions?

4. Is the information handled by or for the traffic division transmitted in the most efficient way and presented in the most useful form?

The detailed programmes for each stage of the proposed project are set out below in section 4.

3.4 Expected Benefits

The proposed research programme should benefit the police force in three ways.

.1 Objectives and control and information systems should be improved so that all decisions made are in line with the objectives of the traffic division, using the information appropriate to the decision. Improvements in the method of handling the information should also be made.

.2 The proposed project will pave the way for complete revision of the control systems of traffic divisions, and the introduction of Management by Objectives*.

.3 The aims of a police traffic division are currently being expressed in such general terms that it is difficult to ensure that research being carried out is contributing to operational effectiveness. Following the project it will be possible for further research programmes to be more closely alligned to this requirement.

3.5 Why the Business School is particularly well equipped to carry out the proposed research

.1 The research proposed in this paper concerns objectives, control and information systems, precisely those areas of management studies which are the declared special fields of interest and expertise of the Business School.

.2 The research proposal involves an interdisciplinary team, and it is one of the Business School's declared aims to concentrate on work of this type.

.3 The Business School has a wealth of the sort of experience which this project would require, as is evident from Section 8 below.

3.6 The Structure of the Proposed Research Team

.1 It is proposed that the research team should be organised with four full time members, and with a panel of five expert advisers, who would act as consultants to the project as and when occasion demanded.

.2 The expert advisers would be Messrs. Baker, Constable, Machin, Reynolds and Jenkins (see section 8 below).

.3 The full time staff should include one full-time police officer, on secondment, one behavioural scientist, a specialist in control and information systems, and the full-time scientist from the previous police project, Mr. Biss (see section 8 below).

.4 One of the three full-time scientists should be appointed in charge of the day to day running of the project and the co-ordination of the work of the whole team.

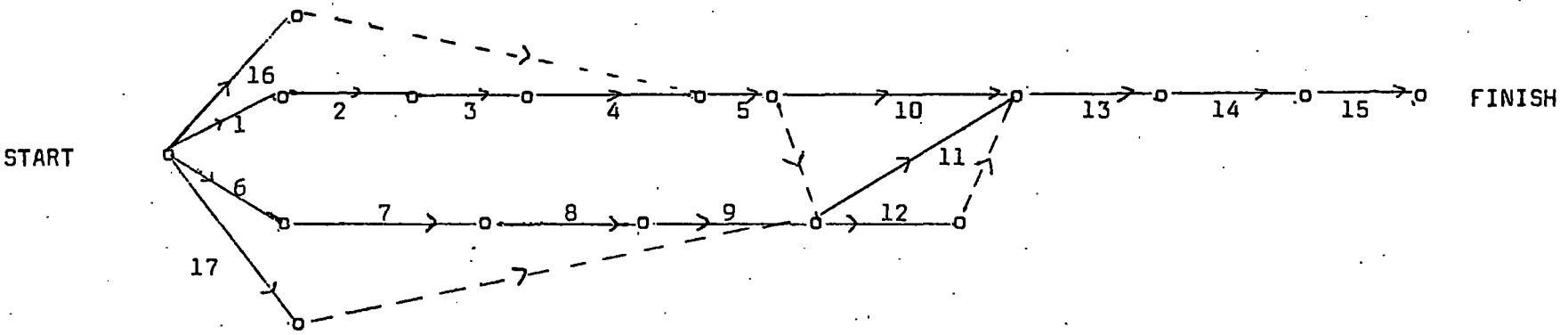
.5 He would respond to Mr. Machin as the permanent member of the School ultimately responsible for the project.

4. THE DETAILED RESEARCH PROGRAMME

4.1 Stage I

The programme for this stage is summarised in the Critical Path (C.P.A.) Diagram on the next page. If all three members of the team

C.P.A. Diagram For Stage I



Activity	Time elapsed in weeks	Man Weeks	Activity	Time elapsed in weeks	Man Weeks
1. Design questionnaire	-	4	10. Analyse questionnaires	-	6
2. Run pilot study with questionnaire	-	4	11. Arrange and conduct interviews	-	15
3. Modify questionnaire	-	4	12. Analyse interviews	-	6
4. Print and circulate questionnaire	2	-	13. Write and print report on first stage	-	9
5. Await return of sufficient completed questionnaires for analysis to start	3	-	14. Organise seminar	4	-
6. Select samples for follow-up	4	1	15. Conduct seminar	-	-
7. Design interview schedule for follow-up	-	3	16. Obtain backing of each Chief Constable for the circulation and completion of questionnaires	4	1
8. Test schedule	-	3			
9. Modify schedule	-	3	17. Obtain backing of each Chief Constable for the programme of interviews within his Force	4	1

are available from the start of the project, then it will be seen from the diagram on the previous page that the path 1, 2, 3, 4, 5 is critical and will take nine weeks, activities 10, 11 and 12 can be completed in a further nine weeks. With three weeks for writing up, the total length of the project would be 21 weeks. This would only be possible if the new member of staff is able to take a full part of the work from the outset. If this is not so, as is most likely with a new member of staff unfamiliar with police practice, then he would reasonably spend the early part of the experiment familiarising himself with police practice. If activities 1, 2 and 3 were performed by just two members of the team this would increase the length of time for the project to 23 weeks.

The proposed length of the phase of six months thus provides a float of three weeks for unexpected delays. One of these weeks would be accounted for by the effect of Christmas. The completion of the project within six months is dependant on the early recruitment of a third member of the project team. Delay in filling this post would affect the completion date as indicated by the C.P.A. diagram.

The post should have been filled by the start of activity II as the police member of the team should not be expected to conduct the interviews.

The questionnaires should be sent out to all police officers above the rank of Inspector, employed in a traffic division, or having responsibility for a traffic division, in any police force which received a Home Office grant.

The purpose of the questionnaire is to establish precisely what each officer regards as the goals of traffic policing. The way in which the officer relates his concepts of the function of a traffic division to the decisions he has to take will also be studied.

This theme will be clarified further in the programme of sample interviews which will be based on the answers to the questionnaires. In the course of Stage I the objectives of senior police officers will be established for police forces throughout the country. These objectives will be used to work back towards the goals of a traffic division.

4.2 Stage II

The second stage of the experiment will confine its attention to three selected traffic divisions. These should provide scope for contrasts in control and information systems, and help the team to consider all reasonable possibilities. Limiting the number to three does, however, allow an examination of each system to be made in depth. In each traffic division the investigation will start with the Chief Constable and work down through the ranks. All officers of the rank of Inspector and above in each traffic division, including the specialist services sections, will be interviewed, together with samples of sergeants and P.C.'s. The interviews will be structured to establish:

1. The man's objectives. These objectives should not merely be vague aspirations, but should be such that it is subsequently possible to see whether they have been achieved or not.

2. How he thinks he is assessed on his objectives. This will affect the man's motivation and may alter his real personal objectives. A distorted assessment of performance may lead to distorted objectives and decision-making disfunctional with the goals of the traffic division.

3. The information he requires. This will also include the reasons why the information is required. The answers to this should relate to the decisions which the man has to make, and his objectives when making these decisions.

4. The information he receives. This will be the principal method of detecting a flow of information within the traffic division. These information flows will subsequently be traced through the division, and coded.

5. The sources of the information. Any possible alternative sources of information will also be sought here. These will aid the development of the model of the information system.

6. The information provided to others. This too will help to trace the information flow within the traffic division, and may reveal instances where information is collected unnecessarily, inefficiently, or in too much detail, or where another officer might provide the same information more efficiently.

7. His subordinates' objectives. Like his own objectives, these should not be vague generalisations. Comparison of these with the objectives his subordinates give will reveal any weaknesses in communication of objectives.

8. What he thinks his objectives should be. This will help us to find and recommend improved objectives.

9. How he thinks he should be assessed. Improved methods of assessment would encourage improved operational performance.

10. What he thinks his subordinates' objectives should be.

Any differences between 1 and 8 above will also be reflected in differences between 7 and 10.

The research programme for this stage is essentially very straightforward, after the preliminary work. The third full-time scientist in the team should be recruited one month before the end of the first stage of the project. In this month he could familiarise himself with police practice.

A C.P.A. diagram of the preliminary work to this stage of the project is included on page XV. Activities 1 to 9 should have been completed before the end of Stage I and the rest of the preliminary work should take a matter of days. The rest of Stage II consists of the chain of activities of arranging interviews, preparing for them, conducting them and analysing them for all senior officers working downward in rank, and for the selected sample of lower ranks. At the same time the information flows will be traced and coded.

Each type of information will be examined to ensure that it satisfies the requirements of its users in the most economical way possible. Methods of transmission, duplication, processing and presentation of information will be examined critically to ensure that they are as efficient as possible, consistent with the requirements of users.

The critical path in the preliminary work is the path 6,7,9,10, 11,12. This indicates that preparation for the second stage should start at least seven weeks before the end of the first stage.

4.3 The use of the results

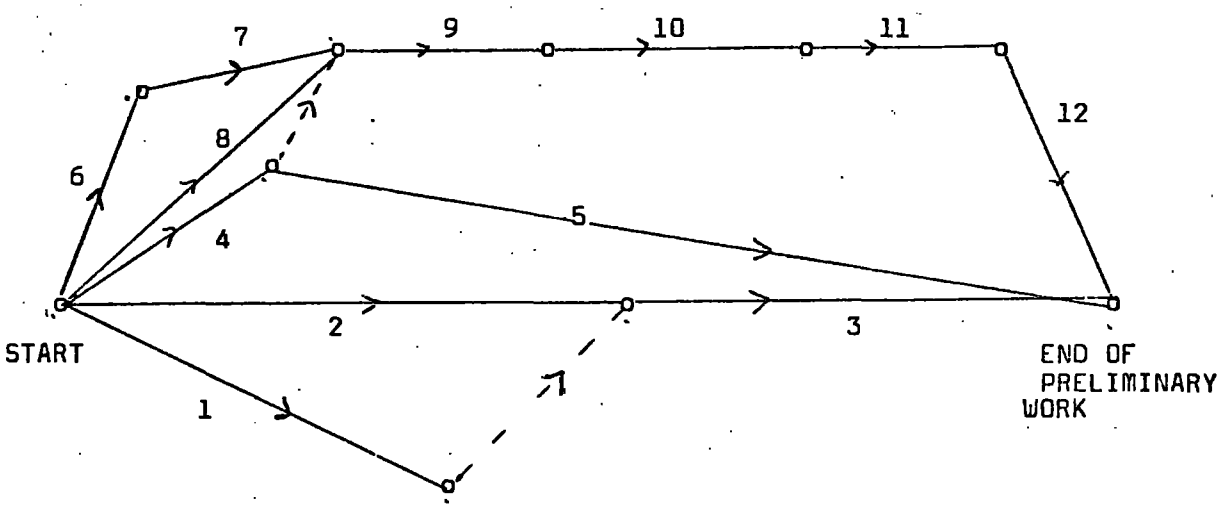
1. It is expected that the Home Office, together with ACPO, will, on the basis of the results obtained from Stage I, and the outcome of the seminar, make recommendations or directives for all Chief Constables concerning the goals of traffic policing.

.2 It is anticipated that as a result of the seminar Chief Constables will re-define the goals of their own forces.

.3 It is also expected that the District HMIs and the HMI Traffic will examine the findings which they will use in their own tasks.

.4 If all these expectations have been fulfilled by the end of Stage II, a thorough review and redesign of management control systems in one or several forces may be undertaken, so that the benefits of this approach may be demonstrated, to the eventual benefit of all forces. This work would form a natural extension project after the two-year proposal described here.

C.P.A. Diagram for Preliminary Work for Stage 2



	Elapsed Weeks
1. Design pilot interview schedules	2
2. Obtain a Chief Constable's backing to test the pilot schedules	1
3. Test the pilot schedules	1
4. Find the detailed organisational structure of the traffic divisions	2
5. Select sample of other ranks	1
6. Obtain Chief Constable's co-operation in each of three forces	3
7. Secure nomination of official contact in each force	3
8) Plan briefing on nature and purpose of the investigation) and design and print documents setting this out for 9) officers unable to attend the briefing	2 1
10. Brief senior officers	0
11. Brief other ranks	0
12. Send out written description of the nature and purpose of the investigation to officers unable to attend the briefing,	0

5. A POSSIBLE THIRD STAGE

5.1 The project as outlined in 3 and 4 above will help the Police and the Home Office to move towards agreed goals, and will help them to highlight weaknesses in current methods of operation. In many cases immediate improvements will be indicated from the project, but further major improvements should be possible, which would require a further project to redesign systems in previously highlighted areas of weakness.

5.2 It is impossible to predict the exact nature of these new systems, and this would be the subject of further negotiations between the Home Office and the Business School in just under two years from now.

The control system which would be most suitable is likely to be some variant of Management by Objectives.

5.3 A complete understanding of existing systems should prove indispensable in this redesigning, and the benefits which such an extension project should provide should be regarded as part of the pay-off of the proposed project.

6. COST

The proposed project will last for 24 months. In the first year it will employ two scientists for the full year and one for 7 months of that year. In the second year it will employ three full-time members of staff. A fund is proposed from which members of the advisory panel or other suitable specialists may be paid for detailed involvement in the running of the project. They will not be paid for the advice they give as part of the advisory panel, and will not receive payment without the approval of the Head of the Department

who will not himself charge for consultancy. The travelling expenses for the first year are necessarily high, because of the extensive interviewing schedule for Stage I.

The budget for the first twelve months is :

	£
Salaries	6,000
Secretarial services	800
Consultancy fund	400
Travelling	800
Printing, Information, Processing, etc.	500
University overheads	850
	£9,350

The budget for the second twelve months is:

	£
Salaries	6,900
Secretarial	800
Consultancy fund	400
Travelling	500
Printing, information processing, etc.	500
University overheads	900
	£10,000

7. CONCLUSION

This proposal describes a two-year programme of research. It shows how this research is related both to the needs of the police service, and to the expertise and experience of the Business School. Indications are also made of further research which should be of benefit when the proposed programme has been completed.

Two years is the minimum duration of a project for which the Business School is prepared to recruit new staff.

8. DETAILS OF RELEVANT EXPERIENCE OF BUSINESS SCHOOL STAFF AVAILABLE TO ADVISE THE PROJECT TEAM

H.C.Baker, B.Sc., M.A., M.B.I.M. Director of DUBS.
Has spent a number of years studying the human factors involved in problems of technical communication, decision making and operations control. He has undertaken a number of attitude surveys within companies. Consultancy projects include the development of management teams, organisational problems and the introduction of management by objectives into a wide range of organisations.

C.J. Constable, M.A., B.Sc., A.R.S.M., A.M.B.I.M. Assistant Director of DUBS.
Had considerable industrial and consultancy experience before joining the Business School. He spent the academic years 1965 and 1967 at the Harvard University Graduate School of Business Administration. Work for a D.B.A. thesis on Computer Process Control has resulted in his obtaining considerable understanding of Information Systems, a subject he teaches within the Business School.

J.L.J. Machin, M.A., A.A.C.C.A., A.M.B.I.M.
Joined DUBS from industry, where in his last post as Assistant to a Main Board Director of an International organisation he had been involved in seeing that the fundamental changes recommended by outside consultants in the group's management control systems were satisfactorily implemented in a number of divisions and subsidiaries. Since joining DUBS, Mr. Machin has developed courses in Management Control Systems using experience gained at Harvard Business School in 1966/67, and experience arising from close contact with organisations striving to introduce Management by Objectives as widely different as a diesel engine firm and a group of hospitals.

P.M. Jenkins, B.Sc.
Has worked in operational research and management science since 1963. He spent three years in the Defence Operational Analysis Establishment, where work included information systems research for operational defence units. This was followed by two years in the USA building a linear programming system for strategic deployment problems in the U.S. Department of Defence. He joined the Business School in December 1968.

P.M. Reynolds, M.B., Ch.B. Lecturer in Behavioural Sciences
After medical and behavioural science experience in industry, Mr. Reynolds joined the Business School in 1967. His main research interest is in Management Control and organisational change. He has just returned from the Alfred P. Sloan School of Management at Massachusetts Institute of Technology.

T.H. Biss, B.Sc.
Graduated in Mathematics at Nottingham University in 1964, in a course which included elementary training in Statistics, Operational Research and Computing. He spent three years with ICI engaged in Operational Research. Work there

included a detailed investigation of their systems for handling returned bobbins, and the processing and interpretation of information from bobbin returns. Since joining the Business School two years ago he has been employed exclusively on research into police problems. His special contribution to the project will be in the interpretation of stochastic information.

9. GLOSSARY

9.1 Goals	Long range aims (but more than generalisations)
9.2 Objectives	Operational and potentially attainable targets in each of the key areas of an individual's responsibility.
9.3 Management Control Systems	.1 Overall The method by which effort is directed, informed and rewarded to ensure the goals of the organisation are achieved.
	.2 Control systems A good control system presents information to any individual within the organisation in such a way that when that individual takes the decision that seems right for him, it is right for the organisation as a whole.
	.3 Information systems Thus the information required by the control system must be obtained and passed in the cheapest, most effective way possible.
9.4 Management by Objectives	This is a formalised system of management which has become increasingly popular in industry in recent years, and more recently has been introduced into service organisations. It requires a formal statement of each individual's job definition with his objectives, problems and tasks.
9.5 Problems	The internal and external factors potentially hindering the attainment of objectives.
9.6 Tasks	The work plans agreed with supervisors as a means of overcoming the problems and achieving the objectives, consistent with the goals of the organisation.

13. FIGURES

Figs. 1 to 19 relate to Project 1

Figs. 20 to 53 relate to Project 2

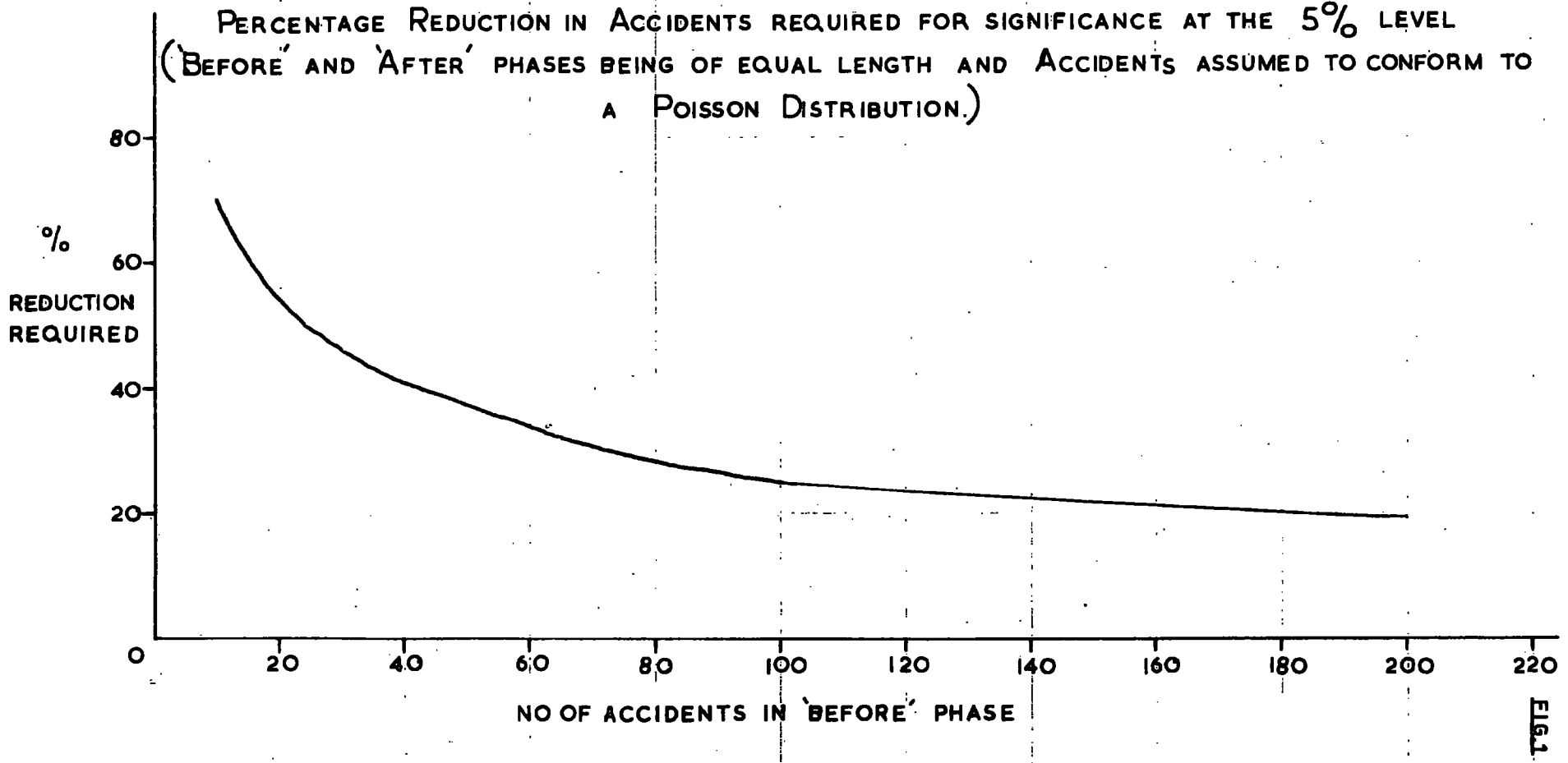
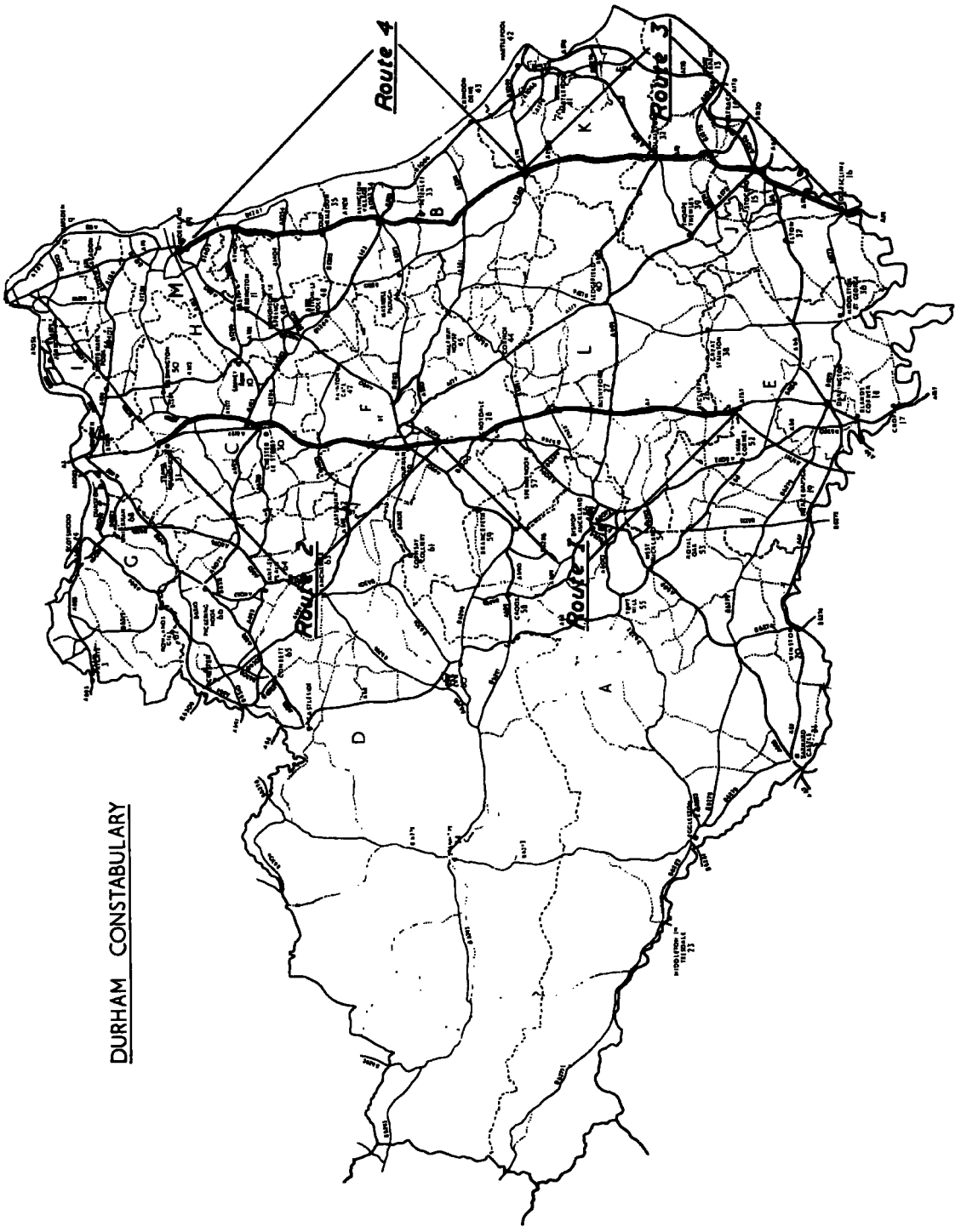

PERCENTAGE REDUCTION IN ACCIDENTS REQUIRED FOR SIGNIFICANCE AT THE 5% LEVEL
('BEFORE' AND 'AFTER' PHASES BEING OF EQUAL LENGTH AND ACCIDENTS ASSUMED TO CONFORM TO A POISSON DISTRIBUTION.)
%
REDUCTION REQUIRED
80
60
40
20
0
20
40
60
80
100
120
140
160
180
200
220
NO OF ACCIDENTS IN 'BEFORE' PHASE

FIG.1

FIG. 2



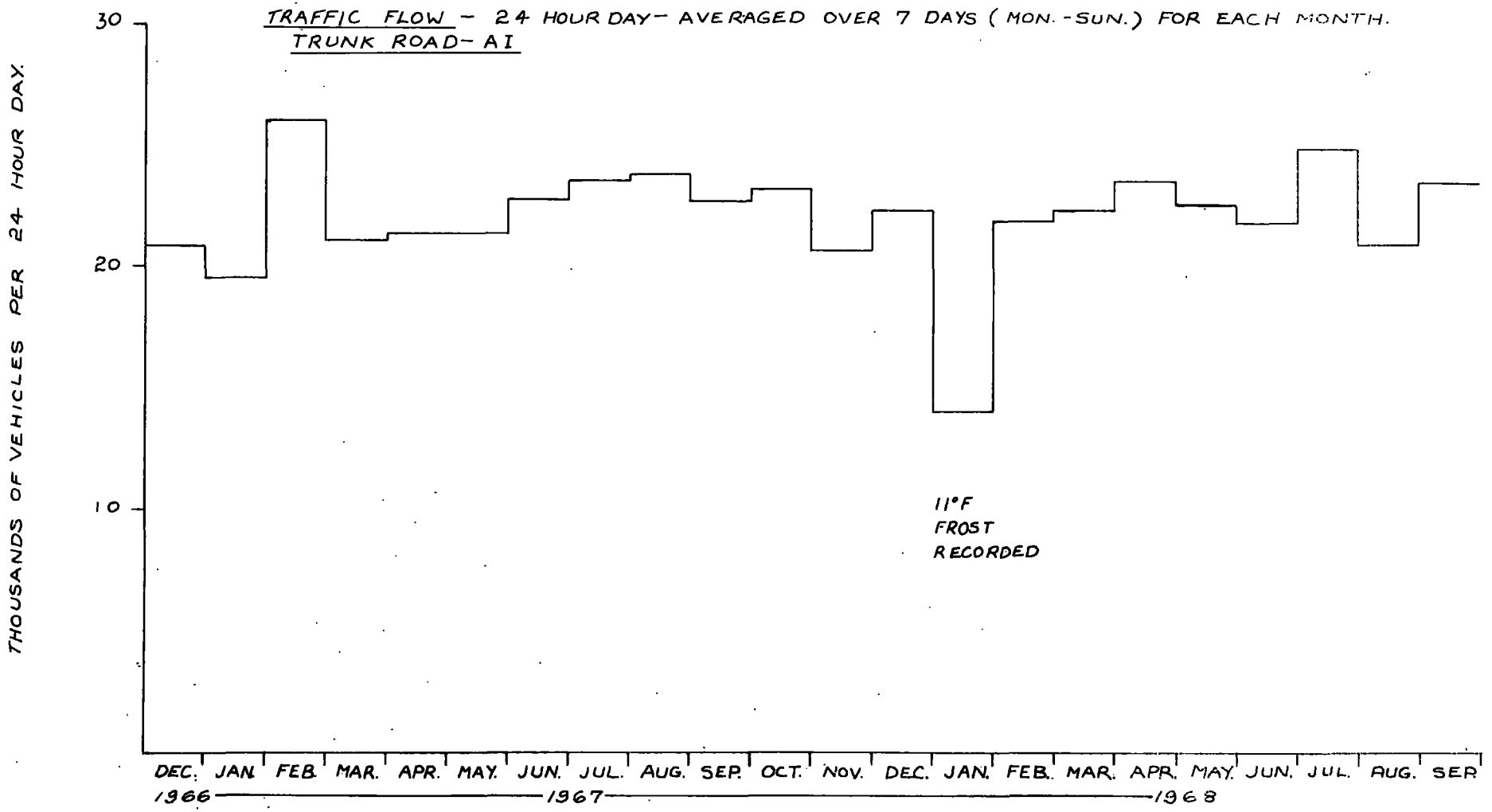

TRAFFIC FLOW - 24 HOUR DAY- AVERAGED OVER 7 DAYS (MON.-SUN.) FOR EACH MONTH.
TRUNK ROAD- A1
THOUSANDS OF VEHICLES PER 24 HOUR DAY.
30
20
10
11°F
FROST
RECORDED
DEC. JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP.
1966
1967
1968

FIG. 3

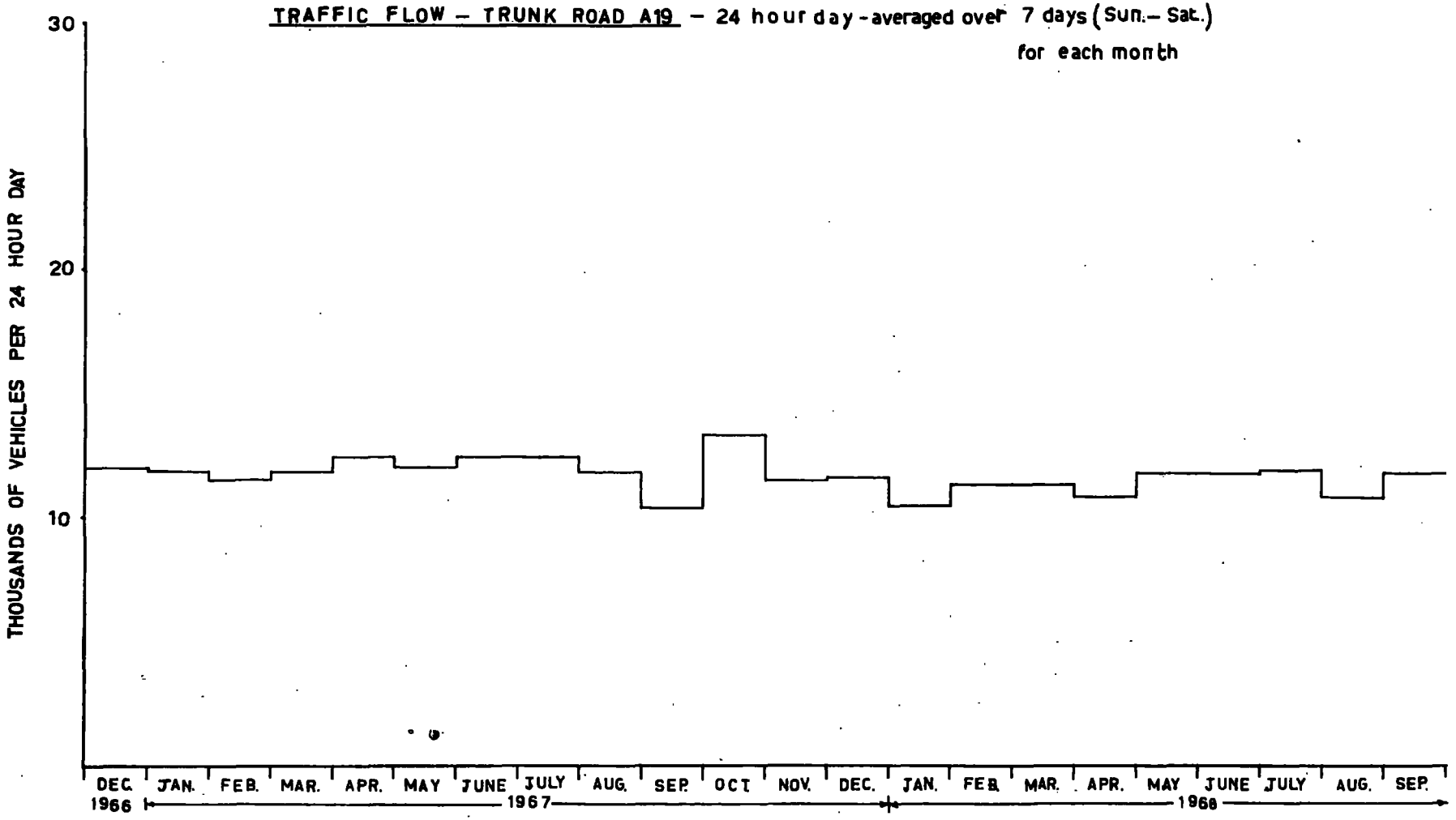

TRAFFIC FLOW – TRUNK ROAD A19 – 24 hour day - averaged over 7 days (Sun.– Sat.)
for each month
THOUSANDS OF VEHICLES PER 24 HOUR DAY
30
20
10
DEC. 1966
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEP.
OCT
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEP.
1967
1968

FIG 4

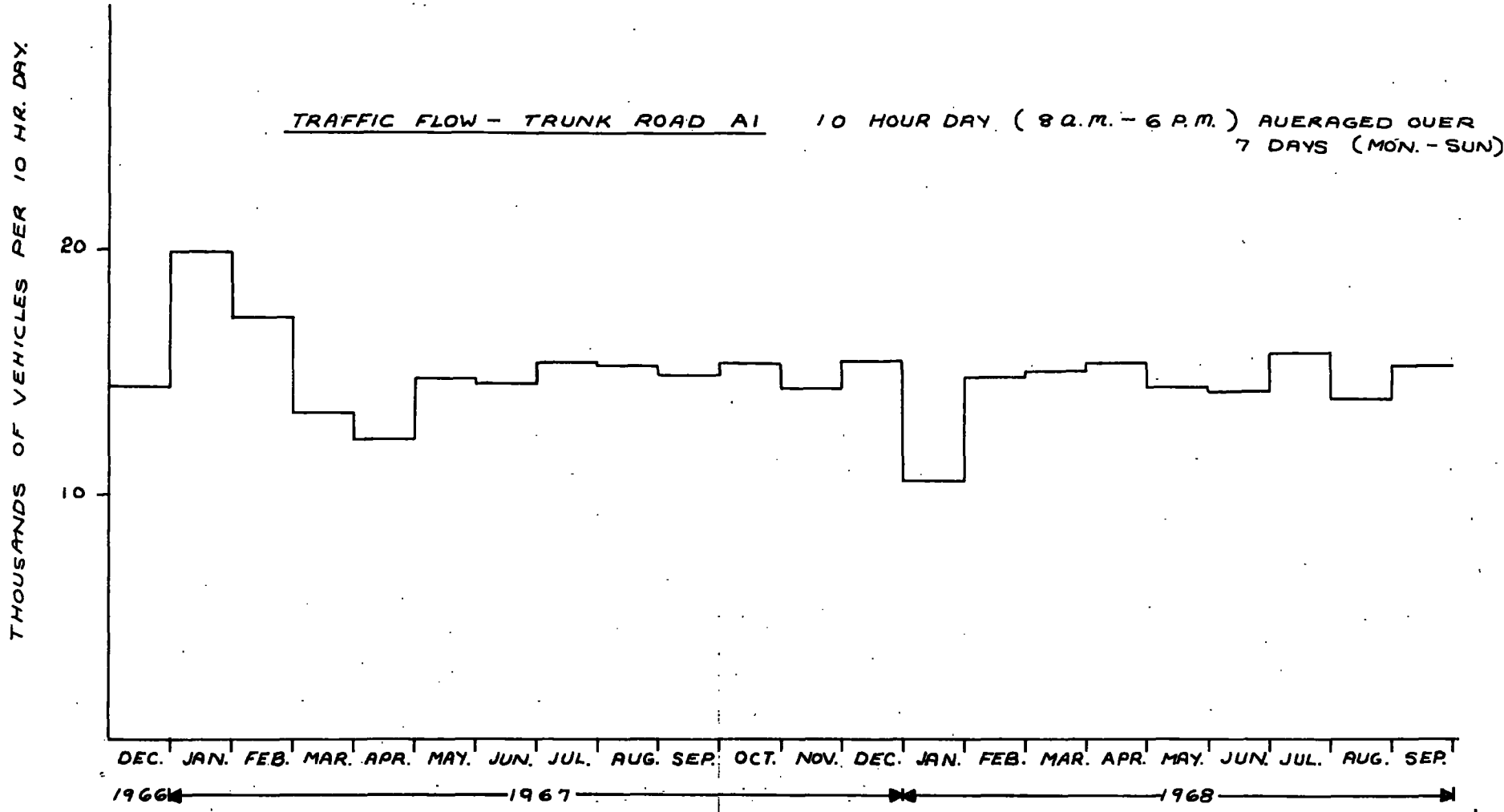

TRAFFIC FLOW - TRUNK ROAD A1 10 HOUR DAY (8 a.m. - 6 p.m.) AVERAGED OVER 7 DAYS (MON. - SUN)
THOUSANDS OF VEHICLES PER 10 HR. DAY
20
10
DEC. JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP.
1966
1967
1968

FIG. 5

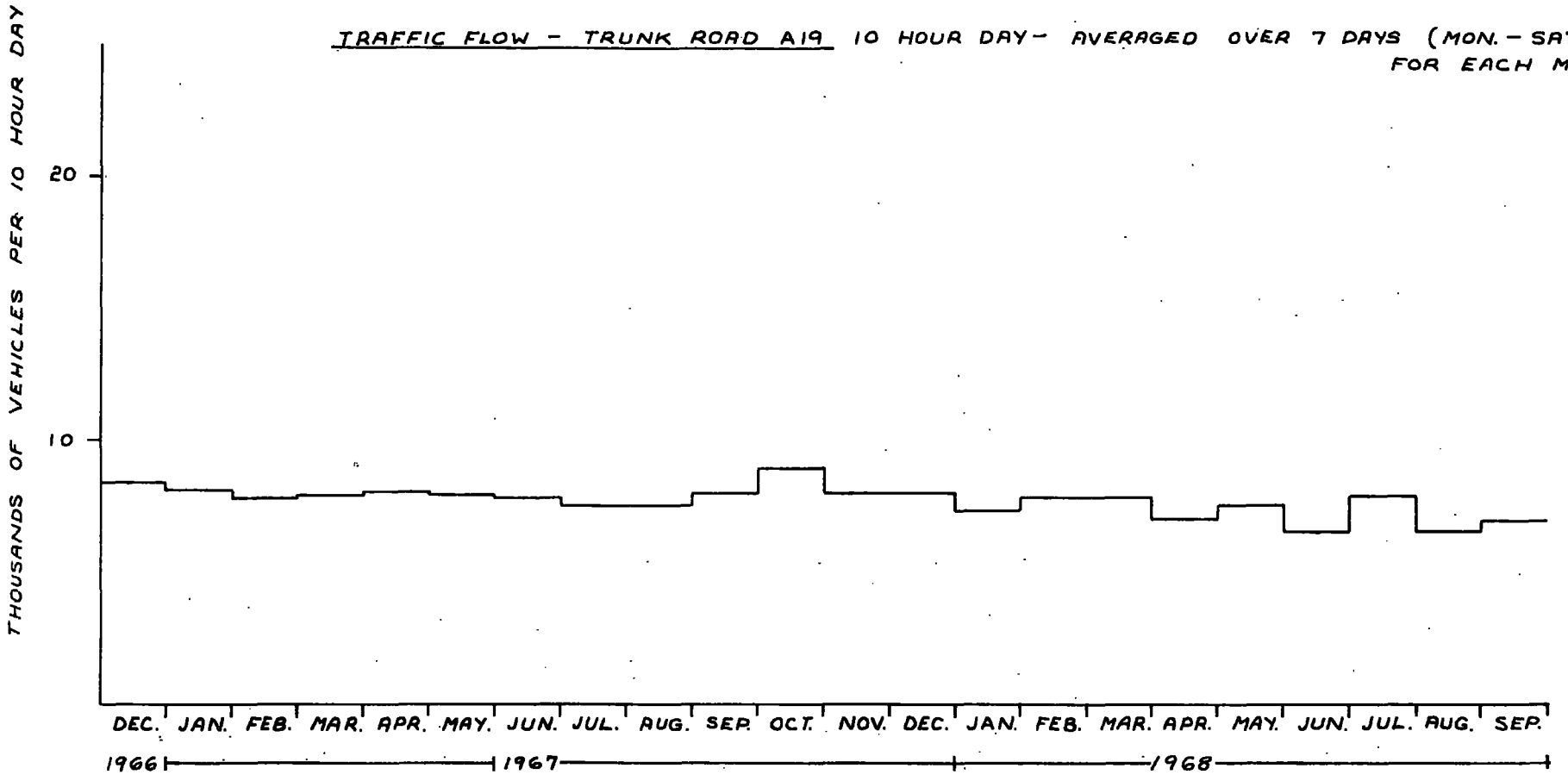

TRAFFIC FLOW - TRUNK ROAD A19 10 HOUR DAY - AVERAGED OVER 7 DAYS (MON. - SAT.) FOR EACH MONTH.
THOUSANDS OF VEHICLES PER 10 HOUR DAY
20
10
DEC. JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP.
1966
1967
1968

FIG. 6

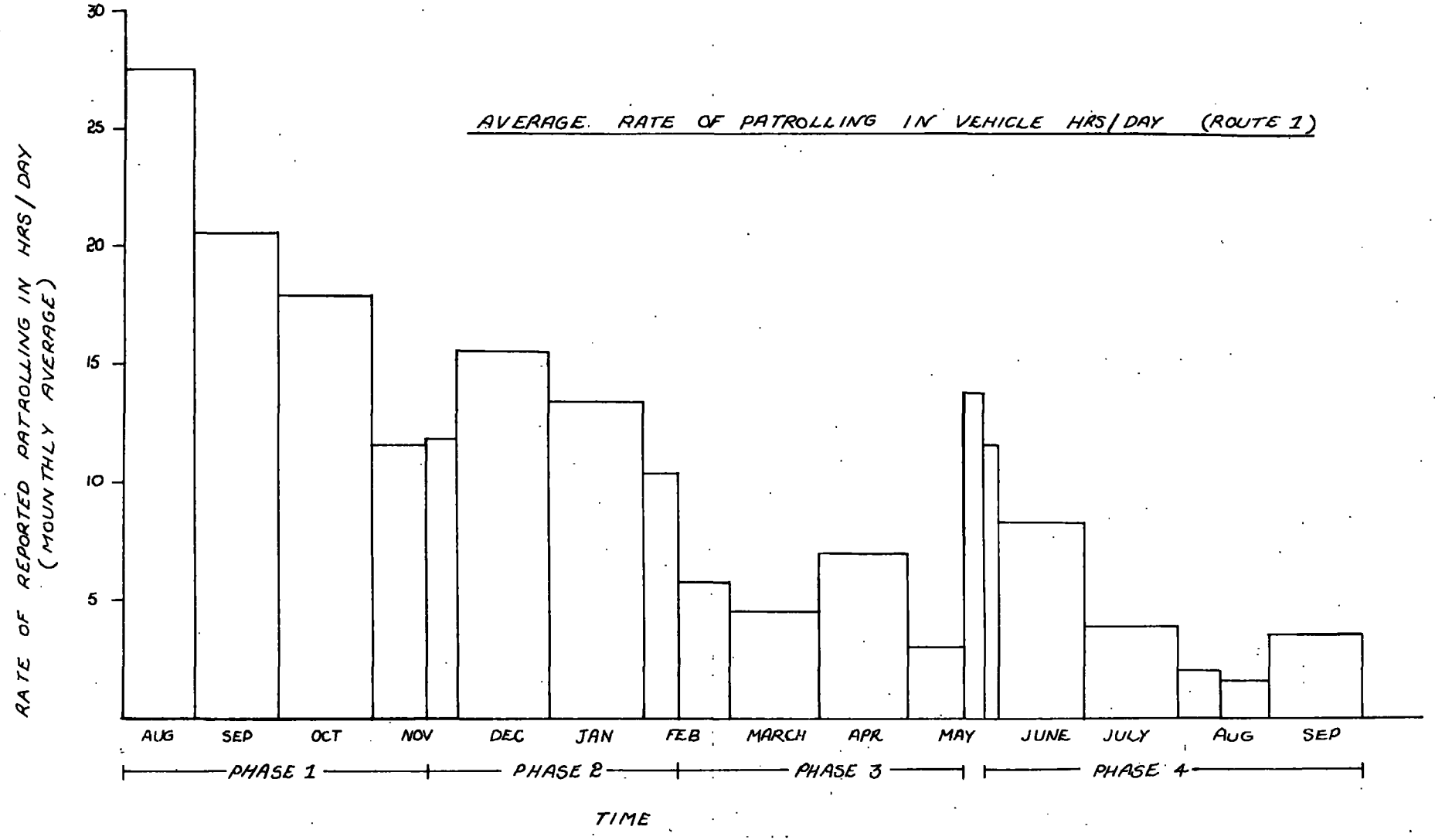

AVERAGE RATE OF PATROLLING IN VEHICLE HRS/DAY (ROUTE 1)
RATE OF REPORTED PATROLLING IN HRS/DAY (MOUNTHLY AVERAGE)
30
25
20
15
10
5
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MARCH
APR
MAY
JUNE
JULY
AUG
SEP
PHASE 1
PHASE 2
PHASE 3
PHASE 4
TIME

FIG. 7

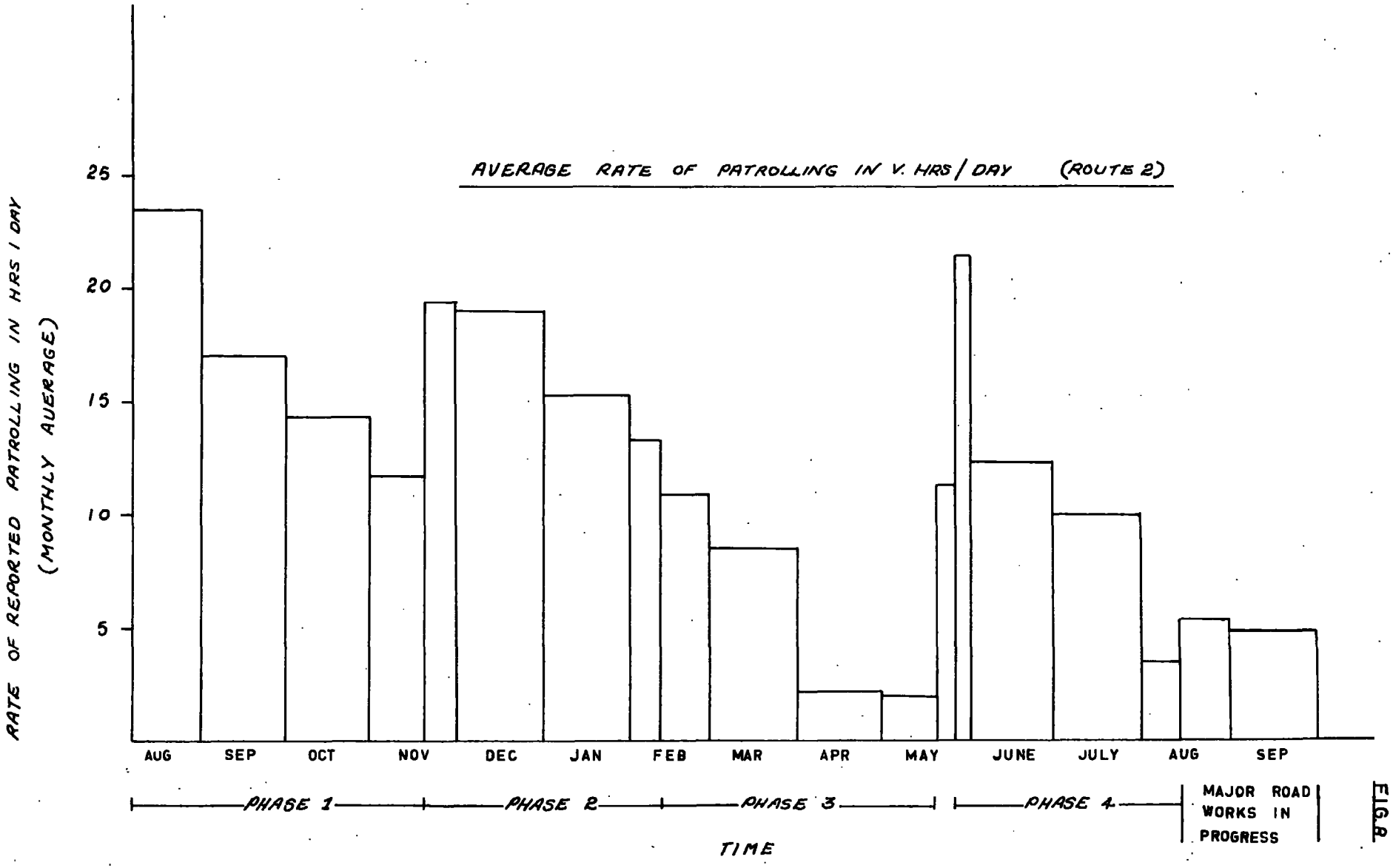

AVERAGE RATE OF PATROLLING IN V. HRS / DAY (ROUTE 2)
RATE OF REPORTED PATROLLING IN HRS / DAY (MONTHLY AUERAGE)
25
20
15
10
5
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEP
PHASE 1
PHASE 2
PHASE 3
PHASE 4
MAJOR ROAD WORKS IN PROGRESS
TIME

FIG.8

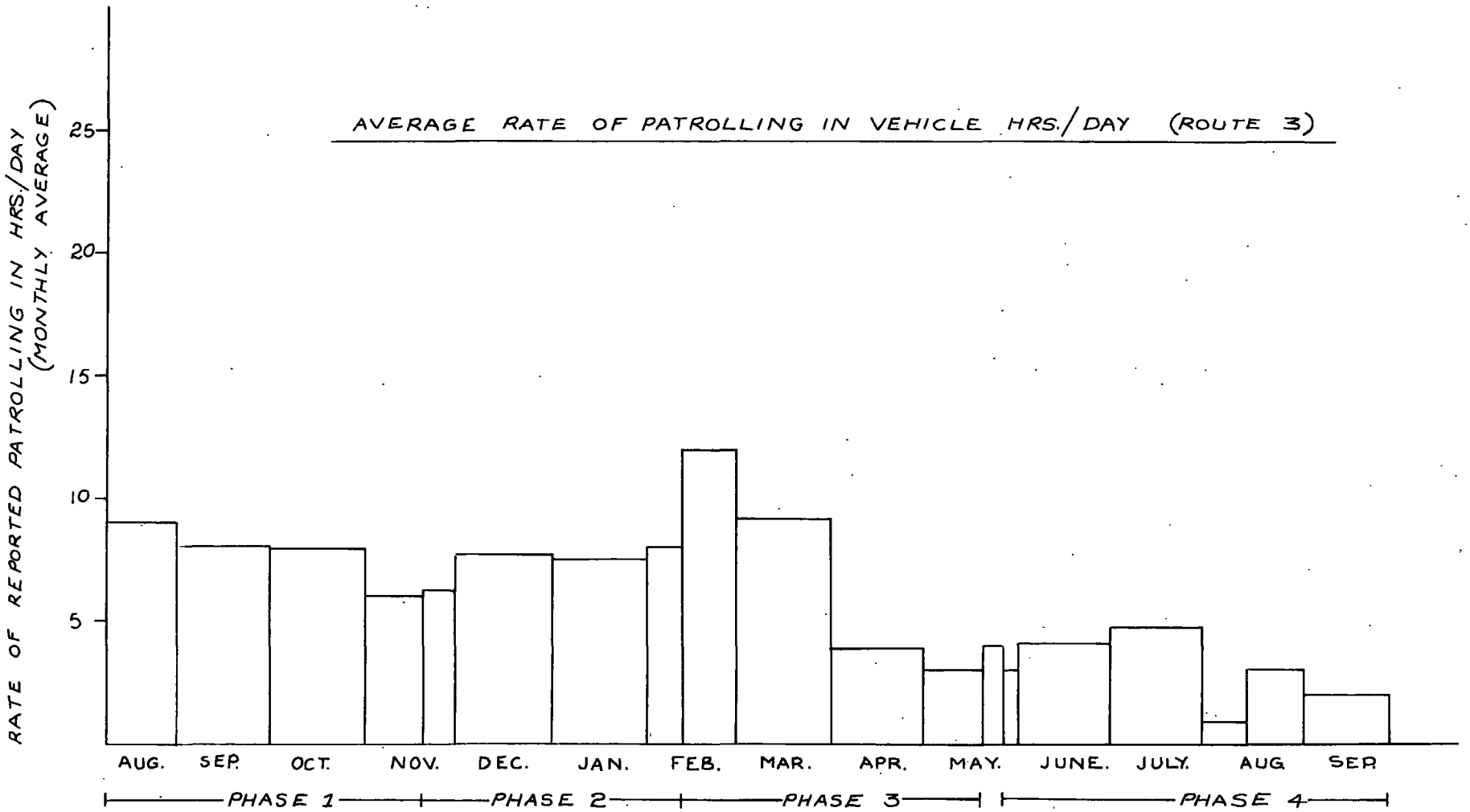

AVERAGE RATE OF PATROLLING IN VEHICLE HRS./DAY (ROUTE 3)
RATE OF REPORTED PATROLLING IN HRS./DAY (MONTHLY AVERAGE)
25
20
15
10
5
AUG.
SEP.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY.
JUNE.
JULY.
AUG.
SEP.
PHASE 1
PHASE 2
PHASE 3
PHASE 4

FIG. 9.

AVERAGE RATES OF PATROLLING IN VEHICLES IN HOURS PER DAY (ROUTE 4-)

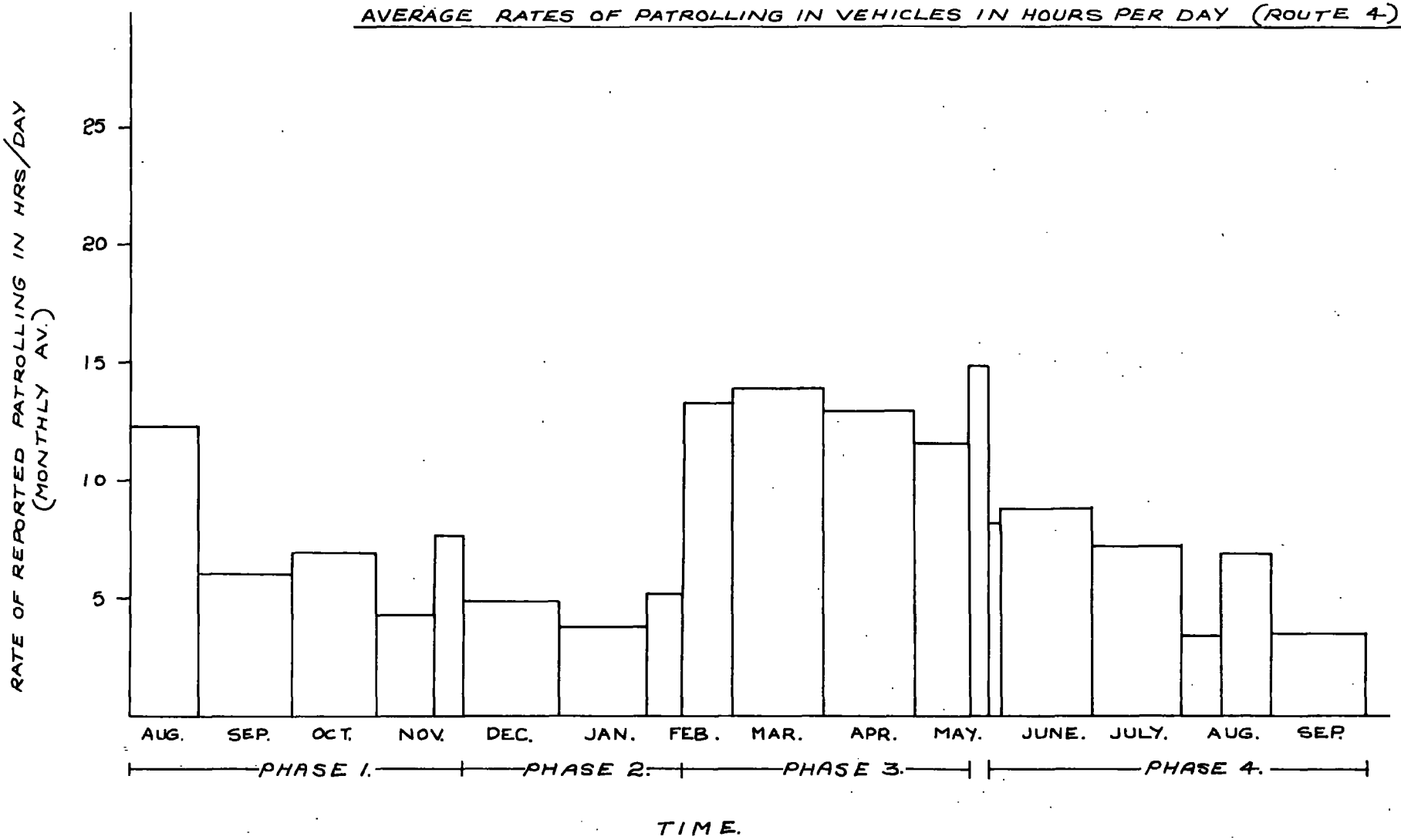


FIG. 10

FIG. 11

RECORDED PATROL LEVELS BY 10 DAY PULSING PERIOD IN PHASE 4.

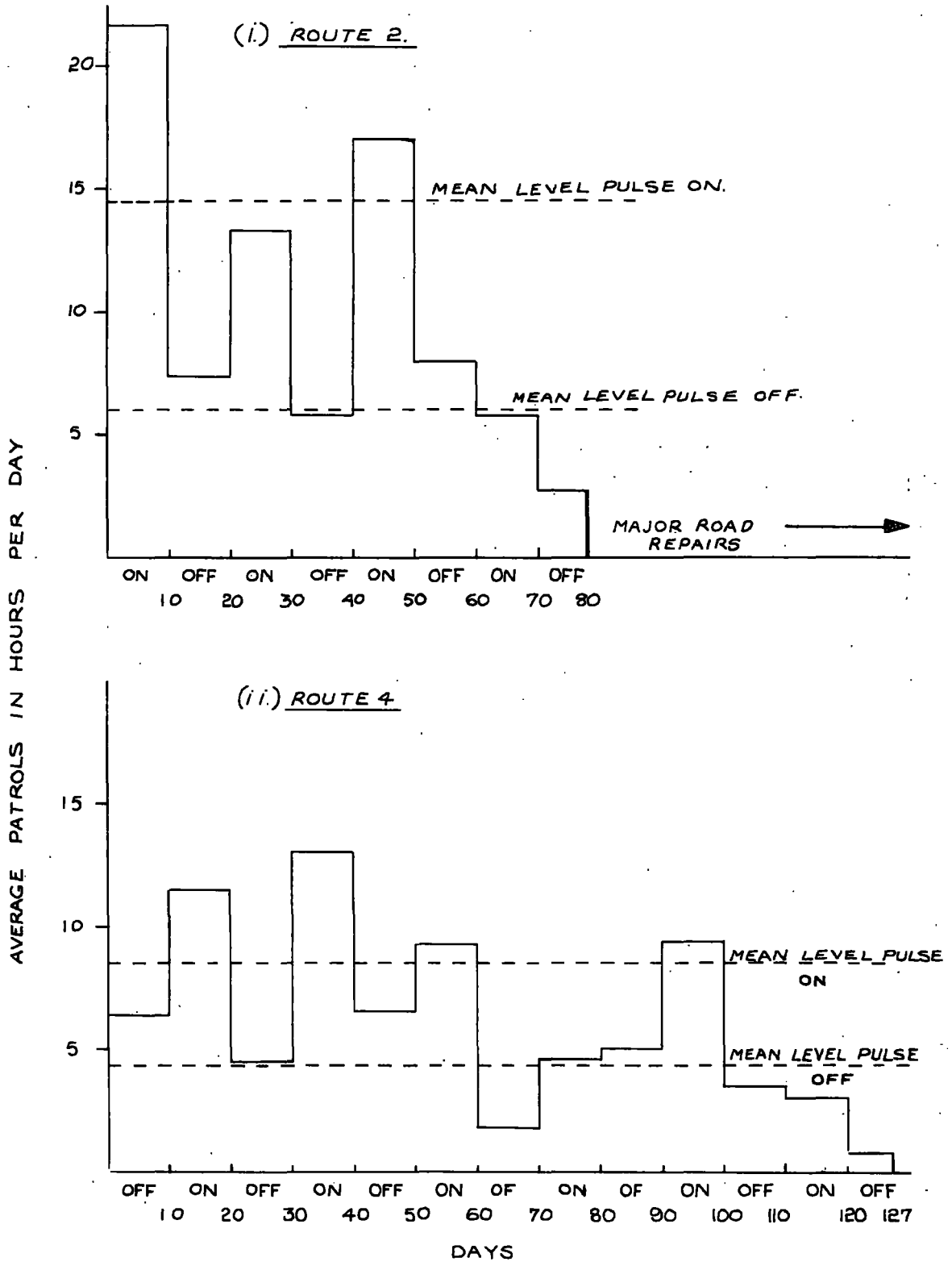
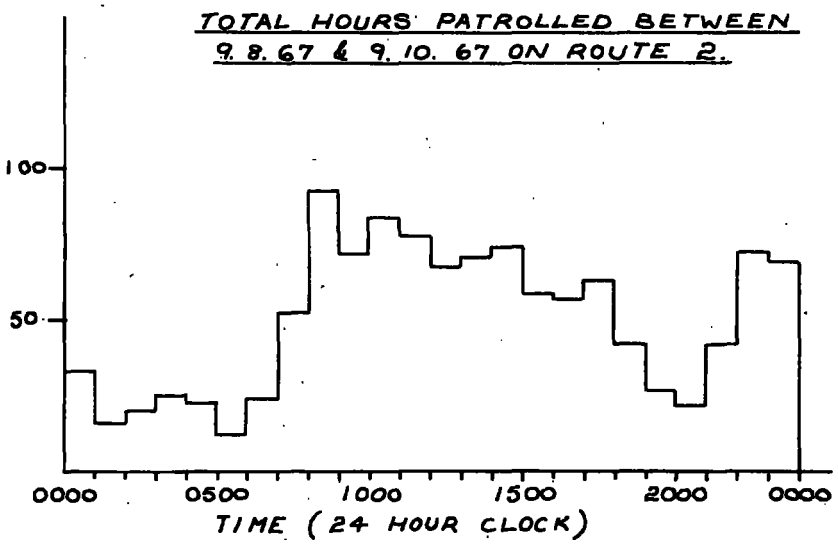
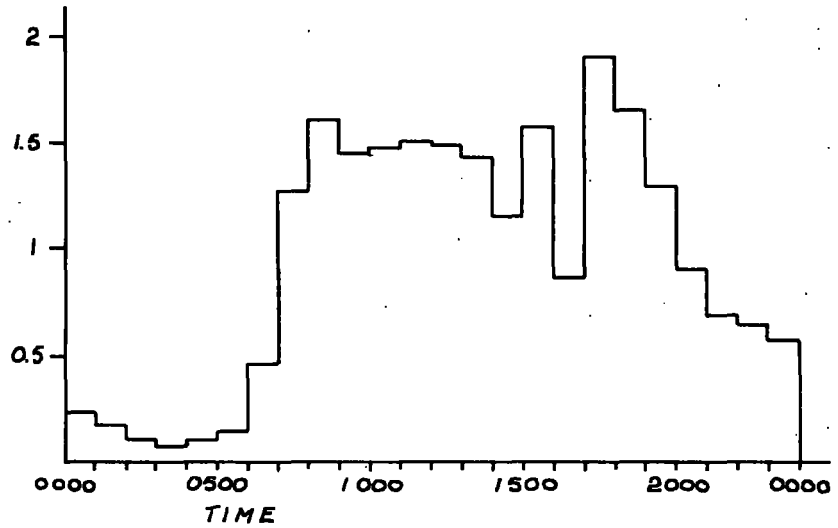


FIG. 12

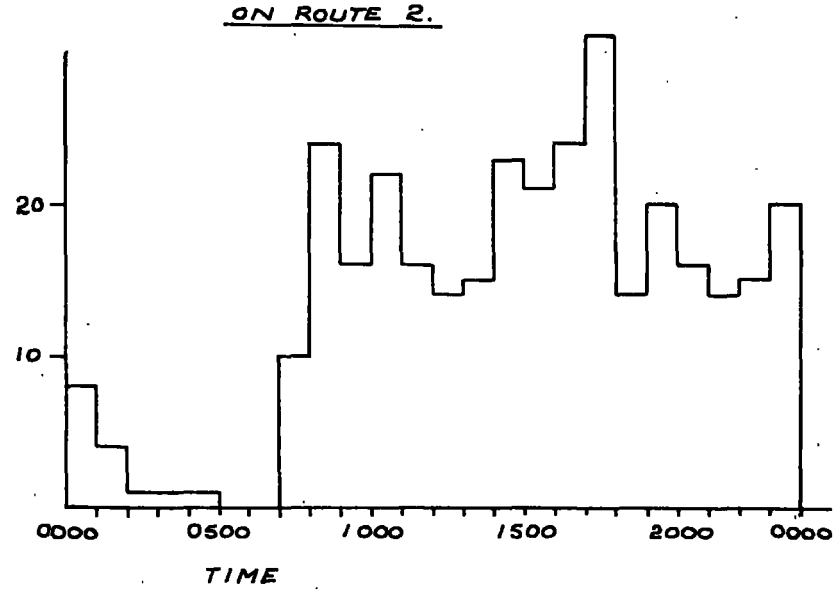
TOTAL HOURS PATROLLED BETWEEN 9.8.67 & 9.10.67 ON ROUTE 2.



AUERAGE TRAFFIC FLOW PASSING NORTHERN END OF ROUTE 2 BETWEEN 11.9.67 & 17.9.67



HOURLY UARIATION IN ACCIDENT RATE ON ROUTE 2.



ROUTE 1 :— TRUNK ROAD A.1. (SOUTH) 24 Hour Day CONTROL ROUTE

× Total Accident Rate
⊙ Injury Accident Rate

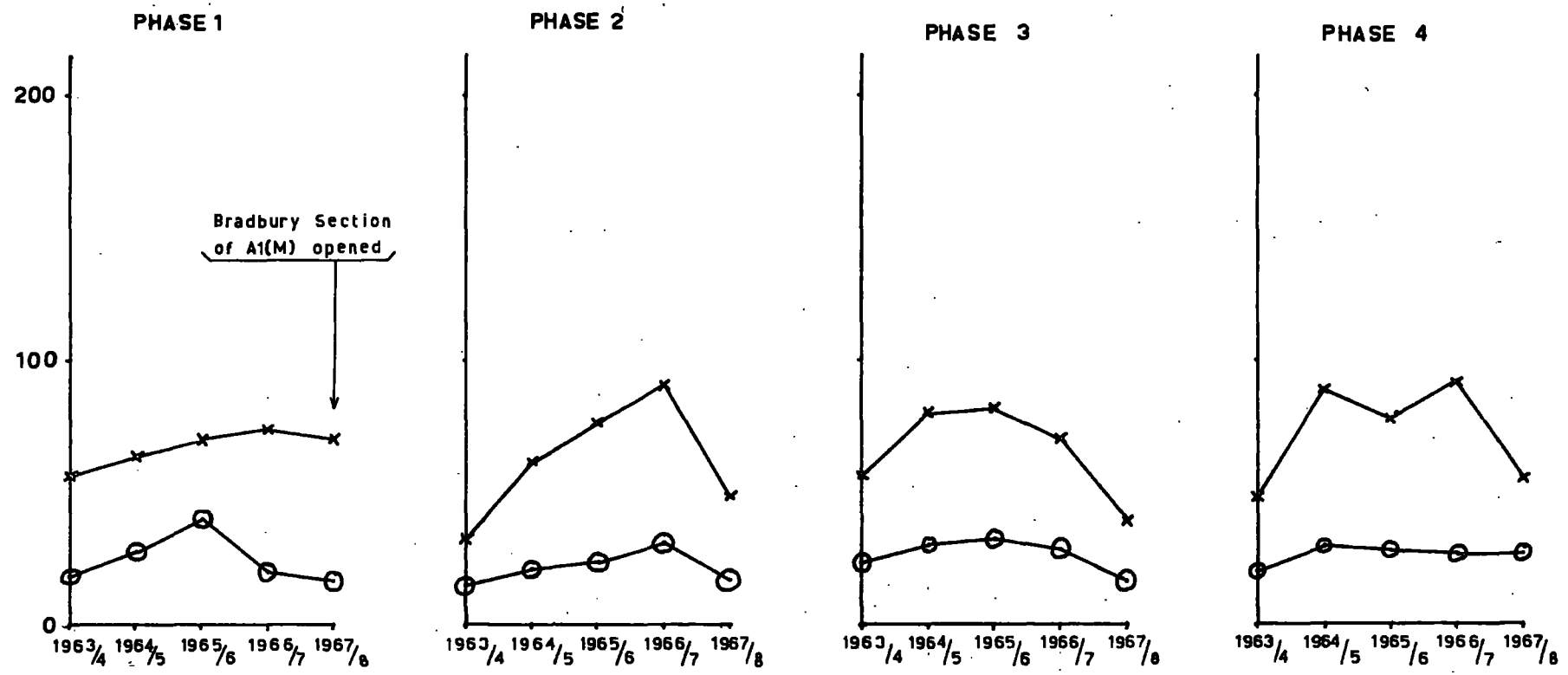


FIG. 13

ROUTE 2:- TRUNK ROAD A.1. (NORTH) 24 Hour Day

× Total Accident Rate
⊙ Injury Accident Rate

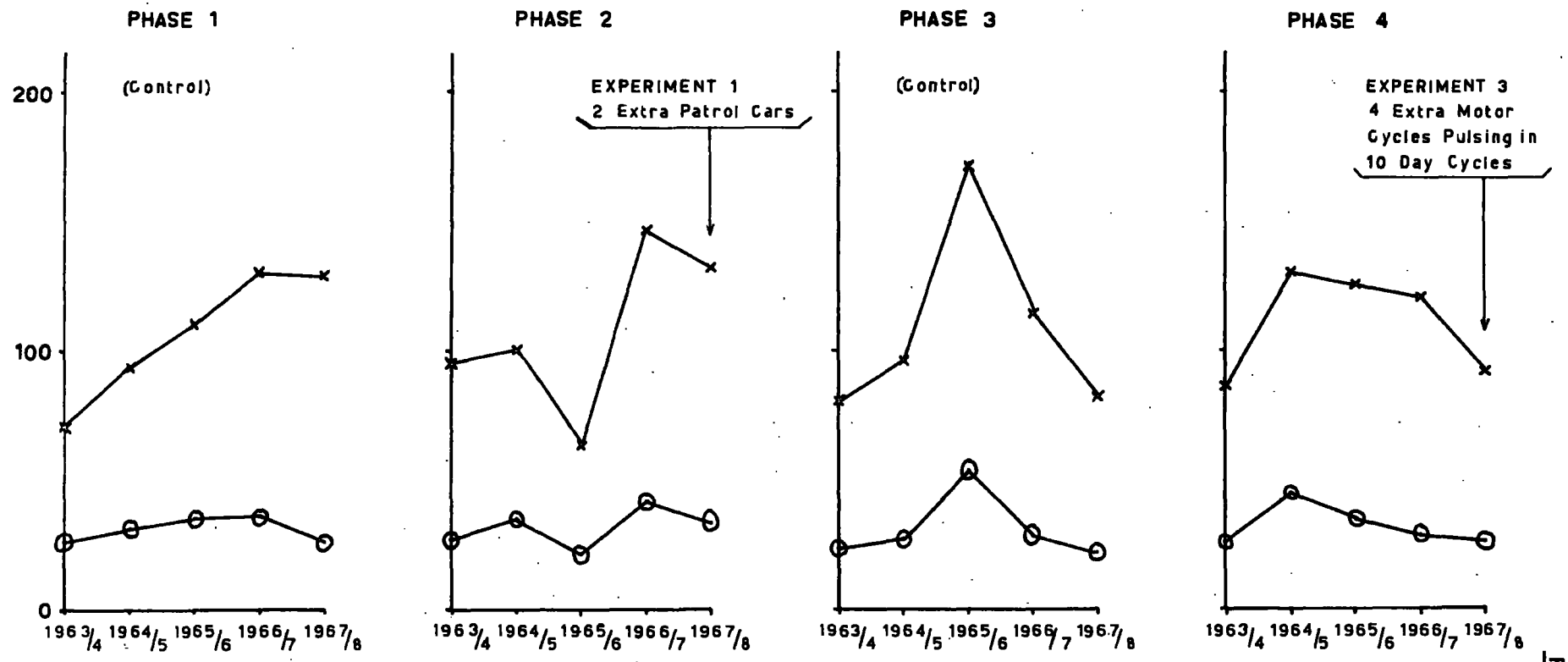


FIG. 14

ROUTE 3 :- TRUNK ROAD A.19. (SOUTH) 24 Hour Day CONTROL ROUTE

× Total Accident Rate
⊙ Injury Accident Rate

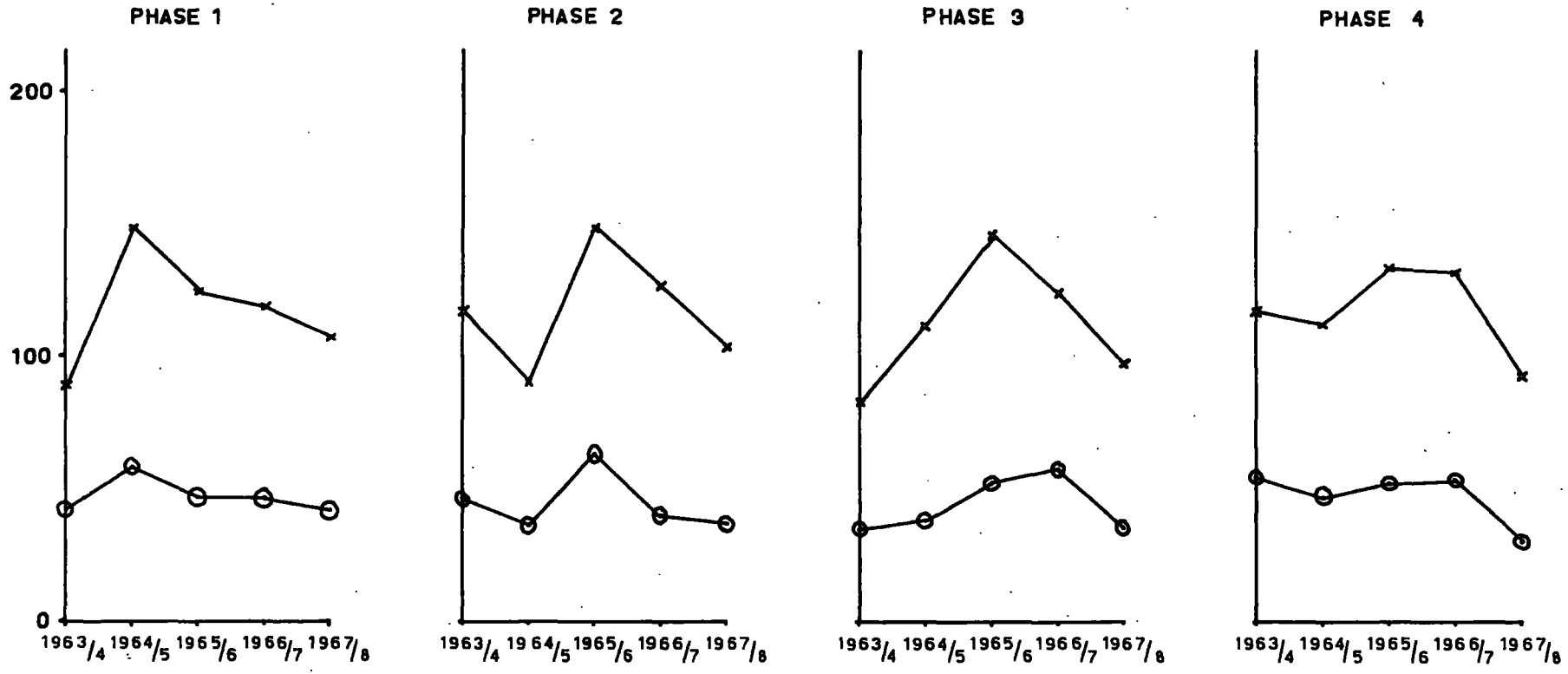


FIG. 15

ROUTE 4 TRUNK ROAD A.19.(NORTH) 24 Hour Day

× Total Accident Rate
⊙ Injury Accident Rate

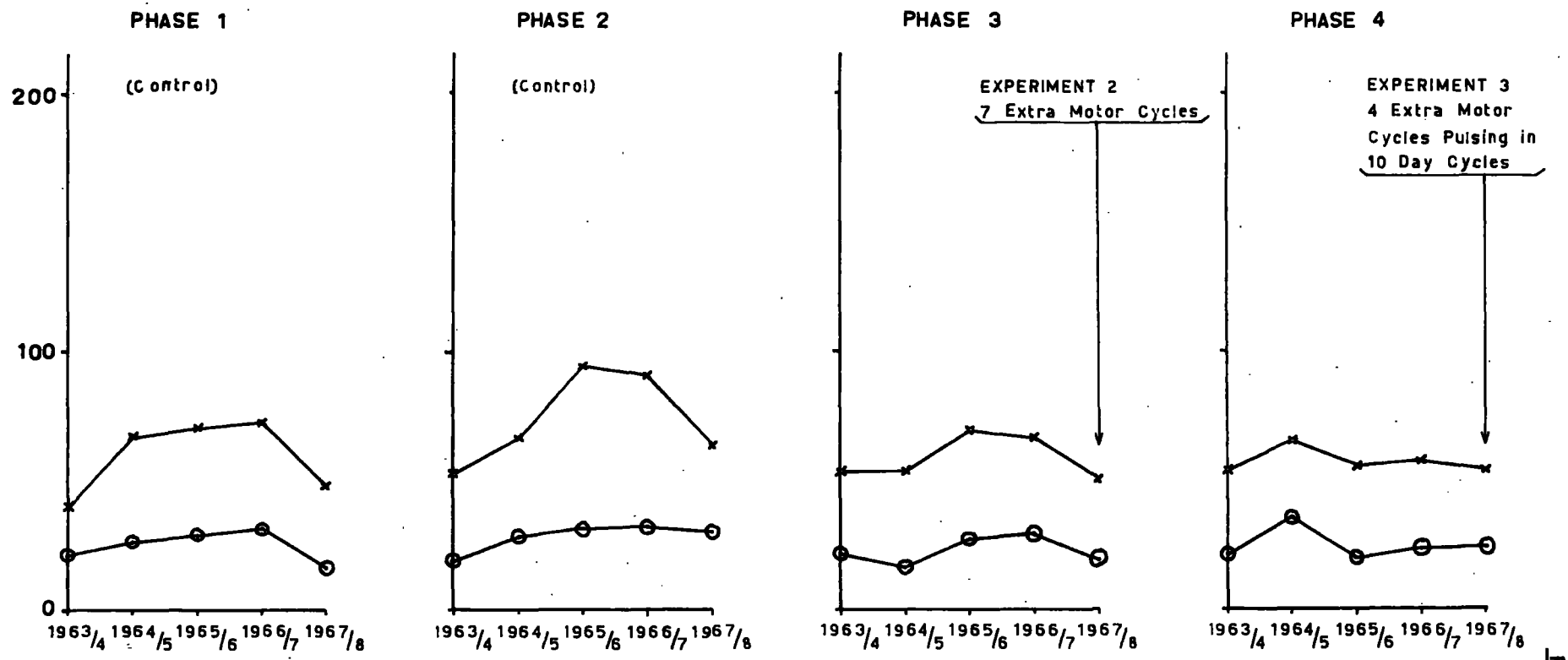


FIG. 16

ROUTE 1:— TRUNK ROAD A.1. (SOUTH) 8 A.M. TO 6 P.M. CONTROL ROUTE

× Total Accident Rate
⊙ Injury Accident Rate

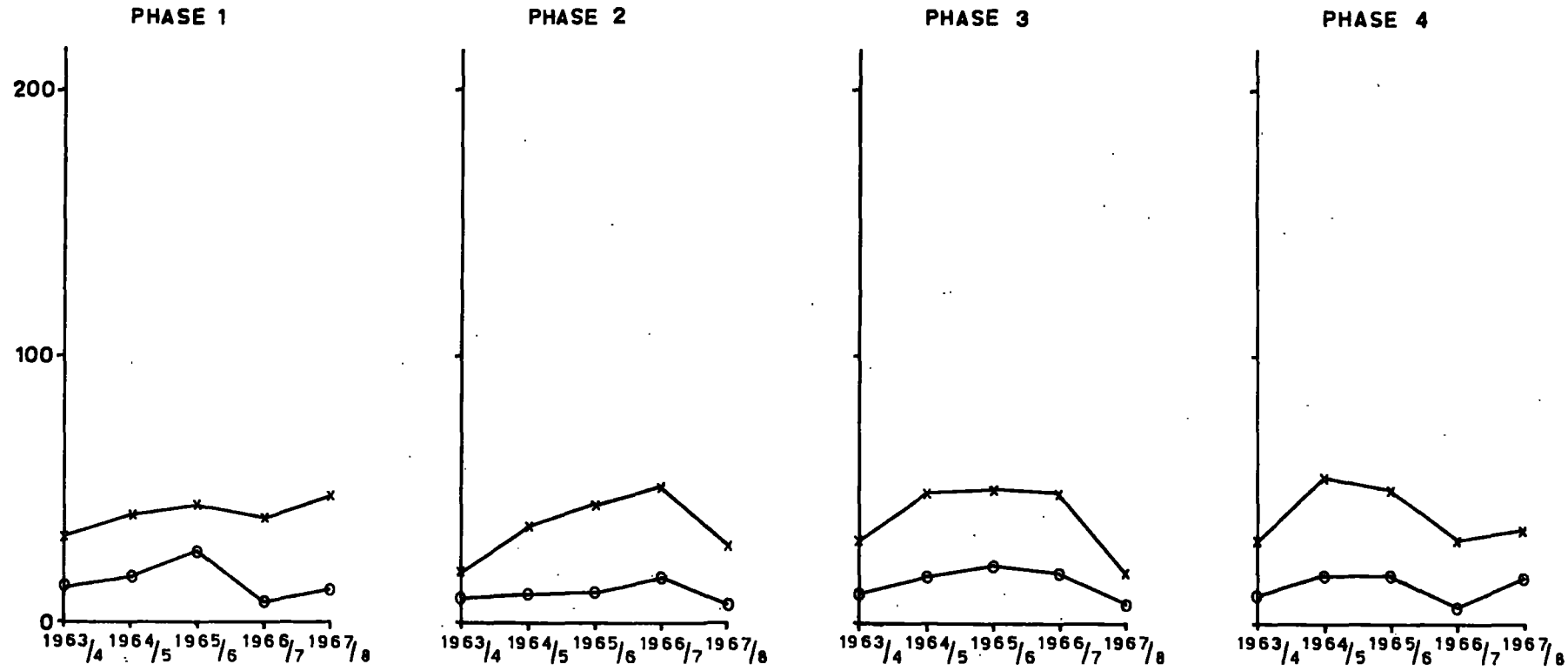


FIG.17

ROUTE 2:- TRUNK ROAD A.1. (NORTH) 8 A.M. TO 6 P.M.

× Total Accident Rate
⊙ Injury Accident Rate

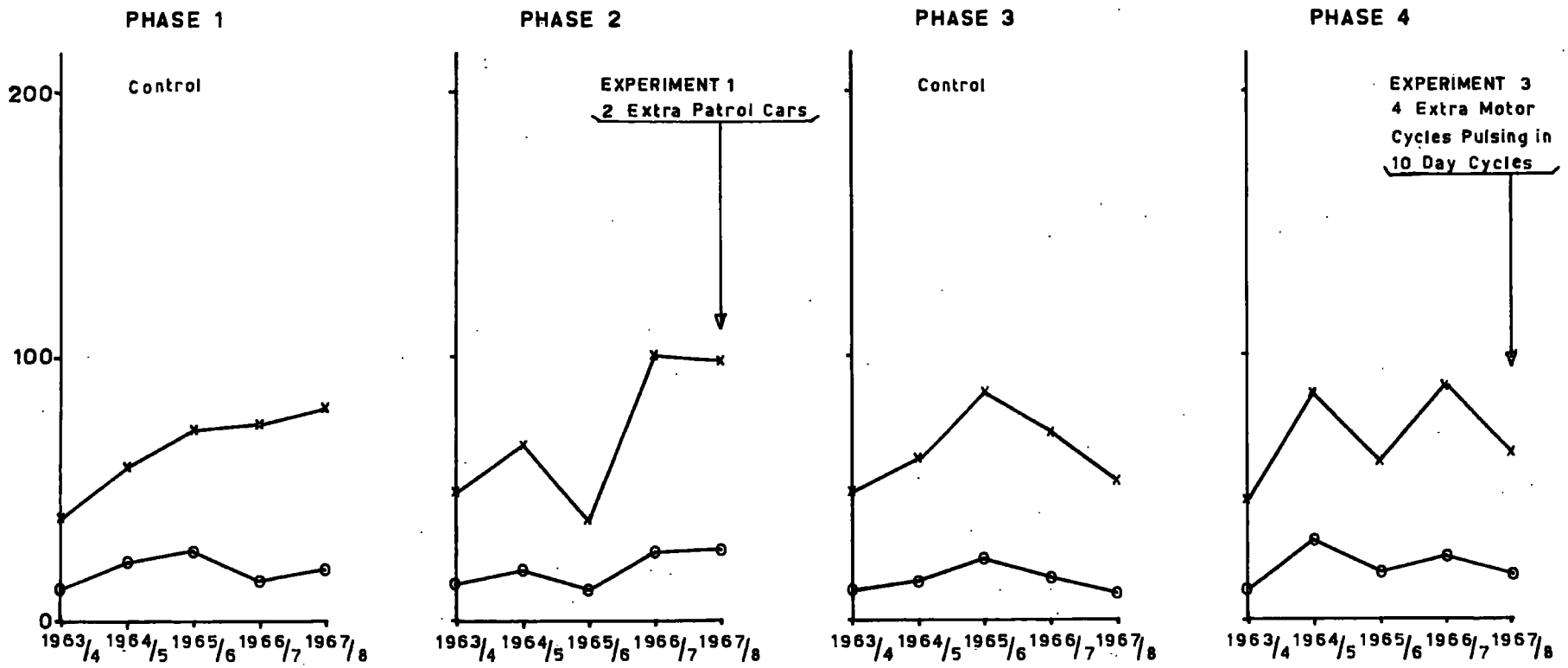


FIG.18

ROUTE 3:- TRUNK ROAD A.19. (SOUTH) 8 A.M. TO 6 P.M. CONTROL ROUTE

x Total Accident Rate
⊙ Injury Accident Rate

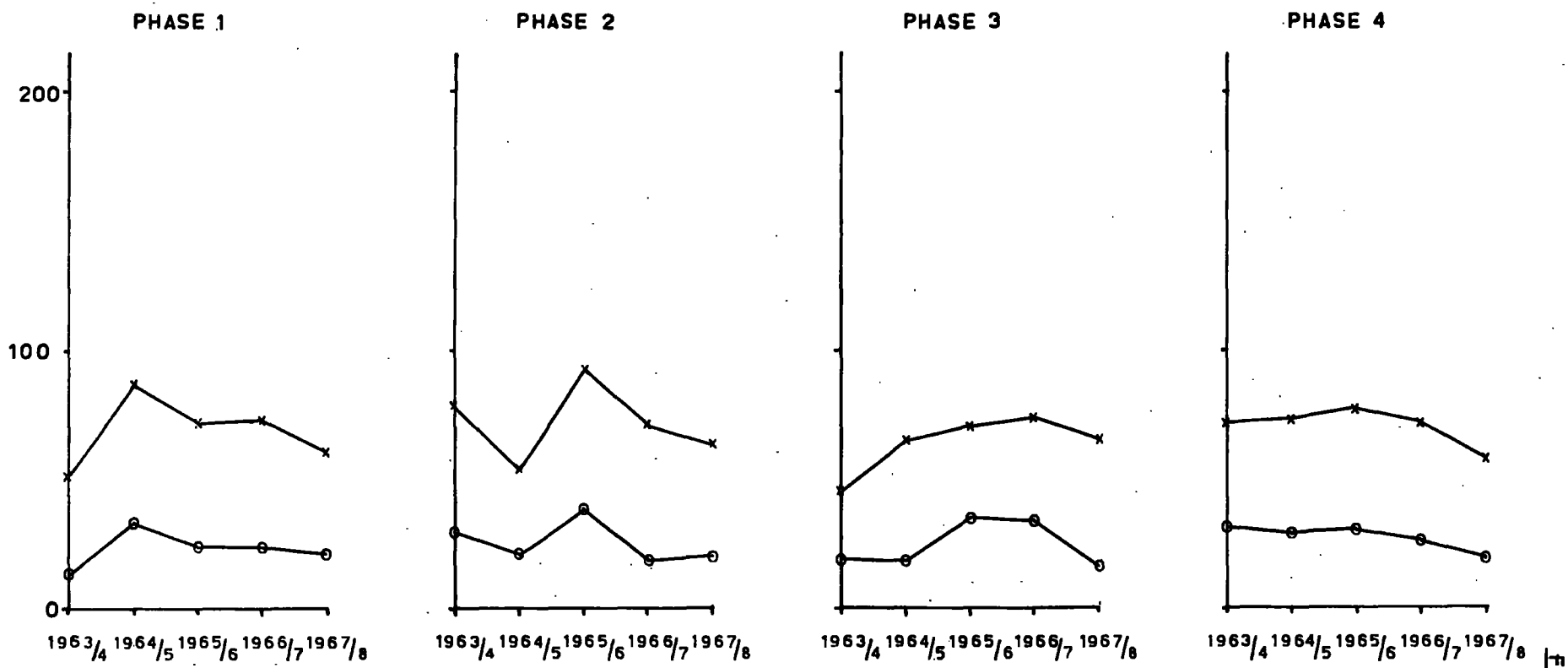


FIG. 19

ROUTE 4:- TRUNK ROAD A.19. (NORTH) 8 A.M. TO 6 P.M.

× Total Accident Rate
⊙ Injury Accident Rate

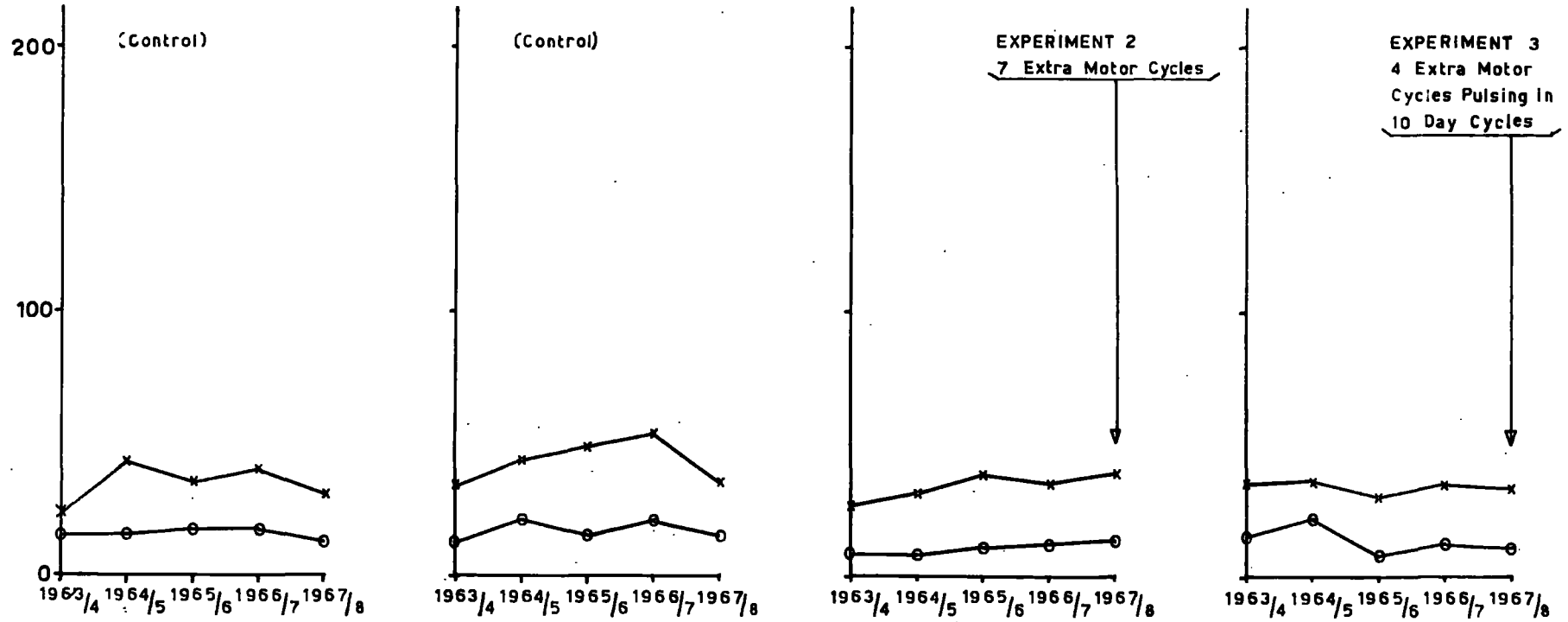


FIG. 20

FIG. 21

MAP OF ROUTES AND MEASURING POINTS

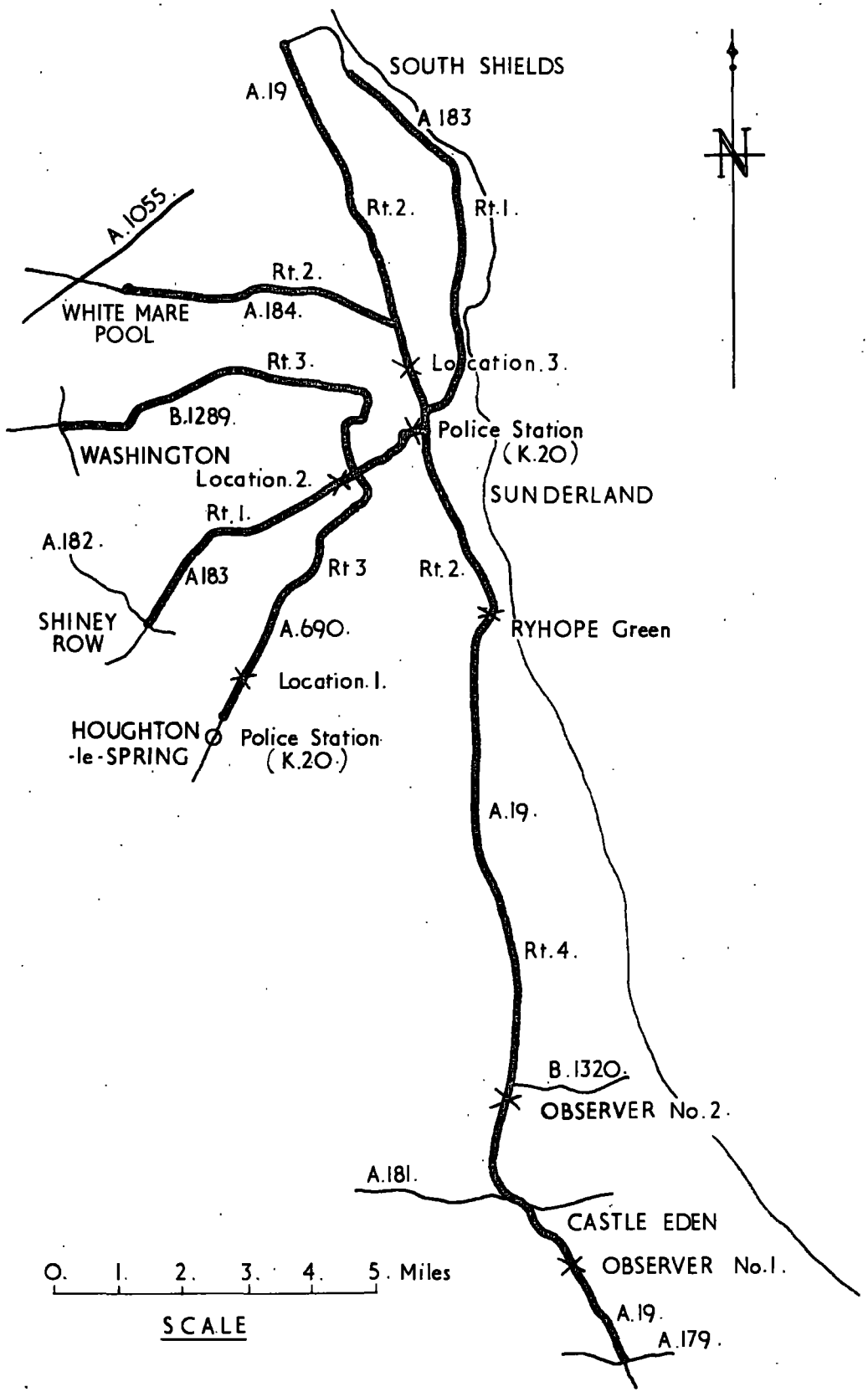


FIG. 22

SKETCH PLAN OF LOCATION 1.

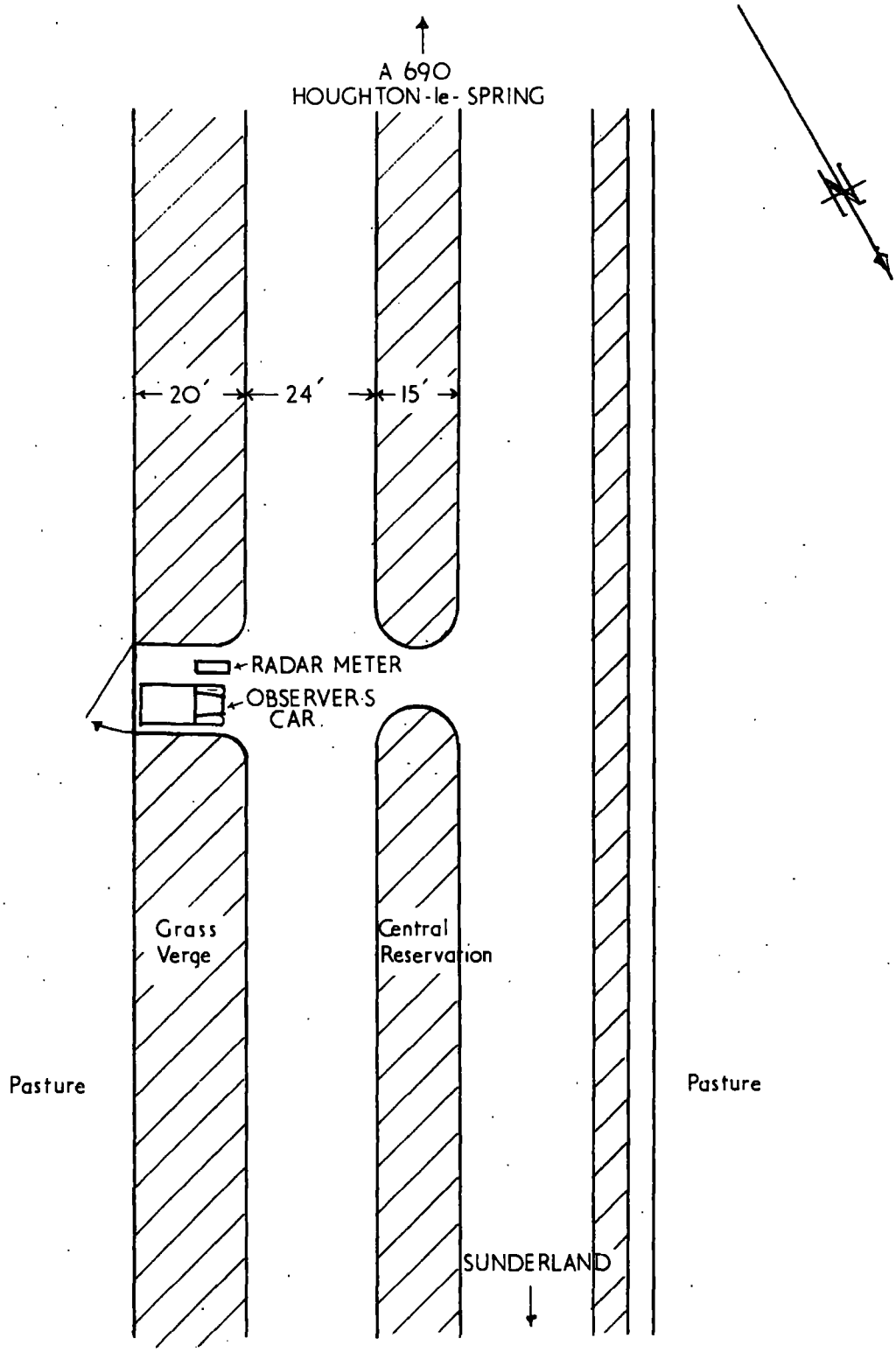


FIG. 23

SKETCH PLAN OF LOCATION 2

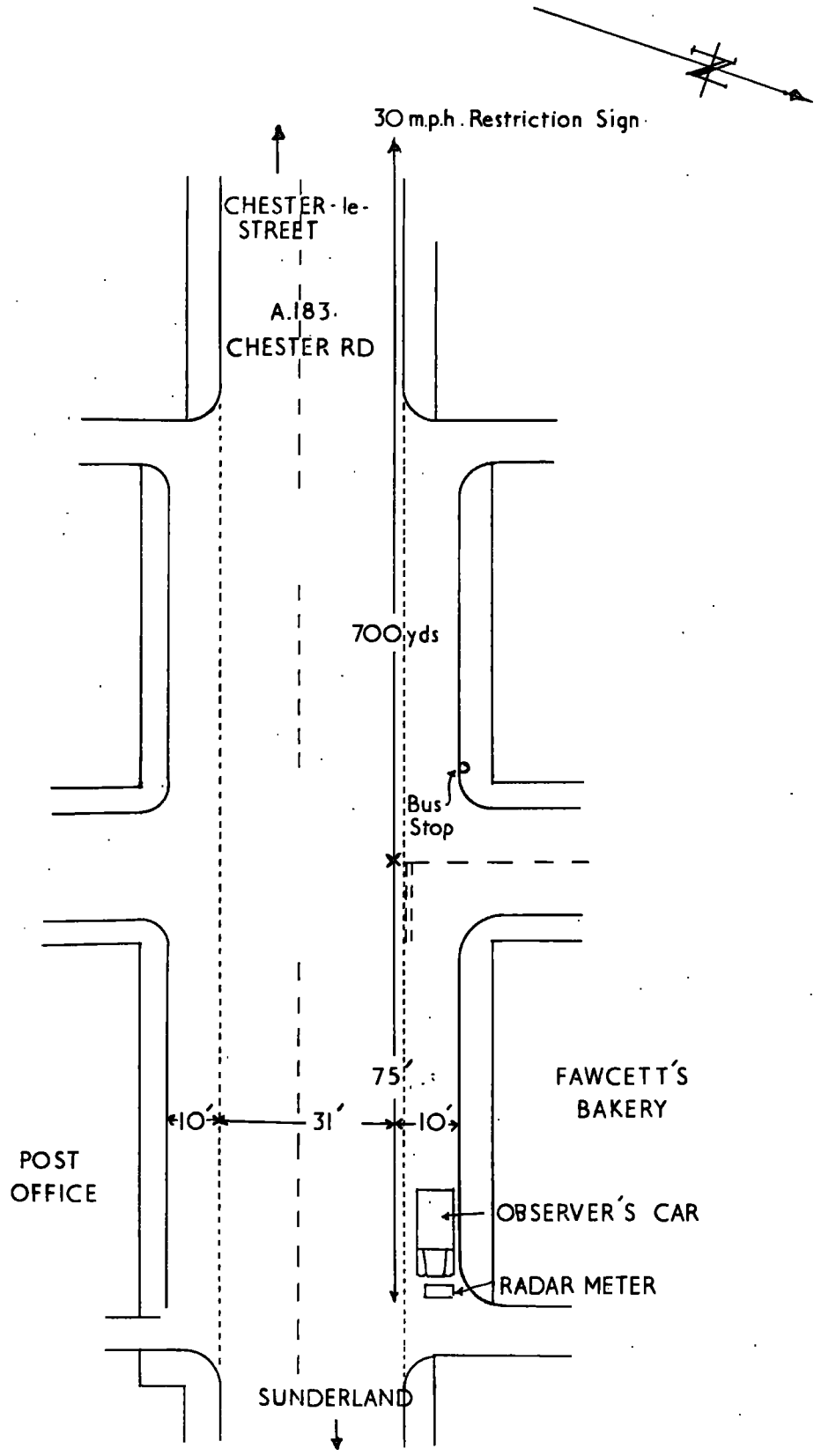
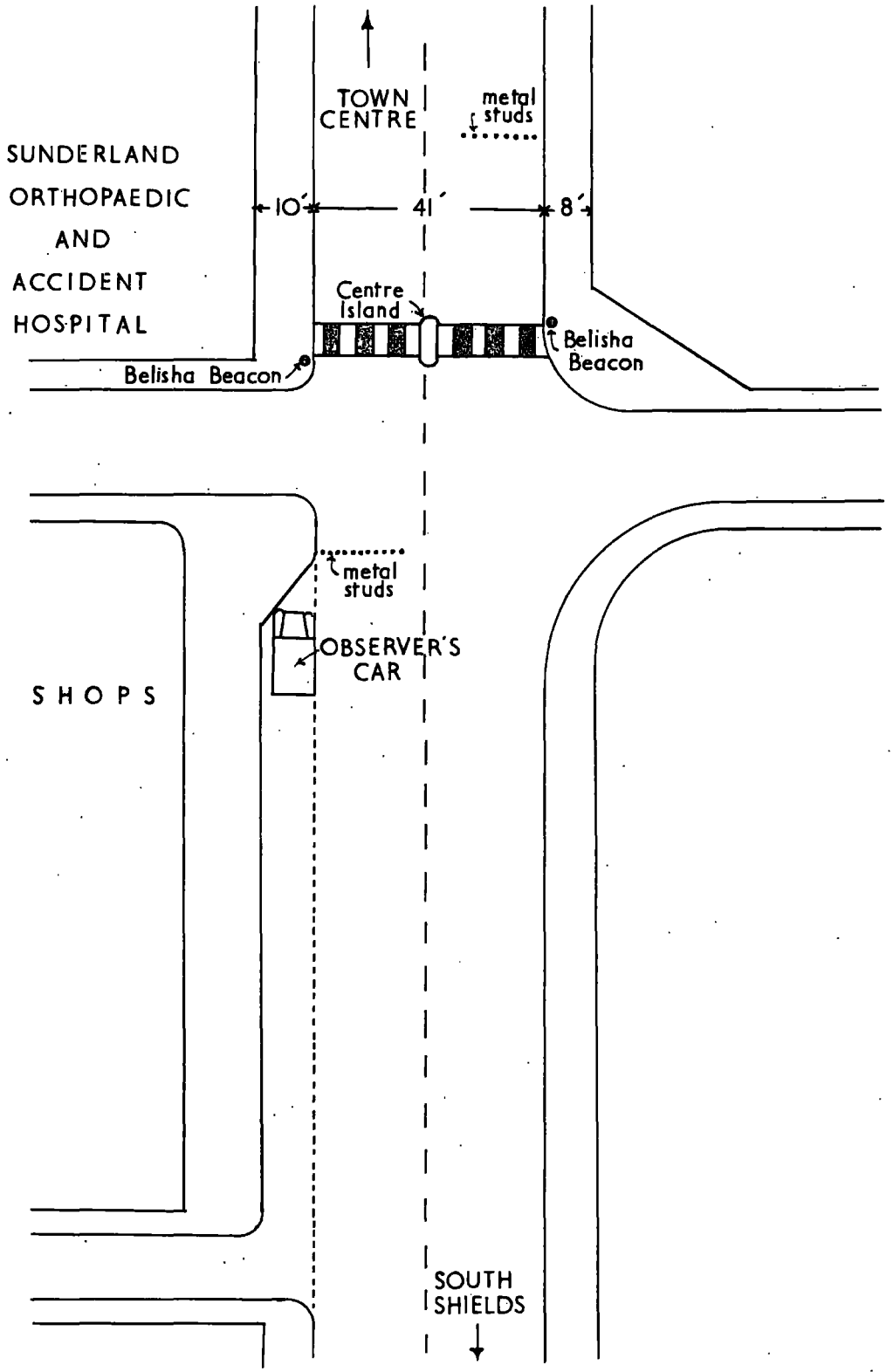


FIG. 24

SKETCH PLAN OF LOCATION 3.



OVERTAKING SECTION

FIG. 25

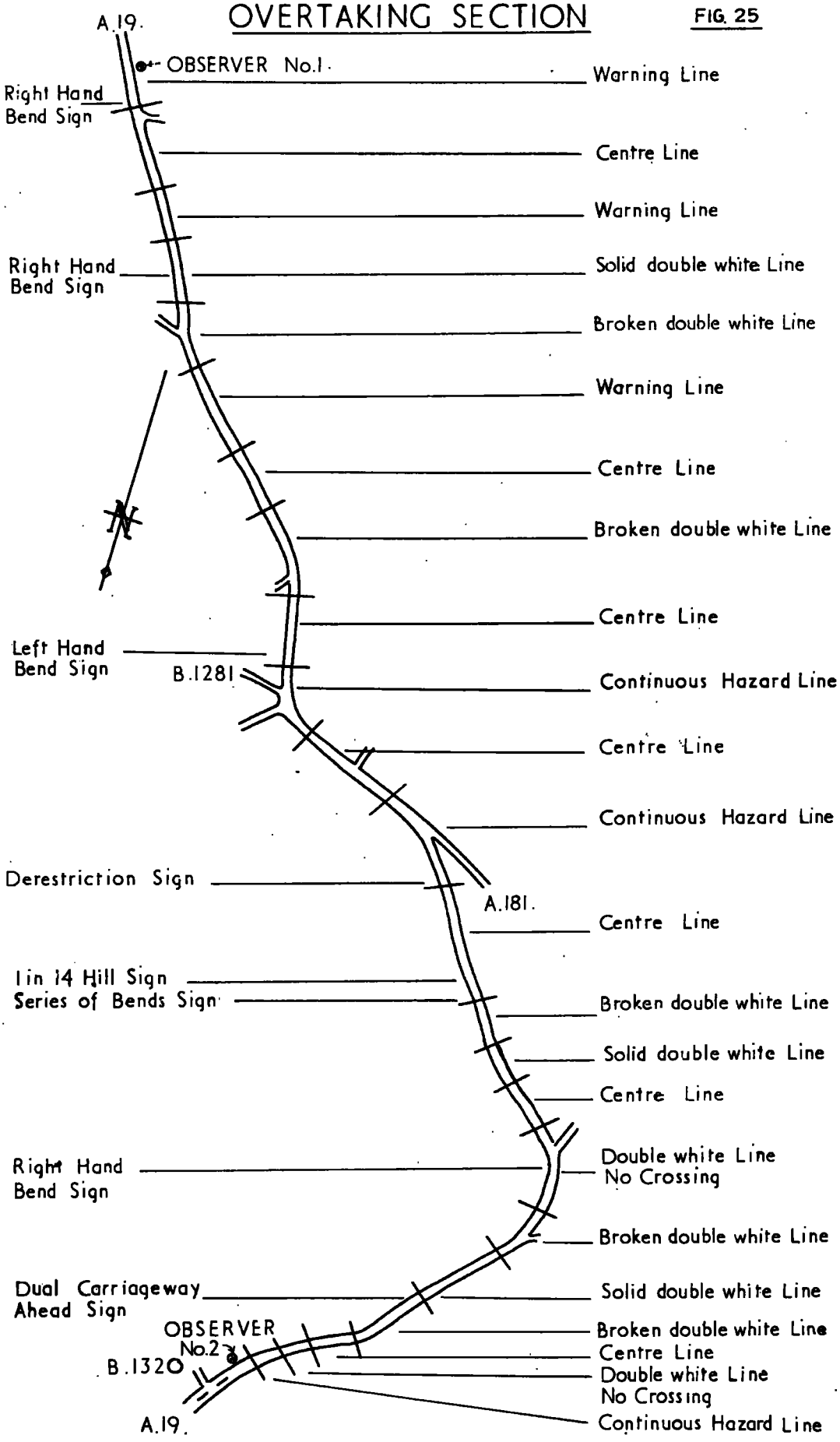


FIG. 26

PATROL LEVEL AND OFFENCES REPORTED

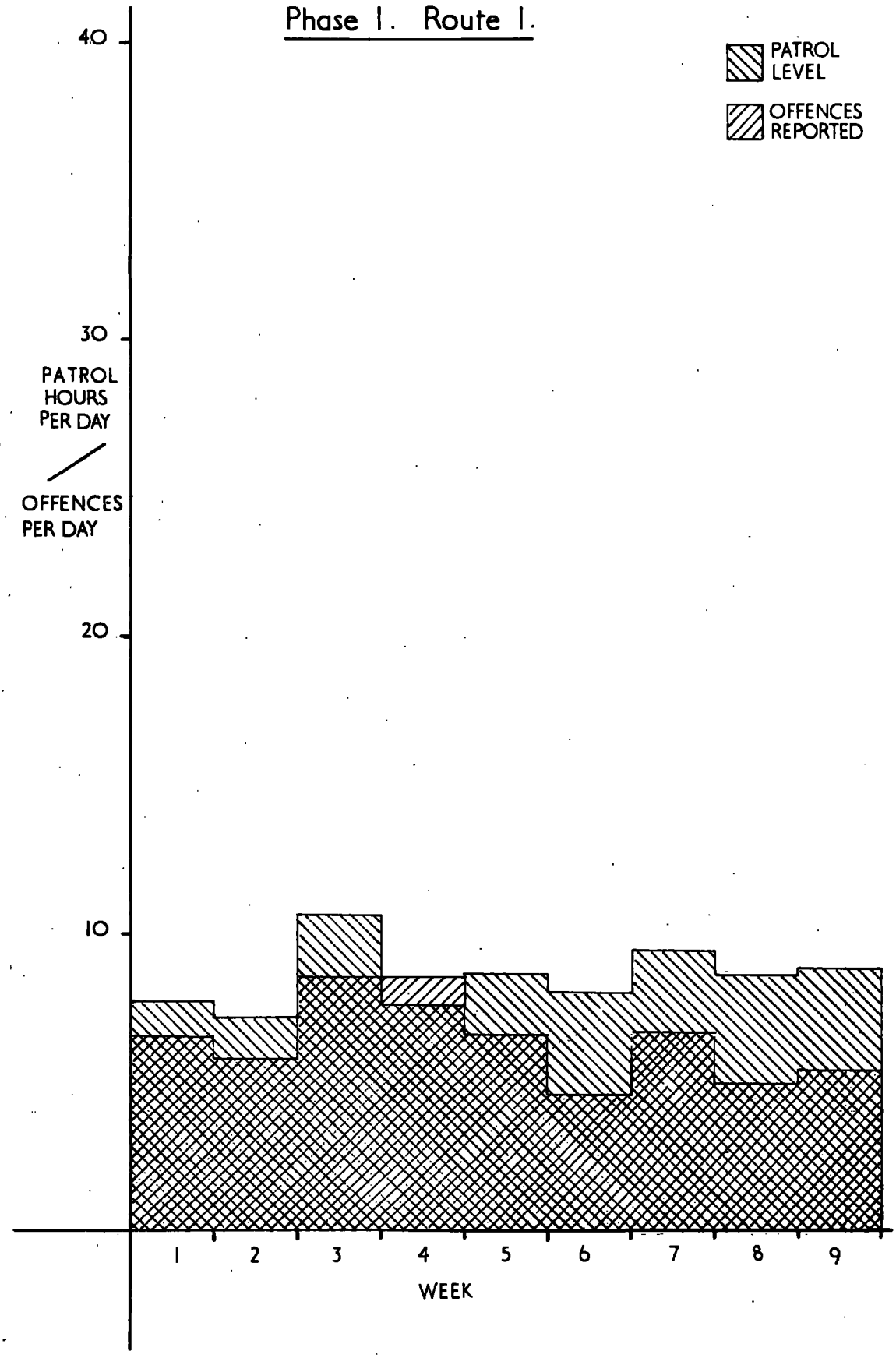


FIG. 27

PATROL LEVEL AND OFFENCES REPORTED

Phase 2. Route 1.

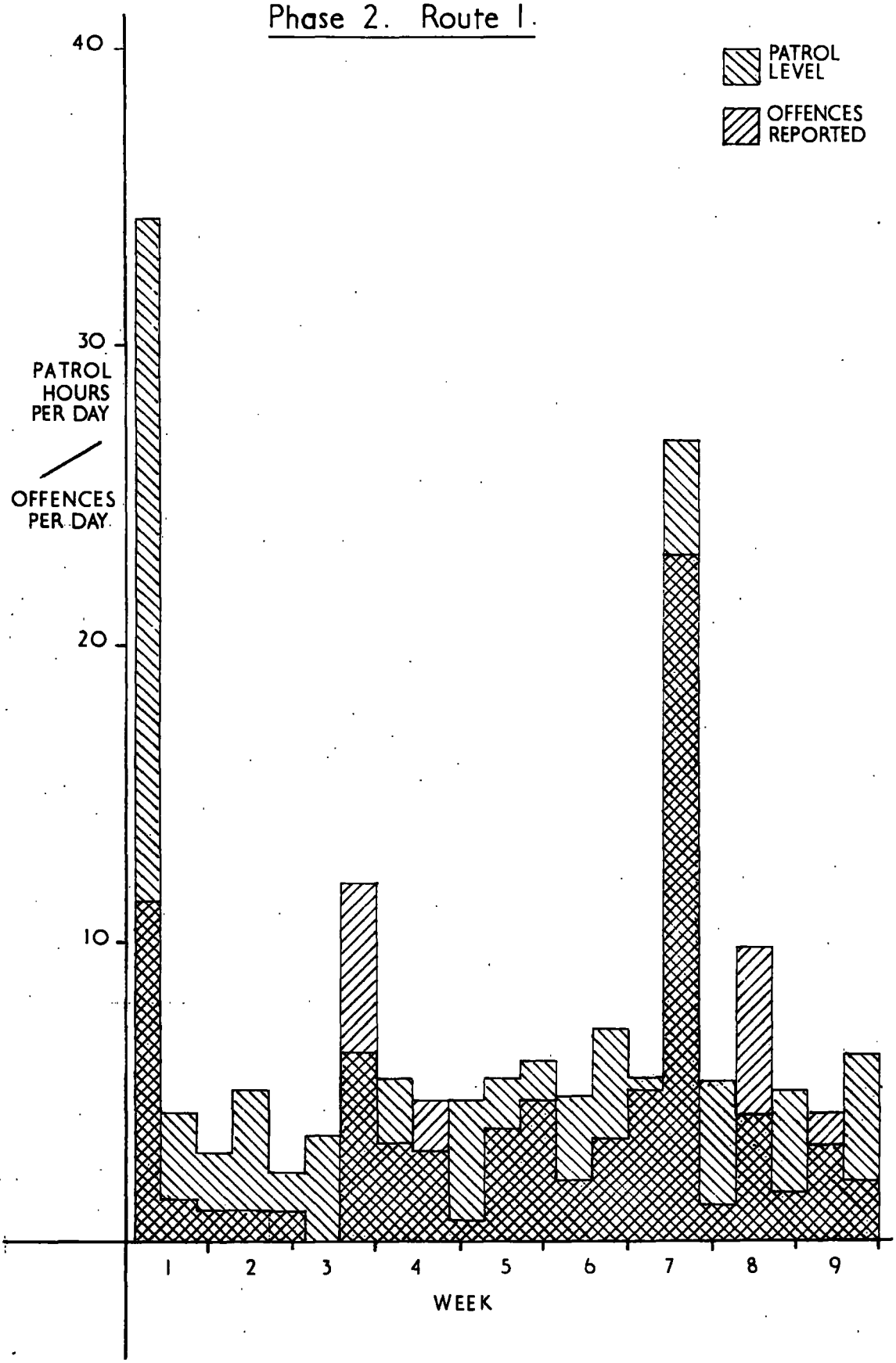


FIG. 28

PATROL LEVEL AND OFFENCES REPORTED

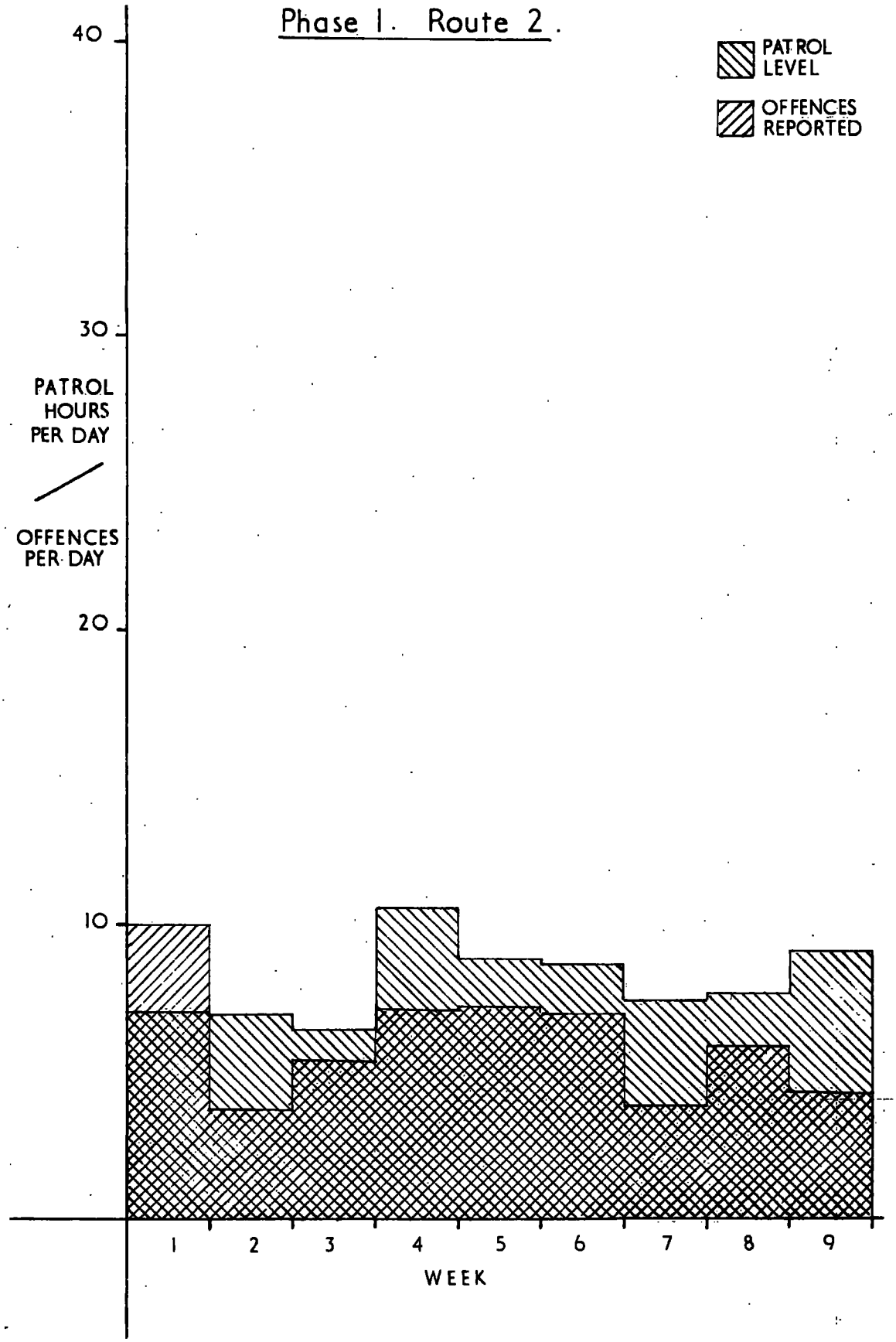


FIG. 29

PATROL LEVEL AND OFFENCES REPORTED

Phase 2. Route 2.

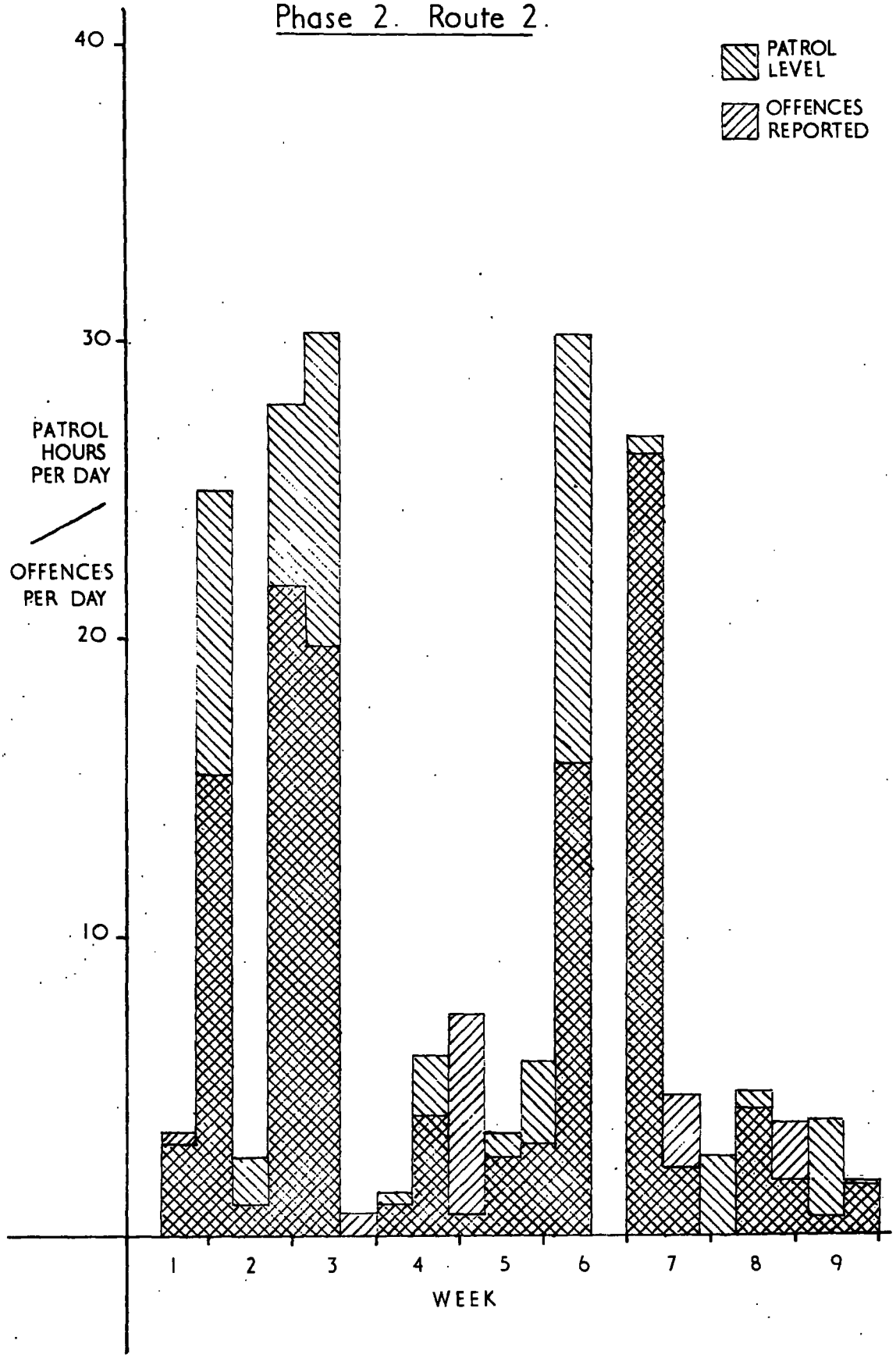


FIG. 30

PATROL LEVEL AND OFFENCES REPORTED

Phase 1. Route 3.

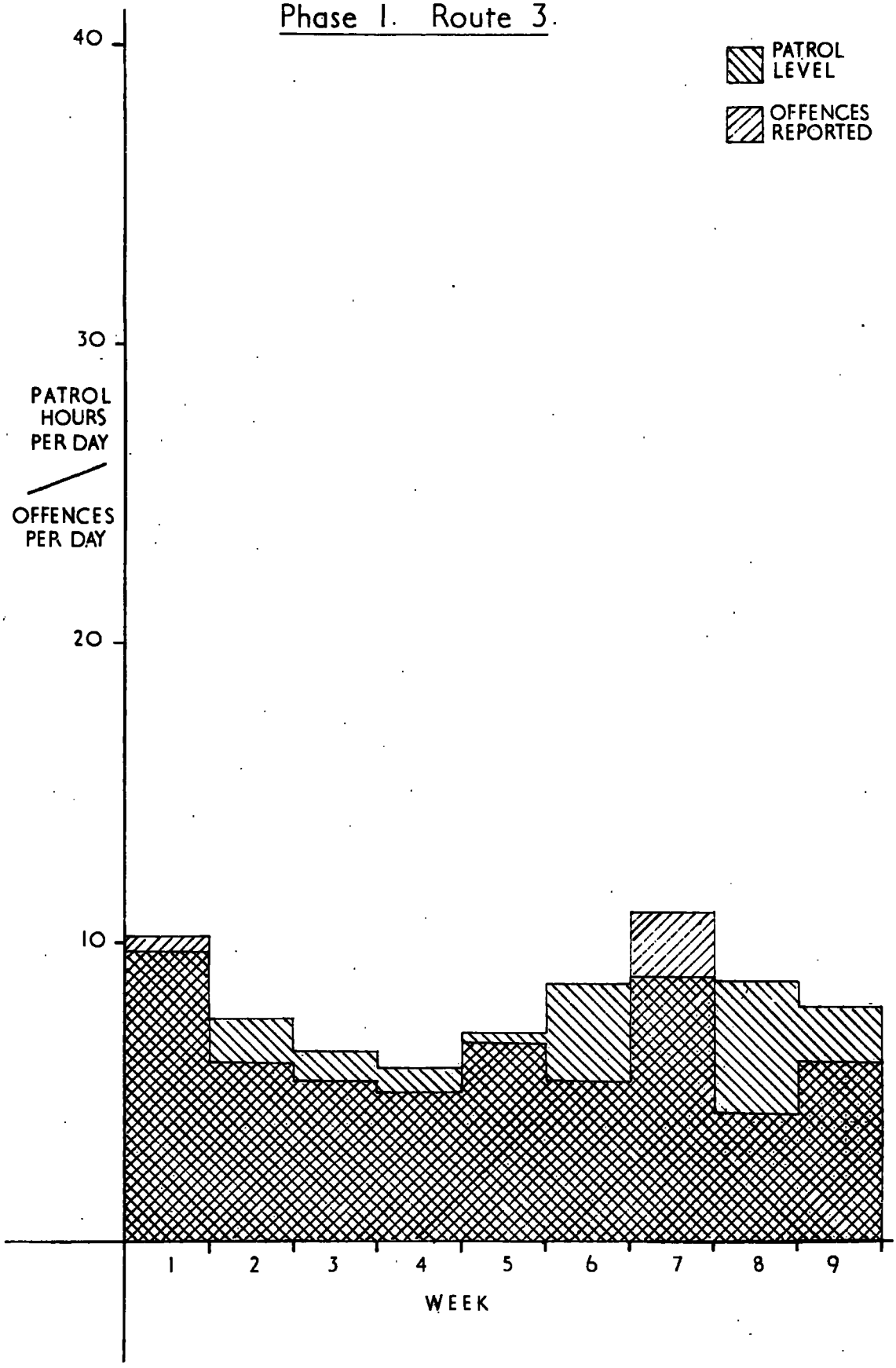


FIG. 31

PATROL LEVEL AND OFFENCES REPORTED

Phase 2. Route 3.

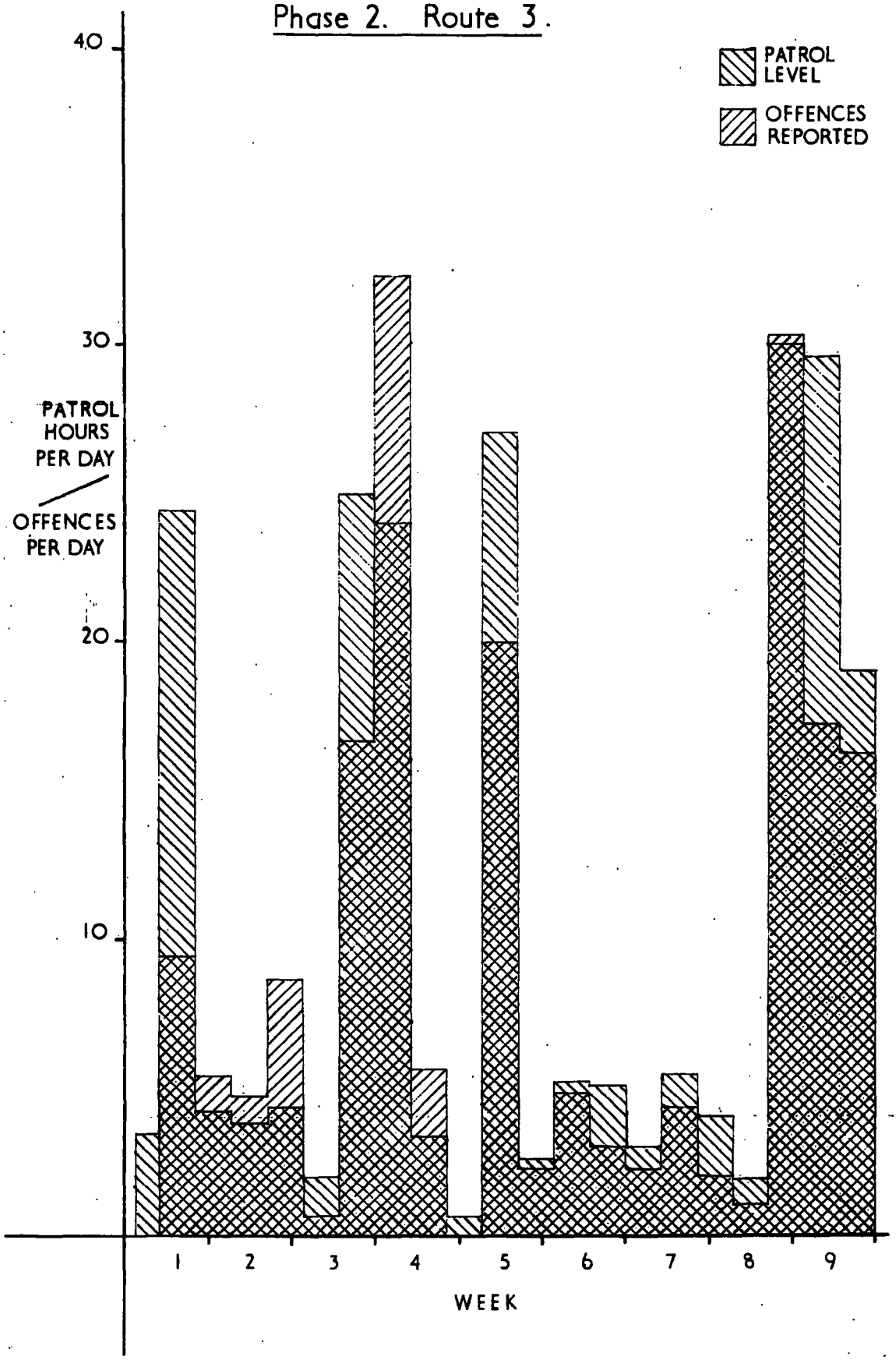


FIG. 32

PATROL LEVEL AND OFFENCES REPORTED

Phase 1. Route 4.

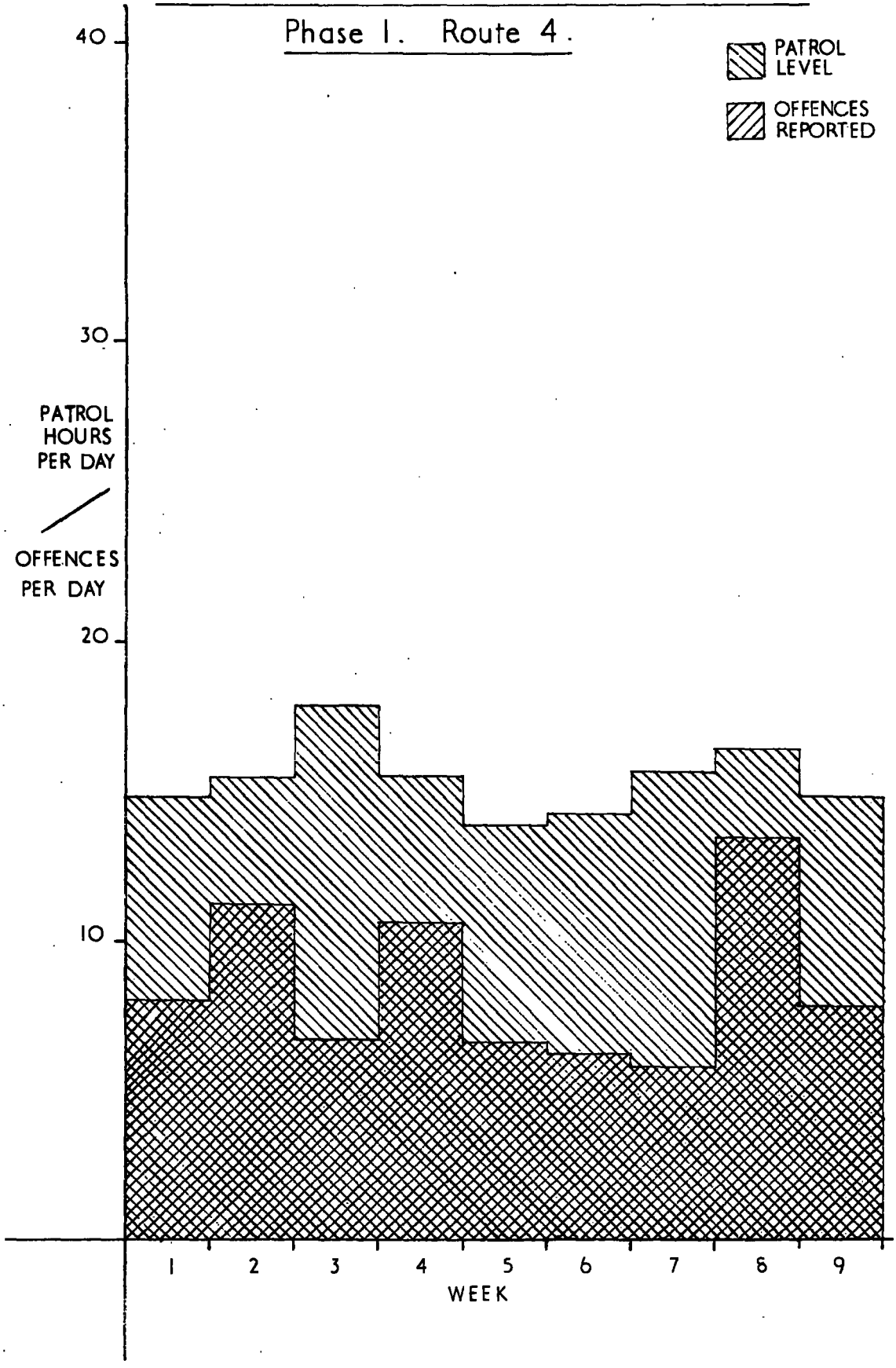
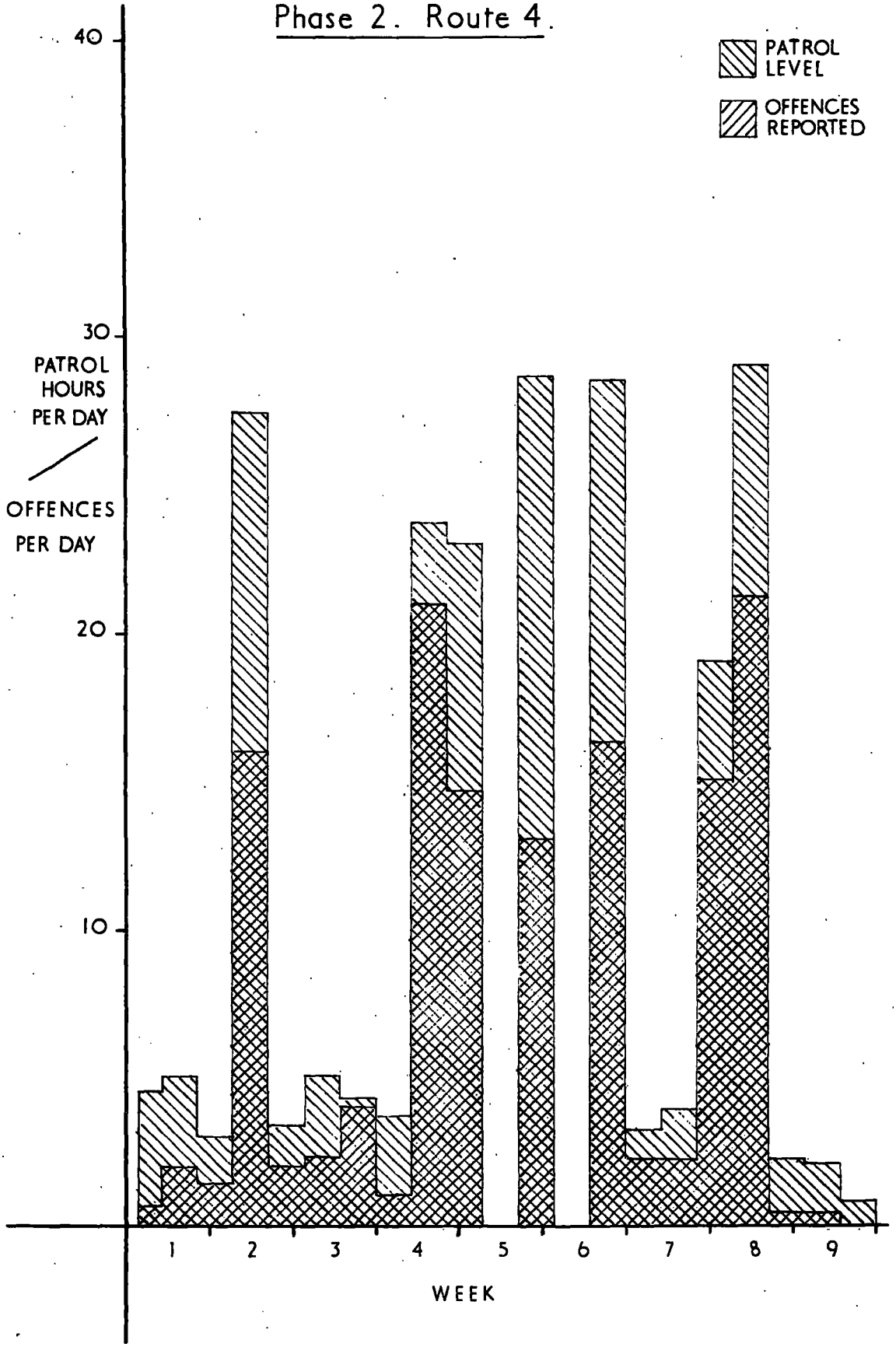


FIG. 33

PATROL LEVEL AND OFFENCES REPORTED

Phase 2. Route 4.



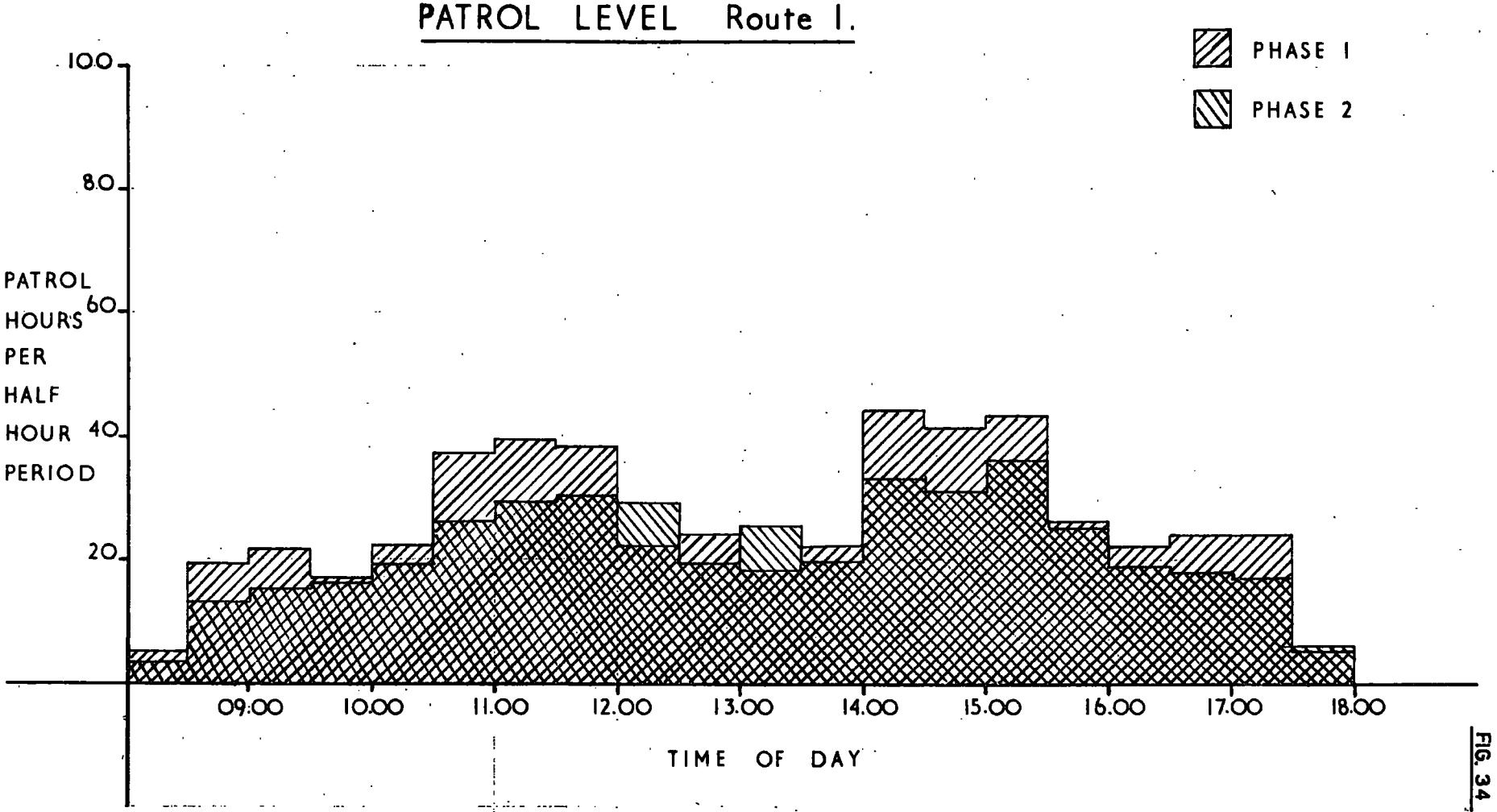

PATROL LEVEL Route 1.
PHASE 1
PHASE 2
100
80
PATROL HOURS PER HALF HOUR PERIOD
60
40
20
09:00
10.00
11.00
12.00
13.00
14.00
15.00
16.00
17.00
18.00
TIME OF DAY

FIG. 34

PATROL LEVEL Route 2.

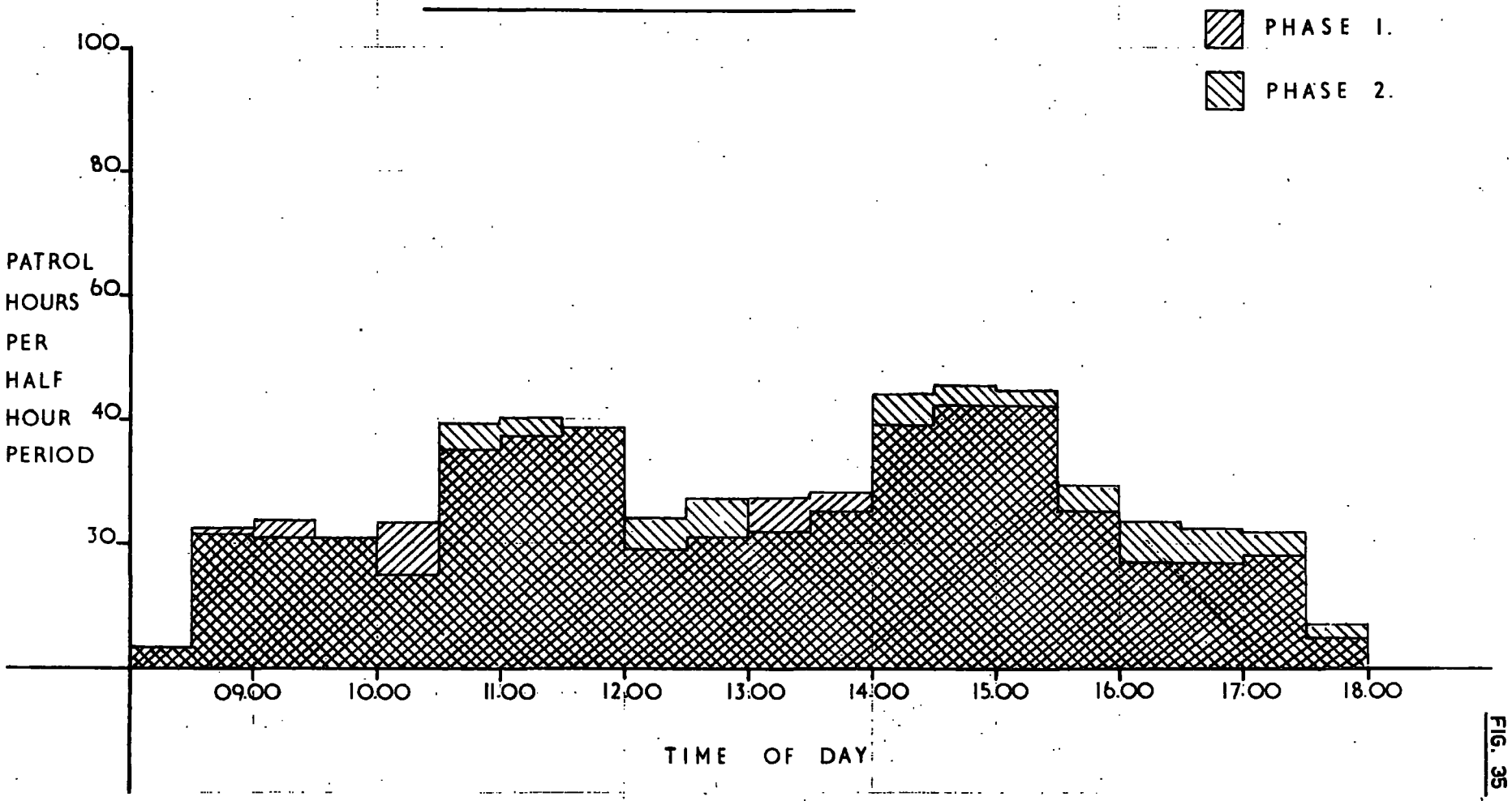


FIG. 35

PATROL LEVEL Route 3.

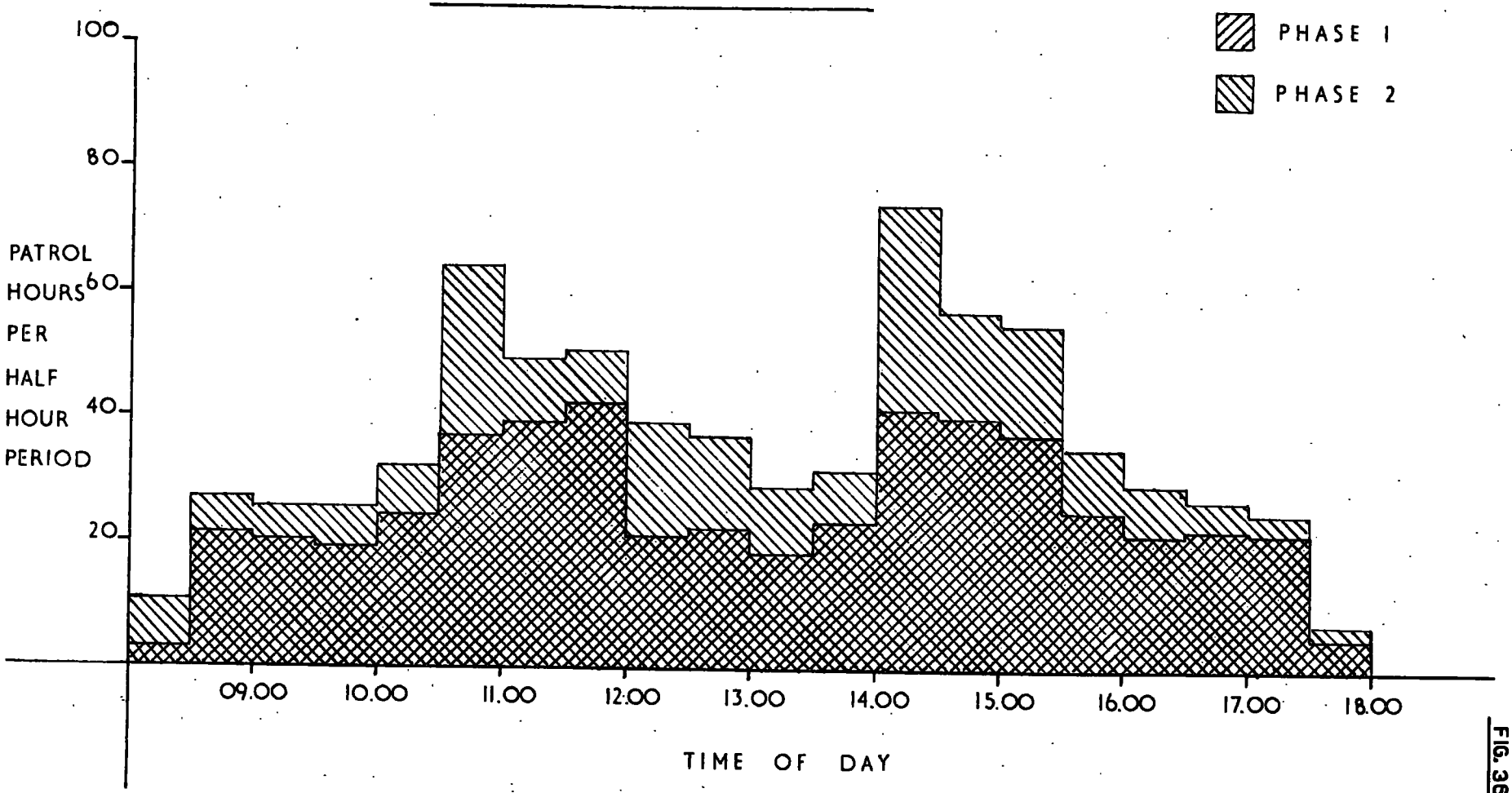


FIG. 36.

PATROL LEVEL Route 4

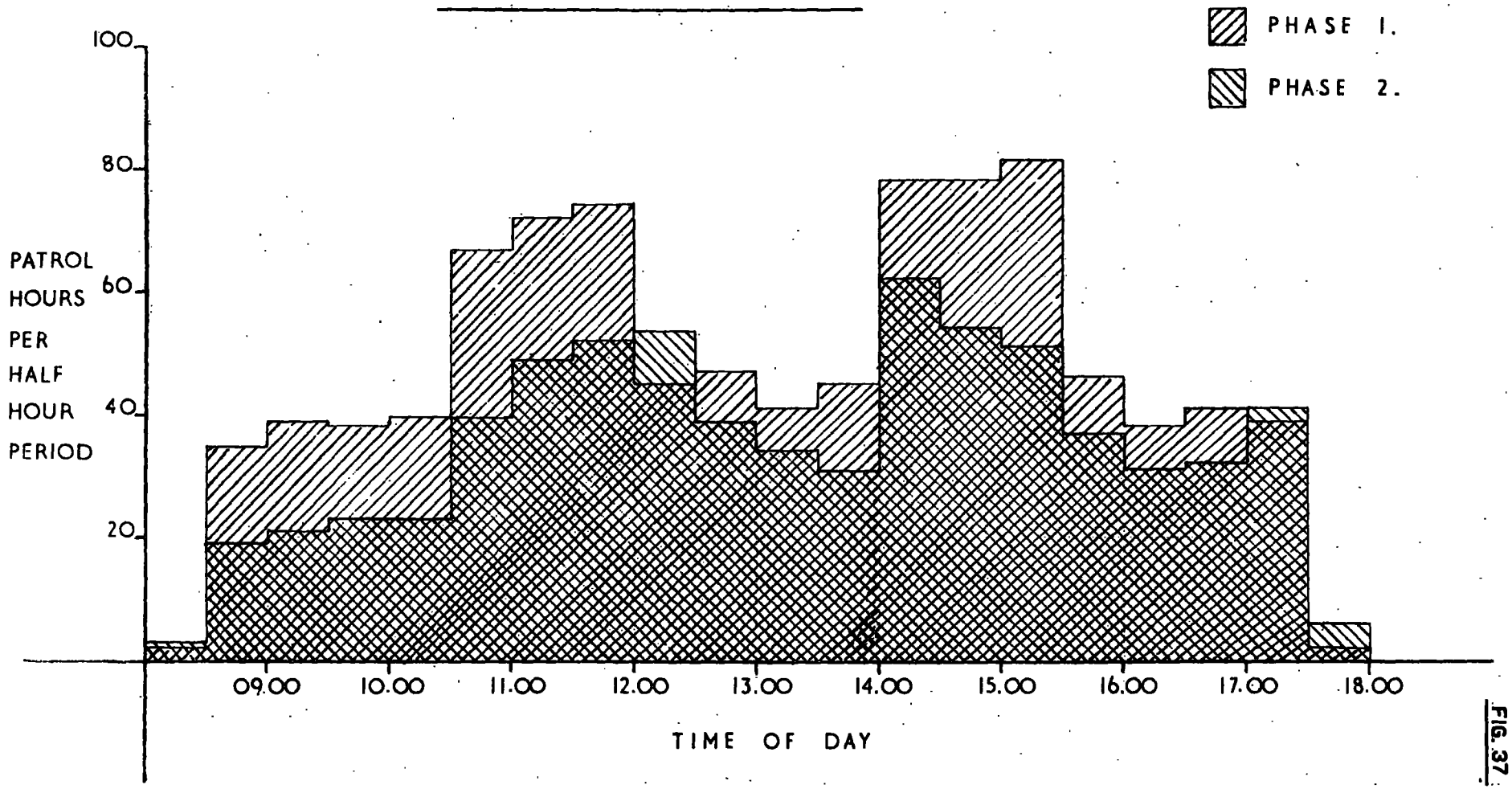


FIG. 37.

FIG. 38

SPEED DISTRIBUTION
HEAVY GOODS - DERESTRICTED ZONE

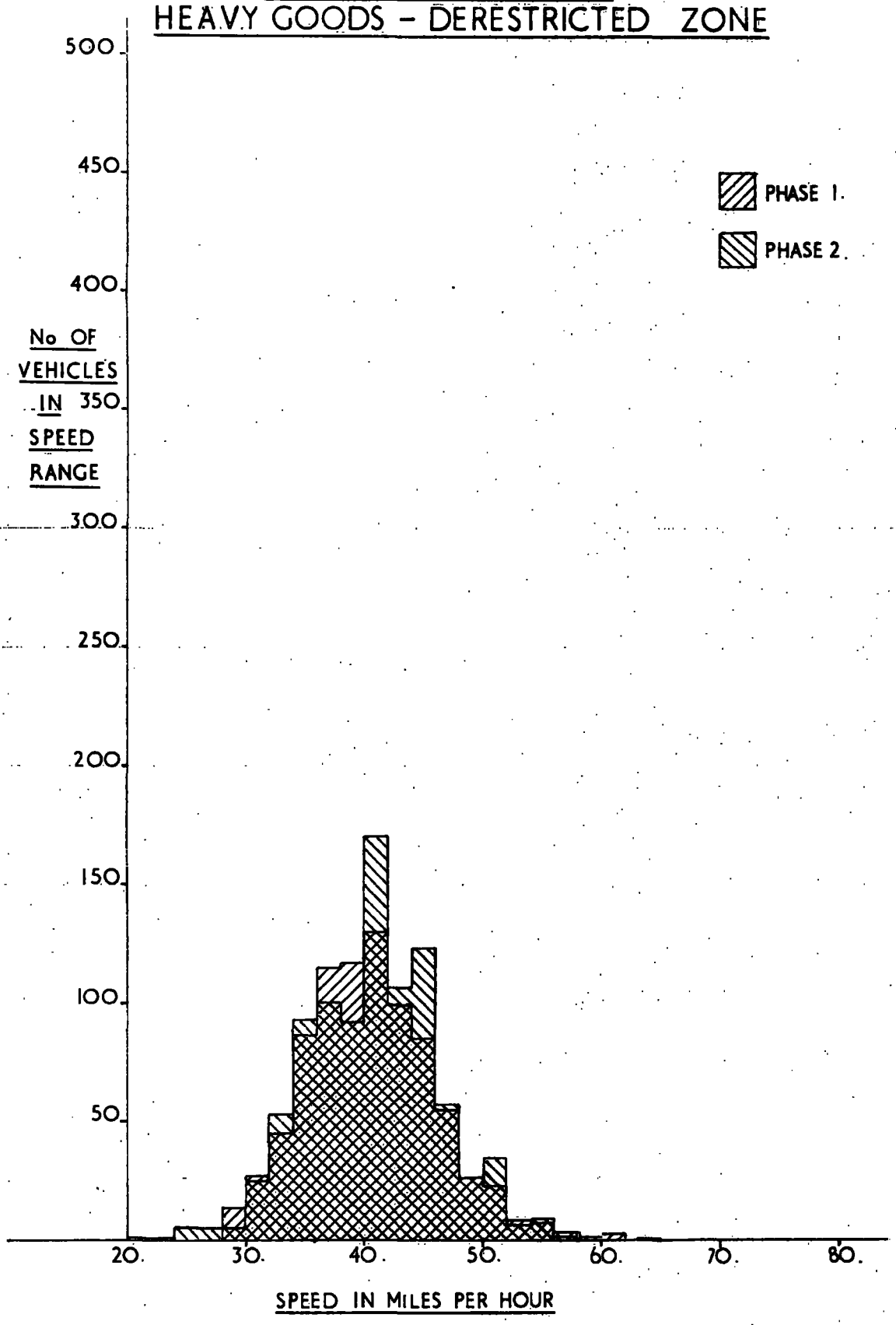


FIG. 39.

SPEED DISTRIBUTION
LIGHT GOODS – DERESTRICTED ZONE.

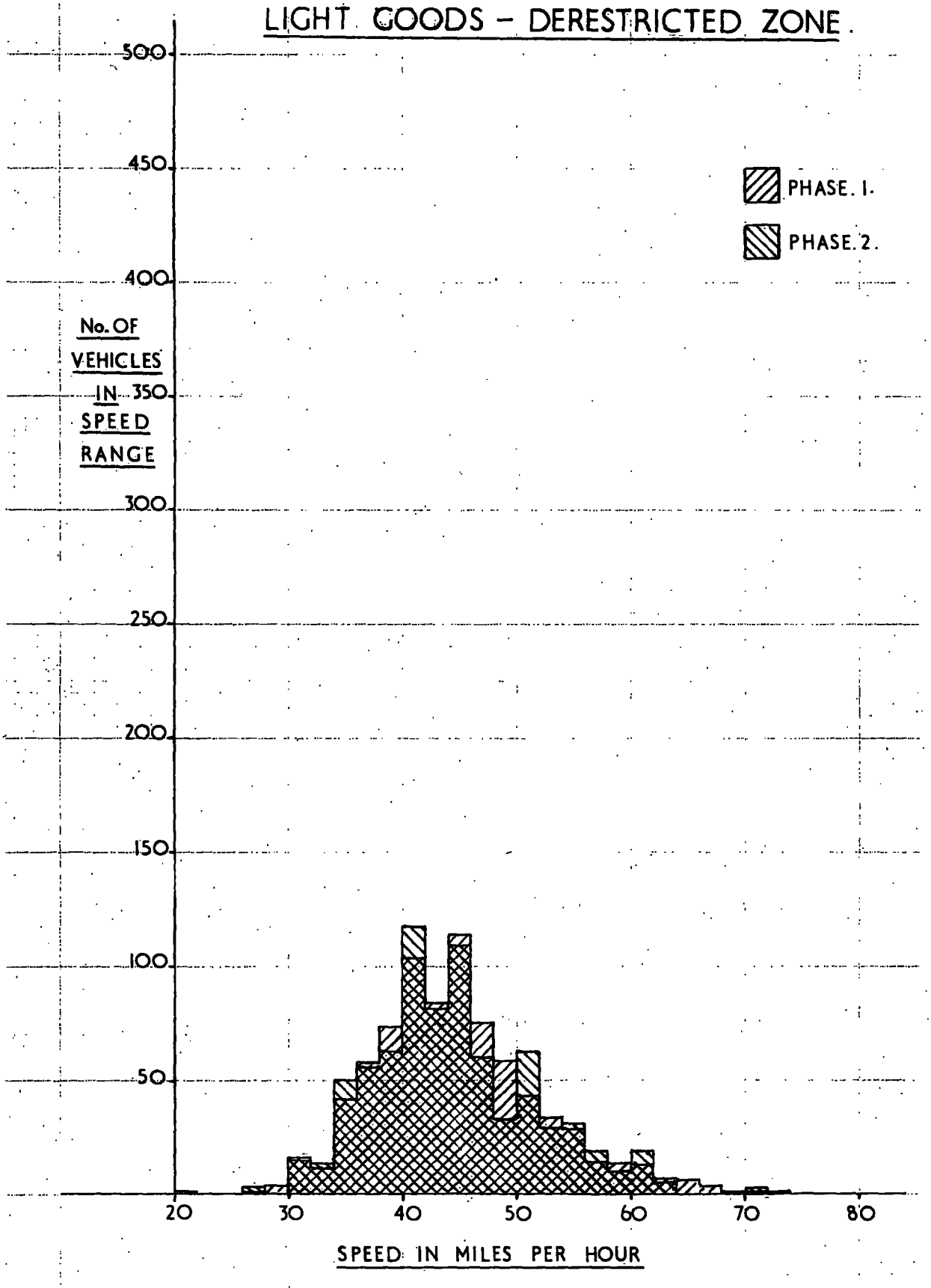


FIG. 40

SPEED DISTRIBUTION

CARS MOTOR CYCLES - DERESTRICTED ZONE.

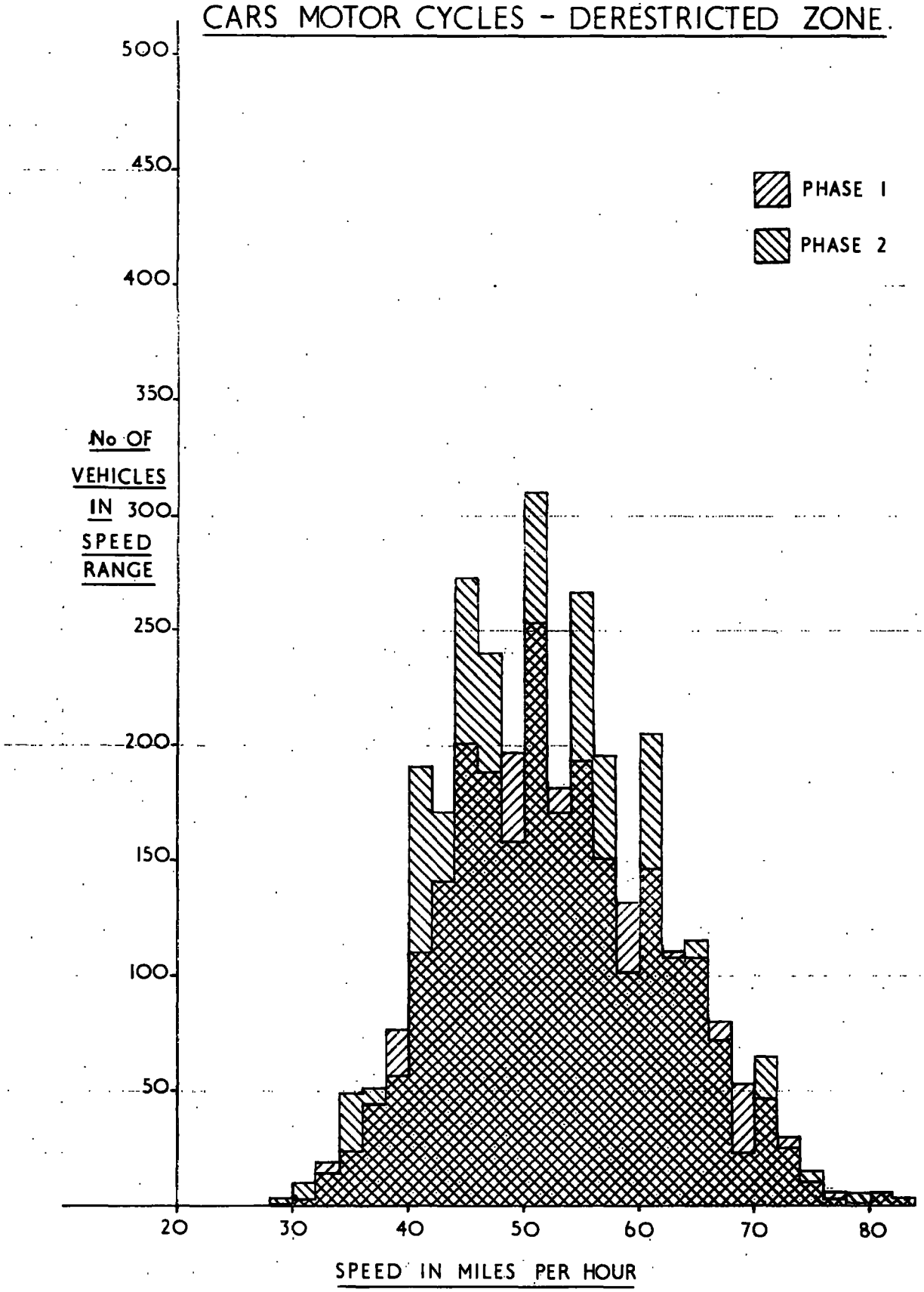


FIG. 41

SPEED DISTRIBUTION

HEAVY GOODS - 30 m.p.h. LIMIT ZONE.

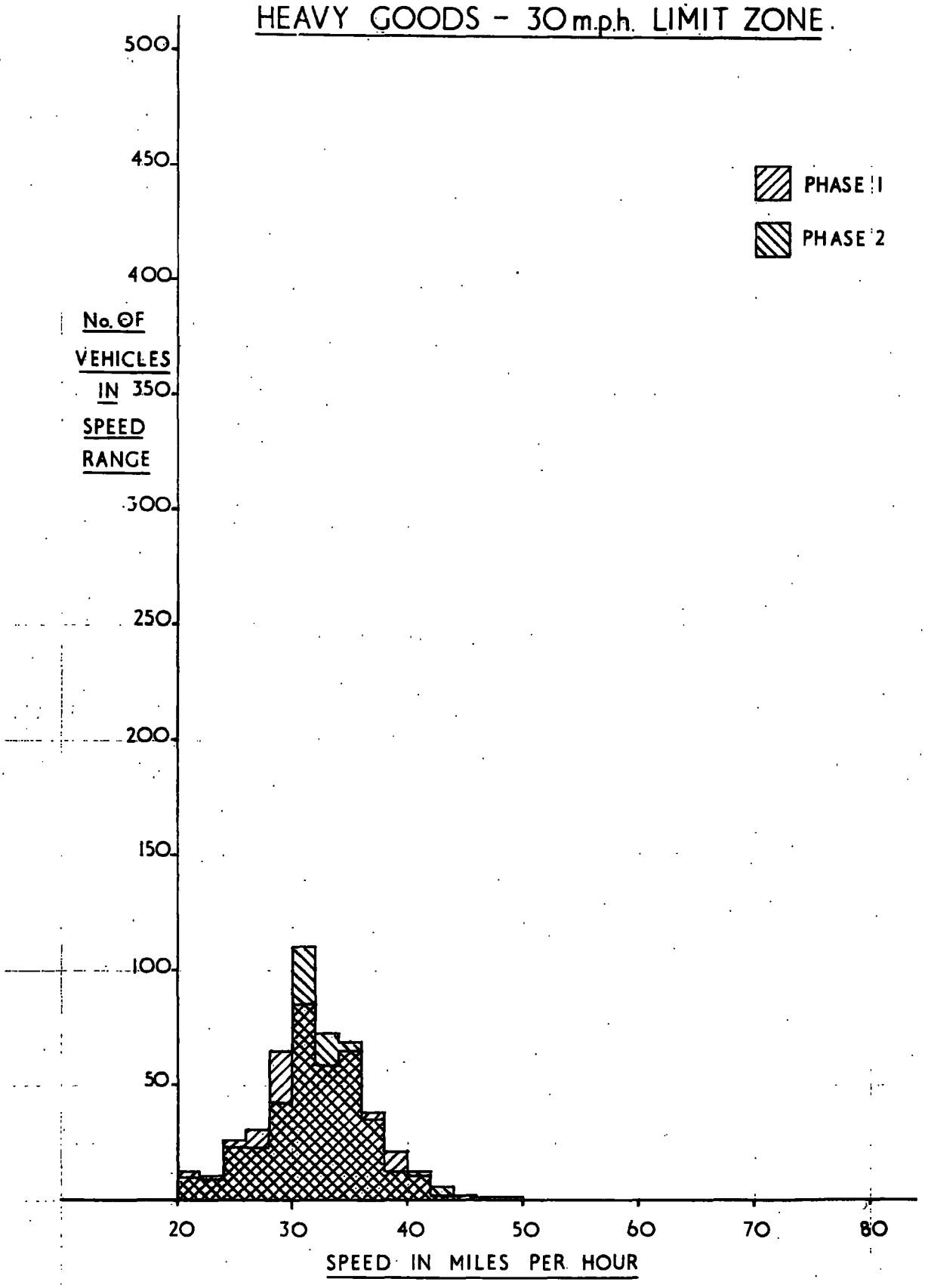


FIG. 42

SPEED DISTRIBUTION

LIGHT GOODS - 30 m.p.h. LIMIT ZONE.

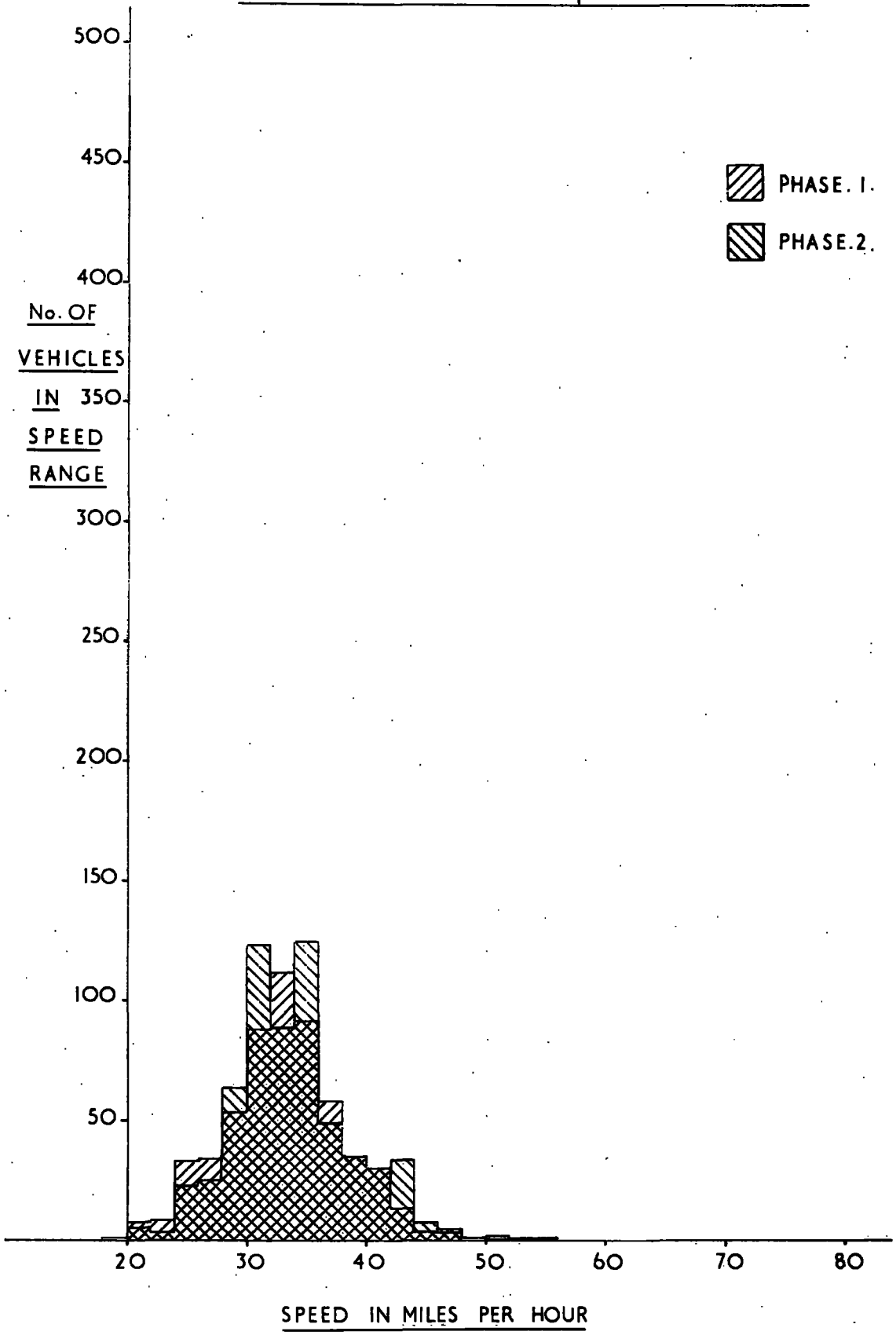


FIG. 43

SPEED DISTRIBUTION
CARS MOTOR CYCLES - 30 m.p.h. LIMIT ZONE

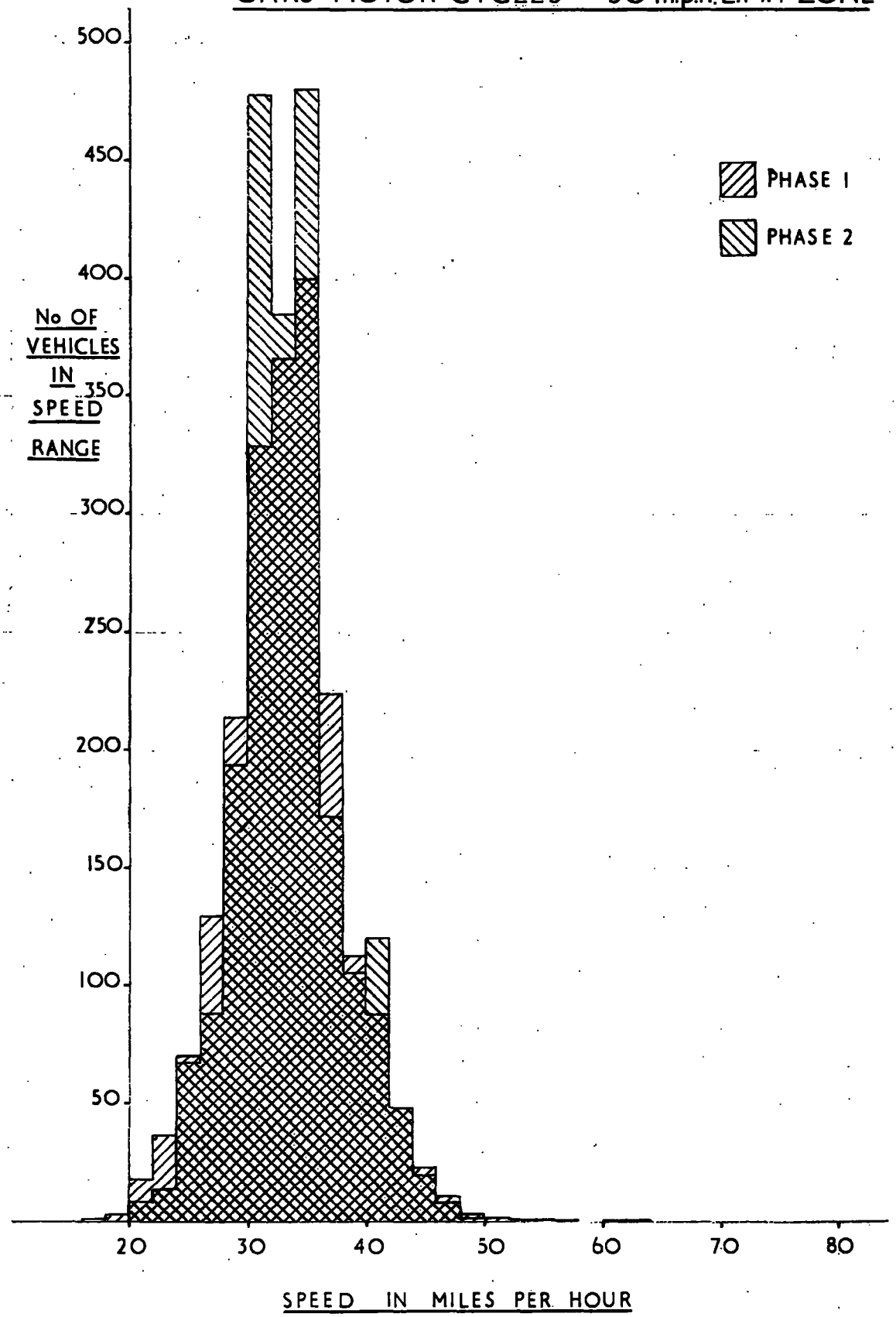


FIG.44

MEAN SPEEDS
HEAVY GOODS - DERESTRICTED ZONE.

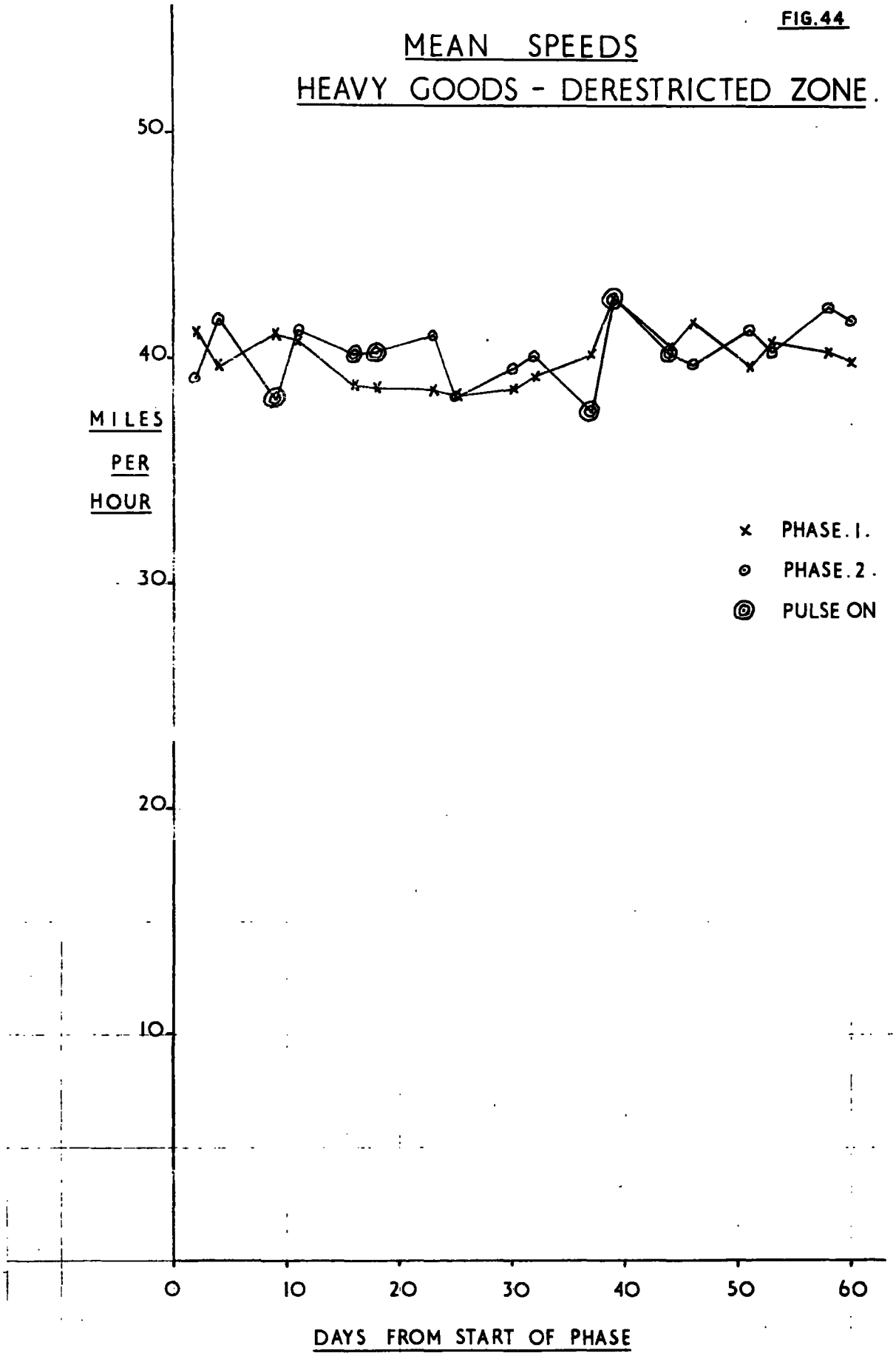


FIG. 45

MEAN SPEEDS
LIGHT GOODS – DERESTRICTED ZONE.

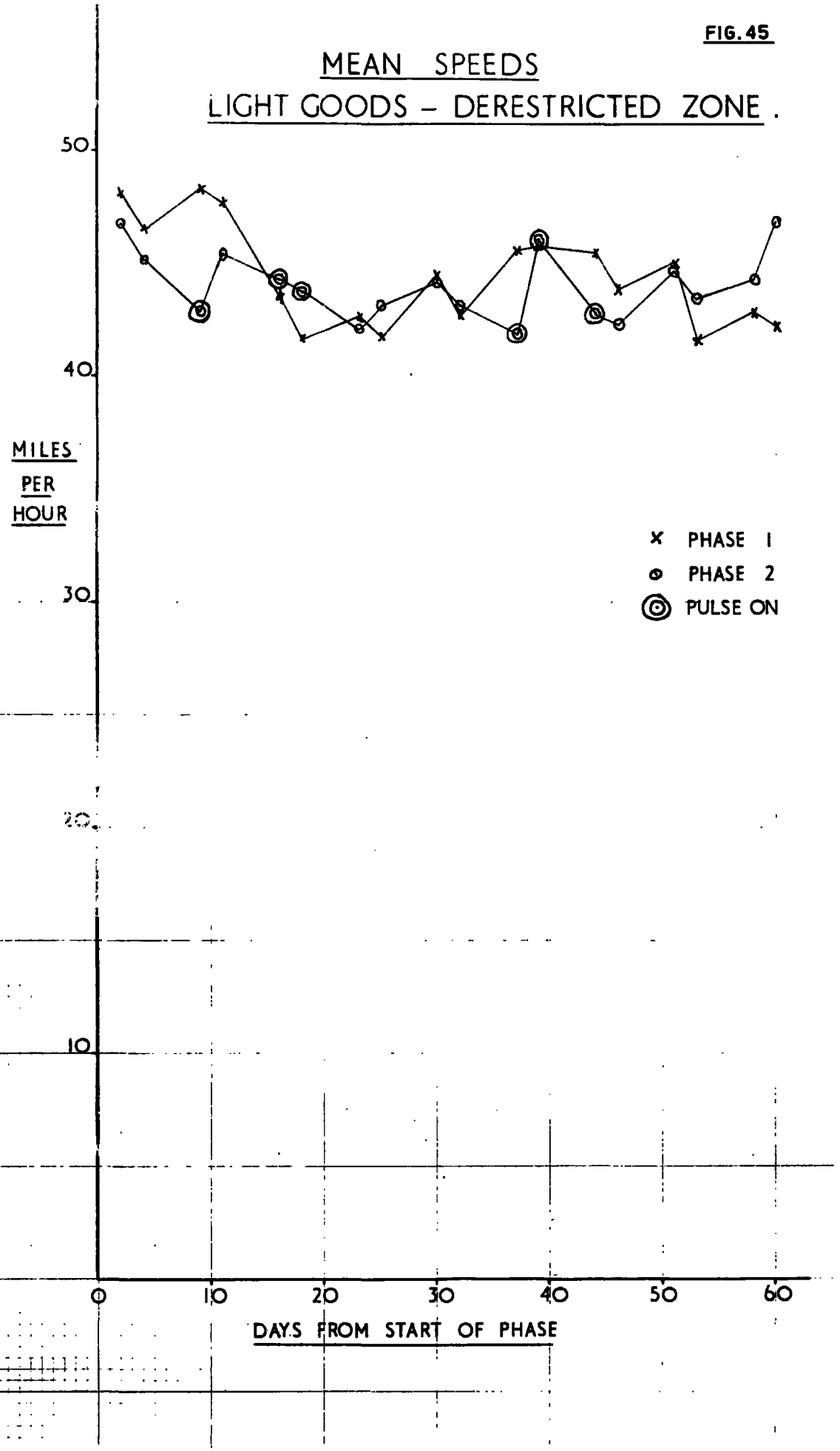
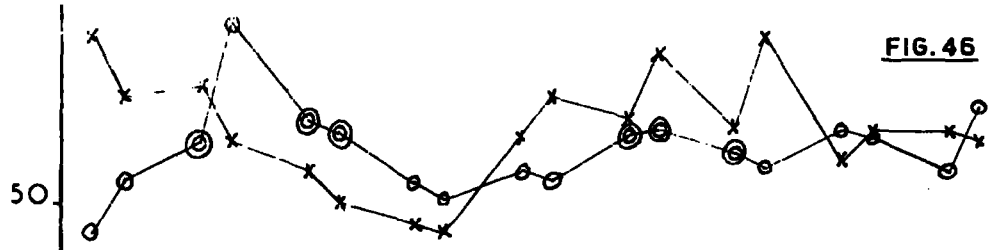


FIG. 46



MEAN SPEEDS

CARS, MOTOR CYCLES – DERESTRICTED ZONE

× PHASE 1
o PHASE 2
◎ PULSE ON

MILES PER HOUR

50
40
30
20
10

0 10 20 30 40 50 60

DAYS FROM START OF PHASE

FIG. 47

MEAN SPEEDS
HEAVY GOODS – 30 m.p.h LIMIT ZONE

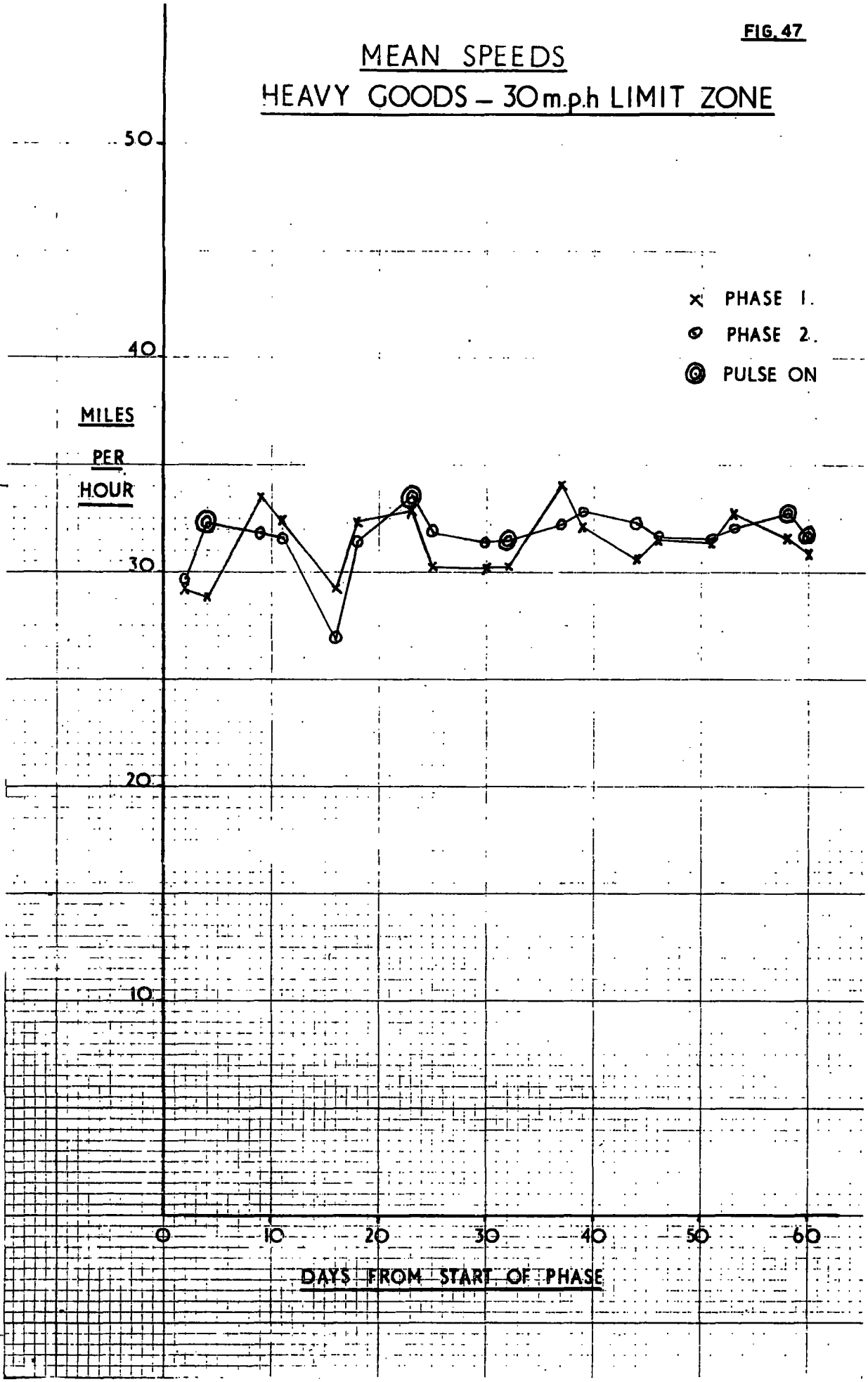


FIG. 48

MEAN SPEEDS
LIGHT GOODS – 30m.p.h. LIMIT ZONE

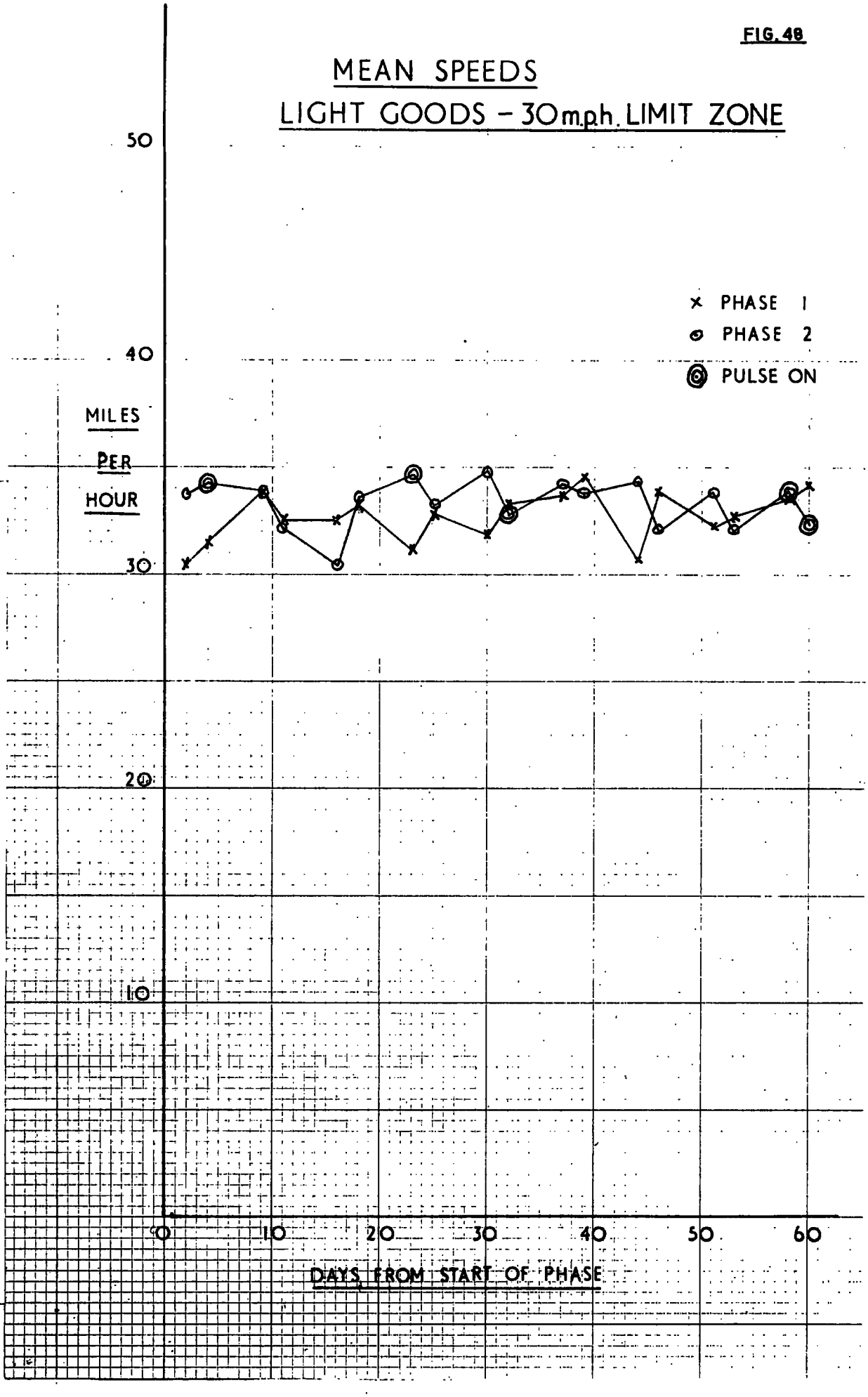


FIG. 49

MEAN SPEEDS

CARS, MOTOR CYCLES – 30m.p.h. Limit Zone

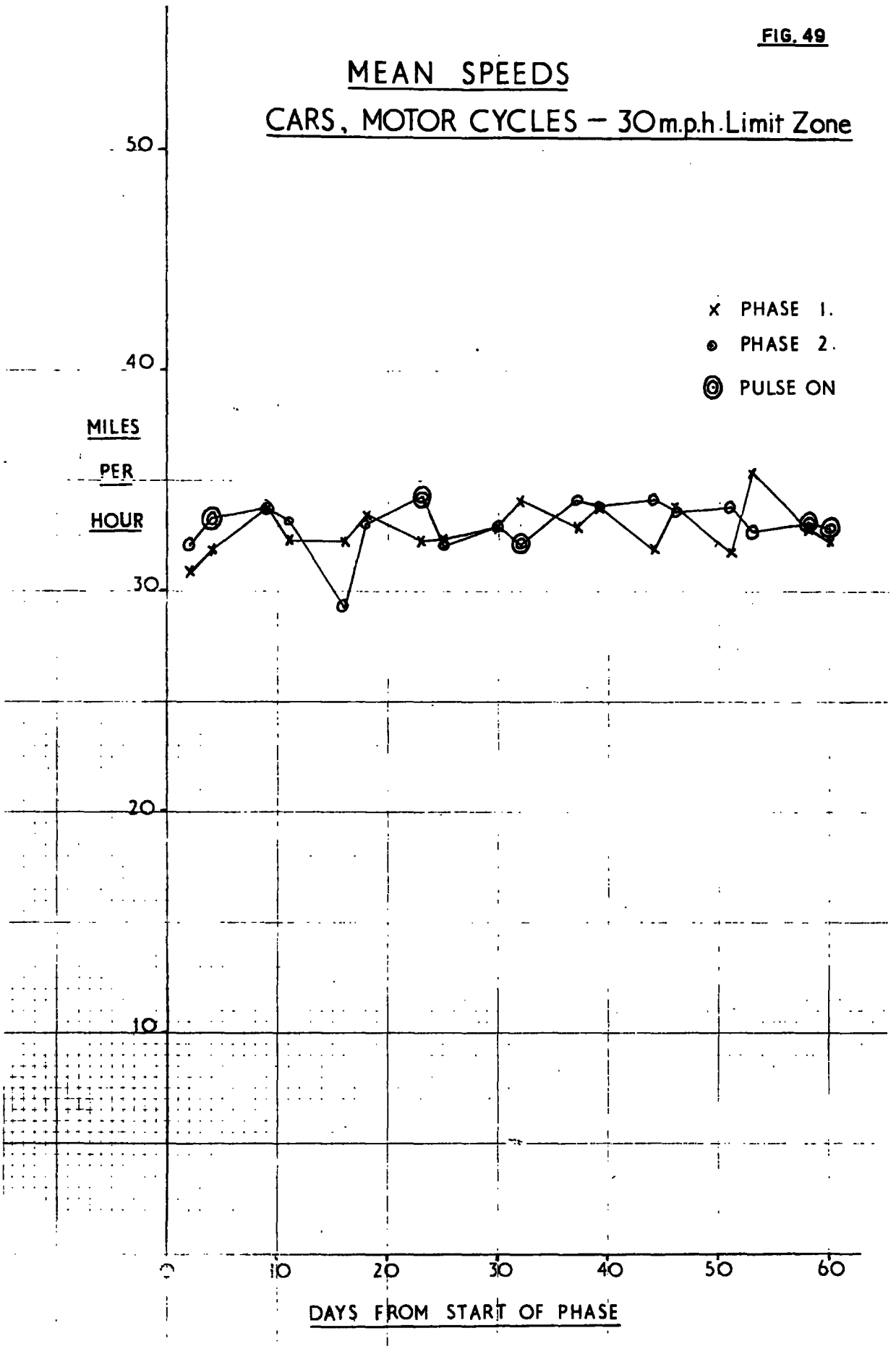


FIG. 50

PEDESTRIAN CROSSING EXPERIMENT

% of Drivers who failed to accord precedence to Pedestrians waiting at the roadside.

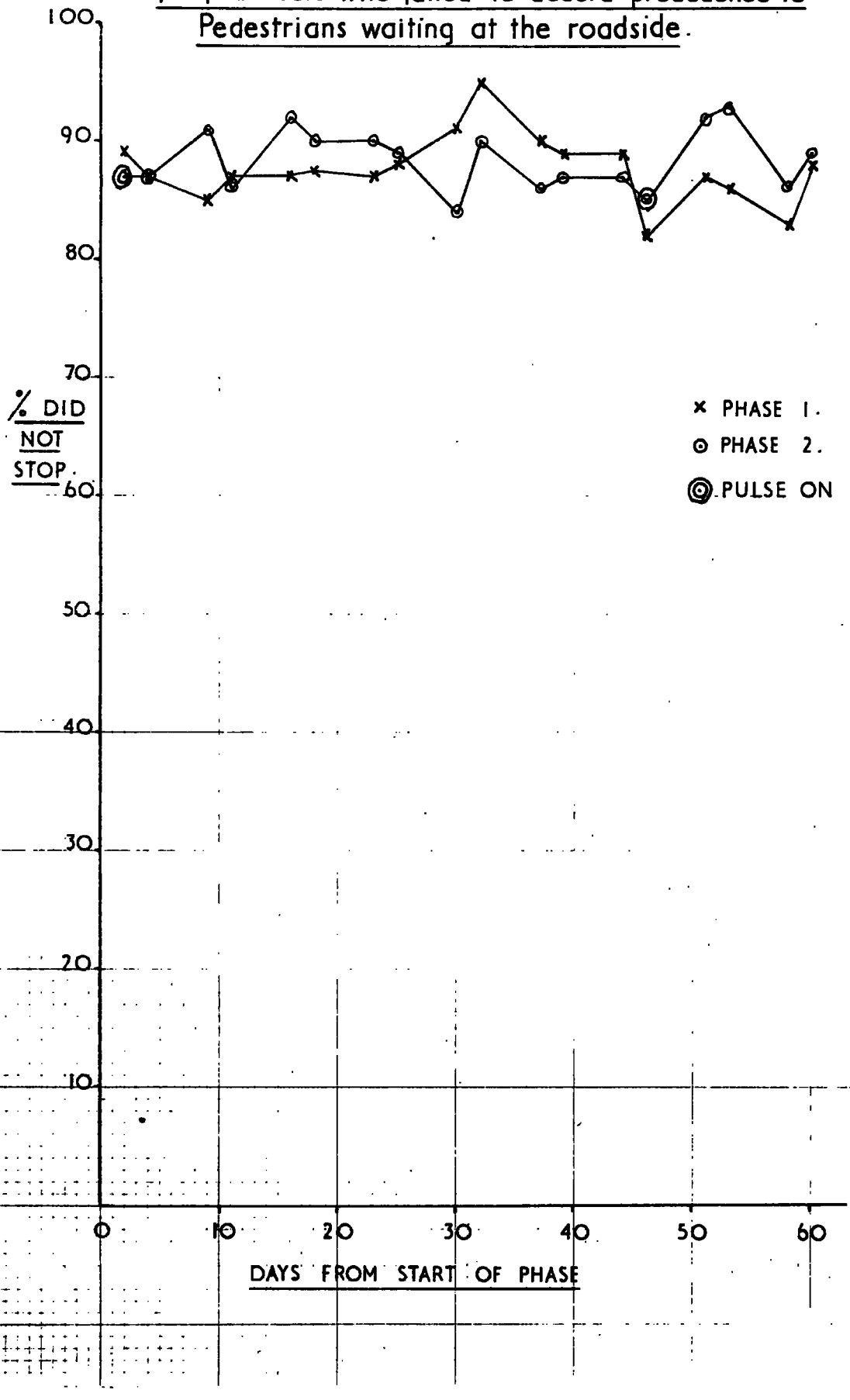


FIG. 51

PEDESTRIAN CROSSING EXPERIMENT

% of Drivers who failed to accord precedence to Pedestrians waiting in the Central Reservation.

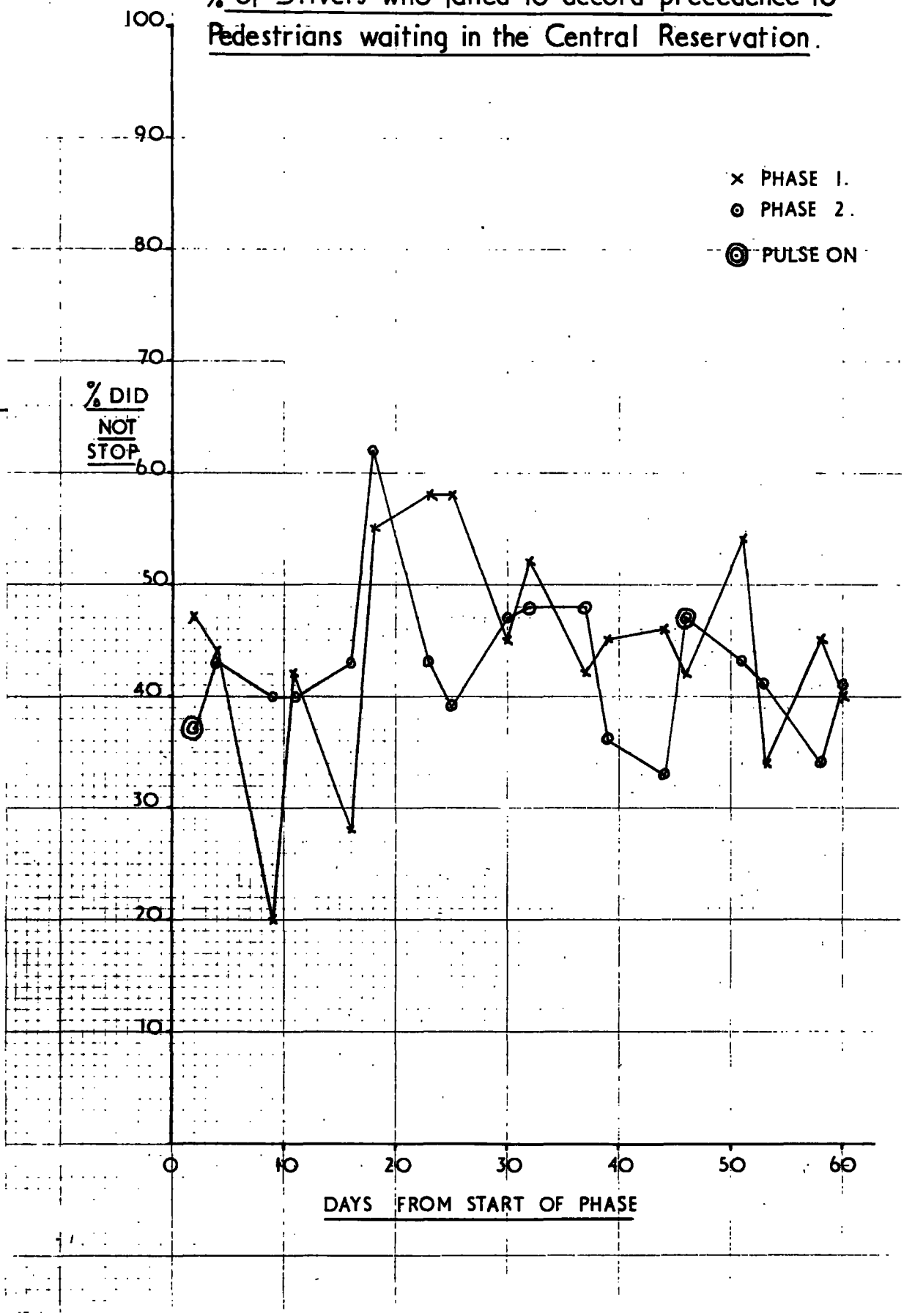


FIG.52

OVERTAKING EXPERIMENT

% of list in common which must be deleted to restore original sequence.

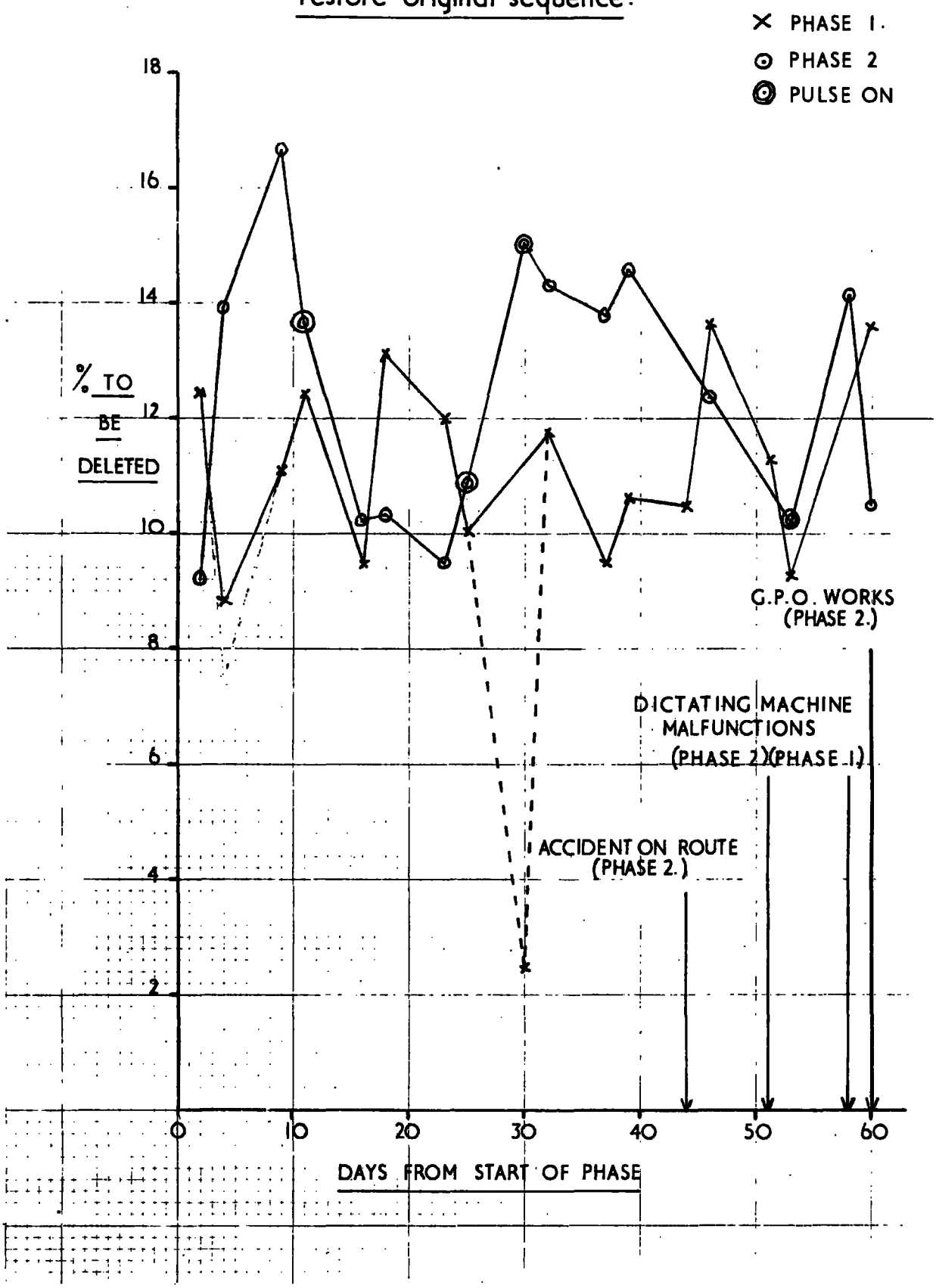
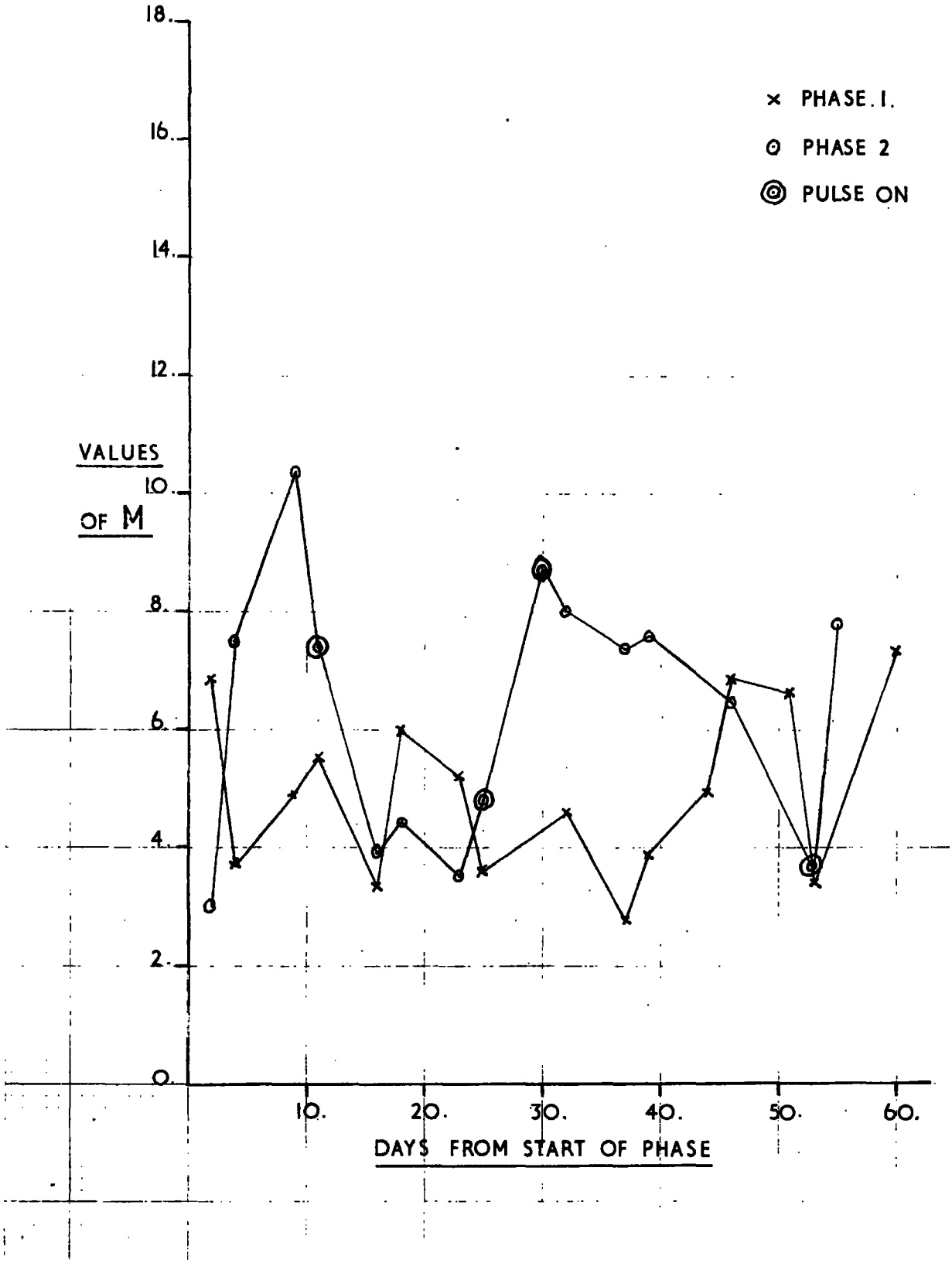


FIG. 53

OVERTAKING EXPERIMENT

Values of the Statistic M.

(See Section 5.9.)



14. DOCUMENTS

DOCUMENT 1:- A Motor Patrol Form (Project 1)

DOCUMENT 1

Any enquiries to be made to Chief Inspector Taylor. Durham 5261.

DURHAM CONSTABULARY

MOTOR PATROL EXPERIMENT

Route A TRUNK ROAD A1 (Aycliffe Interchange to Cock of the North).
" B " " A1 (Cock of the North to Gateshead Boundary).
" C " " A19 (Tees Bridge, Yarm to Junction of A179).
" D " " A19 (Junction of A179 to Monkwearmouth Bridge, Sunderland).

1. General Information

DATE ..... (1-6) CALL SIGN ..... (7-11) DIVISION ..... (12-13)

NO. IN CREW ..... (14)

Average weather during patrol (Please tick) (15)

(1)	(2)	(3)	(4)
Rain	Snow	Fog	Fine
Hail	Sleet	Mist	

Average road conditions during patrol (Please tick) (16)

Dry	Wet	Snow	Ice

2. Information relating to accidents on above routes.

No. of accidents reported (17) .....

(Use 24 hour clock)

TIME		ROUTE		LOCATION OF ACCIDENT	TICK IF INJURY OR FATAL	
	18/21		22			23
	24/27		28			29
	30/33		34			35

3. Activities on Route

No. of traffic offences reported		36	No. of defective vehicles checked		39
No. of persons reported		37	Assistance to motorists		40
No. of verbal cautions (traffic offences only)		38	C.R.O. checks		41

Total length of time spent on escort duties (42) .....

Car times on above routes (Punch 1) (43) (Please use 24 hour clock)						Motor Cycle times on above routes (Punch 2) (43)					
Route A,B,C or D		Time when car entered route		Time when car left route		Route A,B,C or D		Time when cycle entered route		Time when cycle left route	
	44		45-48		49-52		44		45-48		49-52
	53		54-57		58-61		53		54-57		58-61
	62		63-66		67-70		62		63-66		67-70
	71		72-75		76-79		71		72-75		76-79
	44		45-48		49-52		44		45-48		49-52
	53		54-57		58-61		53		54-57		58-61
	62		63-66		67-70		62		63-66		67-70
	71		72-75		76-79		71		72-75		76-79
	44		45-48		49-52		44		45-48		49-52
	53		54-57		58-61		53		54-57		58-61

DOCUMENT 2:- An Amended Motor Patrol Form (Project 1)

3. Activities on Routes:

No. of traffic offences reported		36	No. of defective vehicles checked		39
No. of persons reported		37	Assistance to motorists		40
No. of verbal cautions (traffic offences only)		38	C.R.O. Checks		41

Total length of time spent on escort duties (42) .....

CAR ☐ Punch 43 (1)

MOTOR CYCLE ☐ Punch 43 (2)

Please use 24 hour clock

Route A,B,C or D		Time entered Route		Time left Route	
	44		45-48		49-52
	53		54-57		58-61
	62		63-66		67-70
	71		72-75		76-79
	44		45-48		49-52
	53		54-57		58-61
	62		63-66		67-70
	71		72-75		76-79
	44		45-48		49-52
	53		54-57		58-61

TICK ONE SQUARE TO REPRESENT ¼ HOUR

DISTRIBUTION OF PATROL TIME
Patrol
At scene of accident
At scene of crime
Complaints
Escort
Radar
Static Check
'999' calls attended
Clerical
Dictating
Typing
Court
Taking Statements
Enquiries
Interviews
Duty in connection with car
Miscellaneous

To be completed by Officers who are primarily engaged on Motor Patrol Duties

DOCUMENT 2

Any enquiries to be made to
Chief Inspector Taylor
Durham 5261

DURHAM CONSTABULARY

MOTOR PATROL EXPERIMENT

Route A TRUNK ROAD A. 1 (Aycliffe Interchange to Cock of the North)
Route B TRUNK ROAD A. 1 (Cock of the North to Gateshead Boundary)
Route C TRUNK ROAD A. 19 (Tees Bridge, Yarm, to Junction of A.179)
Route D TRUNK ROAD A. 19 (Junction of A.179 to Monkwearmouth Bridge, Sunderland)

1. General Information:

DATE:..... (1-6) CALL SIGN..... (7-11) DIVISION..... (12-13)

NO. IN CREW..... (14)

Average weather during patrol (Please tick) (15)

(1)	(2)	(3)	(4)
Rain / Hail	Snow / Sleet	Fog / Mist	Fine

Average Road conditions during patrol (Please tick) (16)

Dry	Wet	Snow	Ice

2. Information relating to accidents on above routes.

No. of accidents reported (17).....

(Use 24 hour clock)

TIME		ROUTE		LOCATION OF ACCIDENT	TICK IF INJURY OR FATAL	
	18/21		22			23
	24/27		28			29
	30/33		34			35

DOCUMENT 3:- A Motor Patrol Form (Project 2)

DOCUMENT 3

DURHAM UNIVERSITY MOTOR PATROL EXPERIMENT

Crew P.C. _____ Call Sign _____ Car/Motor Cycle

Date _____ Tour of Duty _____

No.		Route	No.		Route
	Accidents reported en route			Accidents reported en route	
	Traffic offences reported en route			Traffic offences reported en route	
	Traffic offenders reported en route			Traffic offenders reported en route	
	Criminal offences reported en route			Criminal offences reported en route	
	Criminal offenders reported en route			Criminal offenders reported en route	
	Cautions reported en route			Cautions reported en route	

999 Calls

Nature of call and time spent

		Time
1.		
2.		
	Total	

Time Spent Off Patrol

Reason for being off patrol and time (itemise).

		Time
1.		
2.		
3.		
4.		
	Total	

Time Spent on Patrol

Route	Time on		Time off	

Number of "alien" identifiable police vehicles seen on routes

Patrol Cars [ ] Pandas [ ] Others [ ]

Particulars of offences reported or arrests made:

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Particulars of verbal cautions given:

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Signed: _____ P.C. _____

DOCUMENT 4: A Typical Duty Sheet - Phase I (Project 2)

DUTY SHEET

Route Coverage

Route 1 - 10
2 - 10
3 - 11
4 - 20

WEEK 6 PHASE 1

WEEK COMMENCING Monday, 28 April 1969

Officer	Monday 28	Tuesday 29	Wednesday 30	Thursday 1	Friday 2	Saturday 3	Sunday 4
P.C. 1298 Harrison	K.14 K.4	K.12 K.4	W.R.D.	W.R.D.	K.11 K.3	K.11 K.4	K.14 K.3
P.C. 1858 Uren	10am-6pm K.13 K.2	K.14 K.4	K.14 K.1	Office	W.R.D.	W.R.D.	W.R.D.
P.C. 1003 Barrass	K.15 K.4	K.15 K.3	K.15 K.4	K.15 K.4	K.15 K.2	Office	K.15 K.1
P.C. 1504 Hall	K.11 K.1	10am-6pm K.11 K.4	Office	K.14 K.3	K.14 K.4	K.14 K.2	Office
P.C. 584 Callaghan	W.R.D.	W.R.D.	K.11 K.3	K.11 K.2	Office	A.L.	A.L.
P.C. 2041 Storey	Office	K.13 K.3	W.R.D.	W.R.D.	K.13 K.2	K.13 K.4	K.13 K.1
P.C. 2097 Walton	K.12 K.3	Office	K.16 K.1	K.12 K.1	W.R.D.	W.R.D.	W.R.D.
P.C. 2192 Scorer	K.16 K.4	K.16 K.1	Office	K.16 K.4	K.16 K.3	K.16 K.1	K.16 K.2
P.C. 1865 Foreman	W.R.D.	W.R.D.	K.12 K.2	Office	K.12 K.1	8am-4pm K.15 K.4	8am-4pm K.11 K.2
P.C. 2003 Scott	W.R.D.	W.R.D.	K.13 K.3	K.13 K.4	Office	K.12 K.3	K.12 K.4
MOTOR CYCLISTS							
P.C. 1275 Soppitt	K.18 K.4	K.18 K.1	K.18 K.4	K.18 K.3	W.R.D.	W.R.D.	W.R.D.
P.C. 1114 Pringle	K.17 K.1	K.17 K.2	K.17 K.4	W.R.D.	W.R.D.	A.L.	A.L.
						K.17 K.2	K.17 K.4

8 a.m. - 4 p.m.

10 a.m. - 6 p.m.

8 a.m. - 4 p.m.

10 a.m. - 6 p.m.

Inspector Fidiam: W.R.D. - Thursday, Sunday

DOCUMENT 4

DOCUMENT 5:- A Typical Duty Sheet - Phase 2 (Project 2)

DUTY SHEET

Pulse No. 12:
30.6.69
Route 4:

Pulse No. 13:
1.2.3.7.69
Route 2:

Pulse No. 14:
4.5.6.7.69
Route 4:

8 am - 4 pm

Background Patrolling

Route 1: 7
Route 2: -
Route 3: 7
Route 4: -

10 am - 6 pm

WEEK 6 PHASE 2 — WEEK COMMENCING Monday, 30 June 1969

Officer	Monday 30	Tuesday 1	Wednesday 2	Thursday 3	Friday 4	Saturday 5	Sunday 6
P.C. 2041 Storey	K.13 K.4	K.13 K.2	K.13 K.2	K.13 K.1	W.R.D.	W.R.D.	W.R.D.
P.C. 2097 Walton	A.L.	A.L.	A.L.	A.L.	K.16 K.4	K.16 K.3	K.16 K.4
P.C. 2192 Scorer	W.R.D.	W.R.D.	K.16 K.2	K.16 K.2	Office	A.L.	A.L.
P.C. 1865 Foreman	xxx K.12 K.3	K.12 K.1	W.R.D.	W.R.D.	K.12 K.4	K.12 K.4	K.12 K.1
P.C. 2003 Scott	K.16 K.4	K.16 K.2	W.R.D.	W.R.D.	K.13 K.3	K.13 K.4	K.13 K.4
P.C. 1868 Uren	K.11 K.4	K.11 K.2	8am-4pm K.12 K.2	8am-4pm K.12 K.2	Office	A.L.	A.L.
P.C. 1003 Barrass	W.R.D.	W.R.D.	K.15 K.2	K.15 K.2	K.15 K.4	K.15 K.1	K.15 K.4
P.C. 1504 Hall	W.R.D.	W.R.D.	K.11 K.3	xxx K.11 K.3	K.14 K.4	K.14 K.4	K.14 K.3
P.C. 584 Callaghan	K.15 K.4	K.15 K.2	W.R.D.	W.R.D.	K.11 K.1	K.11 K.4	K.11 K.4
P.C. 1521 Heslop	K.14 K.4	K.14 K.3	K.14 K.2	K.14 K.2	W.R.D.	W.R.D.	W.R.D.
MOTOR CYCLISTS							
P.C. 1114 Pringle	K.17 K.4	K.17 K.2	K.17 K.1	K.17 K.2	W.R.D.	W.R.D.	W.R.D.
P.C. 1879 Trueman	K.18 K.1	K.18 K.2	W.R.D.	W.R.D.	K.18 K.4	K.18 K.4	K.18 K.4

8 am - 4 pm

10 am - 6 pm

xxx Ramp Duty

DOCUMENT 5

DOCUMENT 6:- A wireless log Abstract Form (Project 2)

UNIVERSITY/POLICE MOTOR PATROL EXPERIMENT 24.3.69 - 26.7.69

Daily wireless log abstract for "Kelo" vehicles, including all Channels, to be completed each morning, for collection by Inspector Fidiam at Control Room.

WIRELESS LOG ABSTRACT FOR (DAY) (MONTH) CHANNEL

	K.11	K.12		K.13		K.14		K.15		K.16		K.17		K.18	
Time	Message														

DOCUMENT 6

DOCUMENT 7:- A Speed Experiment Data Form (Project 2)

PUNCH		DOCUMENT 7	NOTES.
1 2 3 4 5 6	DATE.		
7	DAY.		
8 9 10 11	TIME.		
12	WEATHER.		
13	RD. CONDITIONS.		
14	RD. TYPE		
15 16 17	LOCATION		
18	POL. ACTIVITY		
19	SPEED LIMIT		
20 21 22	METERED		
23 24 25	TRAFFIC		
26 O 27 . 28 5 29	ADJ.		

CLASS	< 20		20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78		≥ 80		MISSED
HEAVY GOODS																																				
		-1 2																															-2		-3	
	< 20		20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78		≥ 80		MISSED
LIGHT GOODS																																				
		-1 2																															-2		-3	
	< 20		20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78		≥ 80		MISSED
CARS M/C ETC.																																				
		-1 2																															-2		-3	

DOCUMENT 8:- A Pedestrian Crossing Experiment Data Form (Project 2)

PEDESTRIAN CROSSING EXPERIMENT

Date: _____ Location: _____

Time: From _____ To _____

Weather: _____ Road Condition: _____

Road Type: _____ Crossing Type: _____

	Waiting on Roadside		Waiting on Island		Foot on Crossing	
	Stopped	Did not stop	Stopped	Did not stop	Stopped	Did not stop
TOTAL						
%						

Date: _____ Location: _____

Time: From _____ To _____

Weather: _____ Road Condition: _____

Road Type: _____ Crossing Type: _____

	Waiting on Roadside		Waiting on Island		Foot on Crossing	
	Stopped	Did not stop	Stopped	Did not stop	Stopped	Did not stop
TOTAL						
%						

DOCUMENT 9

Extract from the transcription of measurement 4 by Observer 1 on 17 April 1969 (The second overtaking measurement for week 4, Phase 1, Project 1)

132	WHN 945G	
133	CUP 392G	
134	MYG451G	
135	AKY329B	
136	365TTN	
137	MXG973G	
138	BPU621G	
137	GFT762G	
140	GCU366F	
141	OYU222F	
142	MXG286G	
143	DPY826C	low loader
144	UP?369E	
145	TCH826F	
146	XUP932F	
147	ATN820B	
148	PPT272D	
149	9479UP	Mini-Countryman
150	NUP375D	
151	26MMJ	Platform wagon
152	OHN773E	Westminster
153	OTE992G	
154	XTJ556	
155	UPT961E	Jeff Dixon's
156	CPT194G	
157	GDC561E	
158	BCU89C	

DOCUMENT 10

Extract from the transcription of measurement 4 by Observer 2 on 17 April 1969 (The second overtaking measurement for week 4, Phase 1)

132	WHN545E	Escort
	EYE993F.	Cortina estate
133	CUP392G	Jeff Dixon
134	MYE541D	Bedford Dormobile
135	AKY329B	Mini
137	MXG973G	1100
138	BPU521G	Van
	AUP803F	Panda travelling South
141	OYU222F	Cortina
142	MXG286G	Renault
140*	GCU366F	Escort
	APT635F	1100
143	TPY826C	low-loader
146	XUP932F	1100
144*	UP?769E	heavy
147	ATN820B	Tudor Crisps
149	9479UP	Morris Traveller
150	NUP375D	
152	OHN773E	Cambridge
151*	26MMJ	Dawson - heavy
	DBR552C	Anglia
	GTY999G	Wagon
155	UPT961E	J. Dixon's
156	CPT194G	"
157	GDC561E	Marshalls
158	BCU89C	

* These vehicles must be deleted in order to restore the original order

DOCUMENT 11:- An Accident Report Book

PERSONS INJURED (7)

1. Name and full postal address (Mr., Mrs., Miss).....

.....Estimated age.....
(*Exact age if child*)

Whether driver, rider, pillion rider, passenger in Veh. No.....Pedestrian or horse rider.....

Nature of injury (state if fatal).....

Conveyed to.....

Friends to be informed.....

If attending school within County Police Area give name and No. of school.....

Statement .....

.....

.....

.....Initials.....

STRIKE OUT IRRELEVANT ITEMS

ACTIONS OF PERSONS HURT

Pedestrians	Passengers
Crossing Road Masked/Not Masked by Stationary Vehicle	Boarding, Alighting or Falling from P.S.V. Authorised Stop
Crossing Road Masked by Moving Vehicle	Boarding, Alighting or Falling from P.S.V. Moving or not at Authorised Stop
Walking on Road With/Without Footpath Facing Traffic	Sitting or Standing in P.S.V. (including on Stairs)
Walking on Road With/Without Footpath with back to traffic	On Cycle, Catching Feet in Wheels
Standing or Playing in Road	Otherwise on Cycle
On Footpath or Refuge	Boarding, Alighting or Falling from Vehicle other than P.S.V.
In Perambulator, etc.	On or in Vehicle other than P.S.V.
Playing Under or Near Vehicle Moving off	Unknown
Stepping, Walking or Running off Footpath	
Unknown	

Seat Belts				Wearing Crash Helmet			
Fitted		Worn		Motor Cyclist		Pillion Passenger	
Yes	No	Yes	No	Yes	No	Yes	No

(8)

2. Name and full postal address (Mr., Mrs., Miss) .....

.....Estimated age.....
(*Exact age if child*)

Whether driver, rider, pillion rider, passenger in Veh. No. .....Pedestrian or horse rider .....

Nature of injury (state if fatal) .....

Conveyed to.....

Friends to be informed.....

If attending school within County Police Area give name and No. of school.....

Statement .....

.....

.....

.....Initials .....

STRIKE OUT IRRELEVANT ITEMS

ACTIONS OF PERSONS HURT

Pedestrians	Passengers
Crossing Road Masked/Not Masked by Stationary Vehicle	Boarding, Alighting or Falling from P.S.V. Authorised Stop
Crossing Road Masked by Moving Vehicle	Boarding, Alighting or Falling from P.S.V. Moving or not at Authorised Stop
Walking on Road With/Without Footpath Facing Traffic	Sitting or Standing in P.S.V. (including on Stairs)
Walking on Road With/Without Footpath with back to traffic	On Cycle, Catching Feet in Wheels
Standing or Playing in Road	Otherwise on Cycle
On Footpath or Refuge	Boarding, Alighting or Falling from Vehicle other than P.S.V.
In Perambulator, etc.	On or in Vehicle other than P.S.V.
Playing Under or Near Vehicle Moving off	Unknown
Stepping, Walking or Running off Footpath	
Unknown	

Seat Belts				Wearing Crash Helmet			
Fitted		Worn		Motor Cyclist		Pillion Passenger	
Yes	No	Yes	No	Yes	No	Yes	No

Ambulance called by.....at.....a./p.m. Arrived.....a./p.m.....

Doctor..... Called by.....

If it is alleged that a stationary vehicle was a contributory cause of the accident though not actually involved state

Type, i.e., Private car, light goods, P.S.V., etc.....

Additional Particulars .....

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If motor goods vehicle state whether A, B or C Licence.....Give No.....Was licence displayed? Yes No

Were records of work in order? Yes No Is a Report being submitted? Yes No

HO/RT issued for Licence / Certificate / Test Certificate to be produced at.....Police Station

Part of Vehicle in collision: Head; N/Side; O/Side; Rear; None.

Damage to Vehicle.....

.....

Statement .....

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Driver's Initials.....

2nd VEHICLE

Driver or Rider: Mr., Mrs. or Miss.....

Full Postal Address (Business or Private).....

.....Badge No.....Estimated age.....

Owner .....

Full Postal Address (Business or Private).....

Reg'd. No.....Year Reg'd.....Make.....R.F. licence correct.....

If not, give particulars.....

Driver's Lic. issued at.....From.....To.....

Insurance Cert. issued by.....

No. of Certificate.....From.....To.....

Test Certificate issued on.....

Class and type of vehicle.....H.P. or C.C.....U.W.: Tons.....Cwts.....Lbs.....

Public Service Lic.....Seating capacity.....

Witnesses and statements (State whether Pedestrian, Cyclist, Passenger in Vehicle, No., etc.).....

ROUGH SKETCH OF SCENE OF ACCIDENT

(To include measurements taken or marks noted)

Mark North Point

If motor goods vehicle state whether A, B or C Licence.....Give No.....Was licence displayed? Yes / No

Were records of work in order? Yes / No Is a Report being submitted? Yes / No

HO/RT issued for Licence / Certificate / Test Certificate to be produced at.....Police Station

Part of Vehicle in collision: Head; N/Side; O/Side; Rear; None.

Damage to Vehicle.....

.....

Statement .....

.....

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.....

.....

Driver's Initials.....

1st VEHICLE

Driver or Rider: Mr., Mrs. or Miss.....

Full Postal Address (Business or Private).....

.....Badge No.....Estimated age.....

Owner .....

Full Postal Address (Business or Private).....

Reg'd. No.....Year Reg'd.....Make.....R.F. licence correct.....

If not, give particulars.....

Driver's Lic. issued at.....From.....To.....

Insurance Cert. issued by.....

No. of Certificate.....From.....To.....

Test Certificate issued on.....

Class and type of vehicle.....H.P. or C.C.....U.W.: Tons.....Cwts.....Lbs.....

Public Service Lic.....Seating capacity.....

How Accident happened (including Direction of Travel of Vehicles, and Officer's Recommendations on Action to be taken, if any).....

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.....Date forwarded.....Officer's Signature.....Rank.....No.

MINUTES

STRIKE OUT IRRELEVANT ITEMS (2)

Pedestrian Crossing
On Police Controlled Crossing
Within 50 yds. of Crossing
On Light Controlled Crossing
Within 50 yds. of Crossing
On Uncontrolled Flashing Crossing
Within 50 yds. of Crossing
On Uncontrolled Non-Flashing Crossing
Within 50 yds. of Crossing
Not on or within 50 yds.

Movement Before Accident
One Moving Vehicle only
Two Vehicles travelling in same direction
Two Vehicles travelling in opposite direction
Two Vehicles travelling along different roads
More than two Moving Vehicles
No Moving Vehicle

Type of Road
Undivided Two-way Road
Dual Carriageway
Offset/Double White Lines
Level Crossing
One-way Street

Reliability of Information
Police Visited Scene—Vehicles there/Not there
Police Visited Scene—Vehicles moved/Not moved
Scene Not Visited

Not at Junction
Curve to Right for 1st Vehicle
Curve to Left for 1st Vehicle
Blind Bend to Right for 1st Vehicle
Blind Bend to Left for 1st Vehicle
Straight
Hill Up for 1st Vehicle
Hill Down for 1st Vehicle
Hill Top or Hump Back Bridge
No Hill
Not Known

At Junction

Type
T Junction
Y Junction
Crossroads
Roundabout
Other Junction

Control
Police Controlled
Light Controlled
Halt Sign
Slow Sign
Uncontrolled

Weather
Rain or Hail
Snow or Sleet
Fog or Mist
Fine
Not Known

Speed Limit
Yes No

Traffi
Dense
Light
Very Light

Bus Stop
Yes No

Cycle Track
Yes No

Within Guard Rails
Yes No

Road Surface
Dry
Wet
Snow or Ice
Not Known

Footpath
Both Sides
One Side
None

Light
Daylight
Dark

Vehicle Action
Skidded
Did Not Skid

(1)

Day and Date.....Time

Accident.....a./p.m.

Arrived .....a./p.m.

Was it lighting up time? Yes / No

By whom reported (Name and Address).....

.....

To whom reported.....Time and date.....

Nature of accident.....Was Officer reporting a witness? Yes / No

Place.....Map Ref.....

Parish.....Local Authority.....

Classification Nos. of road(s).....Were names and addresses exchanged Yes / No

Type of road sign within 50 yards.....

WAS ANY OFFENCE COMMITTED?.....

Warning formula given to.....

Damage to other property—if any (including animals) and owners particulars.....

.....

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(14)

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DOCUMENT 11

INSTRUCTIONS

1. This book must be used to record particulars of every accident reported to the Police which involves injury to any person or injury to any animal (excluding dogs) or damage to a vehicle or other property.

2. Injured persons must be attended to first.

3. Full particulars as to how the accident happened, names and addresses, and action taken should be given under the appropriate headings, so that a complete account of the occurrence may be obtained from the notes taken.

4. When taking particulars, complete one thing at a time as far as possible, e.g. If two or more vehicles are involved, obtain all the required information relating to one before dealing with another. Allow vehicles to go as soon as dealt with to relieve obstruction.

5. Particulars or road fund licences, driving licences and certificates of insurances need not be recorded provided they are correct, except that where personal injury has been caused, full particulars of the insurance cerificate should be entered.

6. If more than two vehicles are involved, use an additional book.

7. If more than two persons are injured or if any space is insufficient, utilise the space marked "additional particulars" or the last seven lines of page 14.

8. If space is left after recording a statement, draw a pencil line to the end and initial.

9. To enable particulars of accidents to reach Headquarters not later than five days from the time of occurrence, all particulars must be promptly reported.

A. A. MUIR,
Chief Constable.

DIVISIONAL	
Letter	Number

DURHAM CONSTABULARY

ACCIDENT REPORT BOOK

OFFICER REPORTING

Name.....*Rank*..... *No*.....

Station.....

ASSISTED BY

Name.....*Rank*..... *No*.....

Station.....

DOCUMENT 12: An Accident Report Form

Form No. 246. DOCUMENT 12

FOR USE AT H.Q. ONLY.	
Stats. 19	
Recorded	

DURHAM COUNTY CONSTABULARY.

REPORT OF ROAD ACCIDENT INVOLVING INJURY TO ANY PERSON.

DIVISIONAL.	
Letter	Number

STATION DIVISION Date

Officer reporting If a witness ? Assisted by If a witness ?

By whom reported (Name and address)

To whom reported Time and date

Time, day and date of occurrence Was it lighting up time ?

Place Map reference

Nature of accident Road classification

Local Authority Code No. Parish Process report. Yes/No

Ambulance called by at Arrived at Doctor

* Strike out irrelevant items.

*Not At Junction
Curve to Right for 1st Vehicle
Curve to Left for 1st Vehicle
Blind Bend to Right for 1st Vehicle
Blind Bend to Left for 1st Vehicle
Straight
Hill Up for 1st Vehicle
Hill Down for 1st Vehicle
Hill Top or Hump Back Bridge
No Hill Not known

*At Junction	
Type	Control
T Junction	Police Controlled
Y Junction	Light Controlled
Crossroads	Halt Sign
Roundabout	Slow Sign
Other Junction	Uncontrolled

*Pedestrian Crossing
On Police Controlled Crossing
Within 50 yds of Crossing.
On Light Controlled Crossing
Within 50 yds. of Crossing
On Uncontrolled Flashing Crossing
Within 50 yds. of Crossing
On Uncontrolled Non-Flashing Crossing
Within 50 yds. of Crossing
Not on or within 50 yds.

*Movement Before Accident
One Moving Vehicle Only
Two Vehicles travelling in same direction
Two Vehicles travelling in opposite direction
Two Vehicles travelling along different roads
More than Two Moving Vehicles
No Moving Vehicle

*Reliability of Information
Police Visited Scene—Vehicles There/Not There
Police Visited Scene—Vehicles Moved/Not Moved
Scene Not Visited

*Type of Road	
Undivided Two-way Road	Level Crossing
Dual Carriageway	One-way Street

*Road Surfaces	*Footpath
Dry	Both Sides
Wet	One Side
Snow or Ice	None
Not Known	

Cause of Accident Code No.		
Primary	Secondary	Other

*Weather
Rain or Hail
Snow or Sleet
Fog or Mist
Fine
Not Known

*Traffic
Dense
Light
Very Light

*Light
Daylight
Dark

*Speed Limit	
Yes	No

*At Bus Stop	
Yes	No

*Cycle Track	
Yes	No

*Within Guard Rails	
Yes	No

*Vehicle Action
Skidded
Did Not Skid

PERSONS INJURED :—

(1) Name, age and address (Mr., Mrs., Miss)

Driver, Pedestrian, etc.

Nature of Injury (Fat. Ser. Slt.)

Conveyed to

School name and number

Statement made at time of accident

ACTIONS OF PERSONS HURT

Pedestrians

Crossing Road Masked/Not Masked by Stationary Vehicle
Crossing Road Masked by Moving Vehicle
Walking on Road With/Without Footpath Facing Traffic
Walking on Road With/Without Footpath With Back to Traffic
Standing or Playing in Road
On Footpath or Refuge
In Perambulator, etc.
Playing Under or Near Vehicle Moving off
Stepping, Walking or Running off Footpath
Unknown

Passengers

Boarding, Alighting or Falling from P.S.V. Authorised Stop
Boarding, Alighting or Falling from P.S.V. Moving or not at Authorised Stop
Sitting or Standing in P.S.V. (including on Stairs)
On Cycle, Catching Feet in Wheels
Otherwise on Cycle
Boarding, Alighting or Falling from Vehicle other than P.S.V.
On or In Vehicle other than P.S.V.
Unknown

Wearing Crash Helmet			
Motor Cyclist		Pillion Passenger	
Yes	No	Yes	No

(2) Name, age and address (Mr., Mrs., Miss)

Driver, Pedestrian, etc.

Nature of injury (Fat. Ser. Slt.)

Conveyed to

School name and number

Statement made at time of accident

ACTIONS OF PERSONS HURT

Pedestrians

Crossing Road Masked/Not Masked by Stationary Vehicle
Crossing Road Masked by Moving Vehicle
Walking on Road With/Without Footpath Facing Traffic
Walking on Road With/Without Footpath With Back to Traffic
Standing or Playing in Road
On Footpath or Refuge
In Perambulator, etc.
Playing Under or Near Vehicle Moving off
Stepping, Walking or Running off Footpath
Unknown

Passengers

Boarding, Alighting or Falling from P.S.V. Authorised Stop
Boarding, Alighting or Falling from P.S.V. Moving or not at Authorised Stop
Sitting or Standing in P.S.V. (including on Stairs)
On Cycle, Catching Feet in Wheels
Otherwise on Cycle
Boarding, Alighting or Falling from Vehicle other than P.S.V.
On or In Vehicle other than P.S.V.
Unknown

Wearing Crash Helmet			
Motor Cyclist		Pillion Passenger	
Yes	No	Yes	No

	VEHICLE PRIMARILY RESPONSIBLE.	OTHER VEHICLE.
(1)	Index number H.P. or C.C. U.W. Tons Cwt. lbs.	(1) H.P. or C.C. U.W. Tons Cwt. lbs.
(2)	Owner—name and address	(2)
(3)	Driver/rider—full name, age, address	(3)
(4)	Driver's licence Issued at Date of expiry	(4) Issued at Date of expiry
(5)	R.F.L.	(5)
(6)	Insur. Cert. By From To	(6) By From To
(7)	Class and type Make	(7) Make
(8)	Statement	(8)

Give overleaf :—How accident happened (including the recommendation of the Officer reporting) ; additional information and other recommendations.

DOCUMENT 13:- A Revised Accident Report Form

VEHICLE NO. 1

Driver/Rider: Mr./Mrs./Miss ..... Age. .....
Address .....
Injuries ..... Fat./Ser./Slt. Conveyed to .....
Owner .....
Reg.No. ..... Make ..... 1st Reg'd ..... RFL Expires .....
LICENCES ETC:— IN ORDER/PROCESS - DRIV/PSV/GOODS/T.CERT/RECORDS 'L'/PLATES/ACCOMP.
Ins. Cert. By ..... From ..... To ..... No. .....
HO/RT for Lic/Ins./Test to be produced at .....
Class & Type veh. ..... C.C. ..... UW ..... Seating Cap. .....
Artic/Caravan/Other tow. Skidded/ J.Knifed Overturned

Belts.	Dr.	F/Ns	R/Os	R/Ns	No. Passengers	Lights/Side/Head/Full/Dipped/Dim
Fitted					Front	Damaged Front/Rear/N-S/O-S/All/None
Used					Rear	Potential Write Off YES/NO

Damage (State where towed to)
.....
.....
Statement .....
.....
.....
.....
.....
.....
.....
Signature

VEHICLE NO. 2

Driver/Rider: Mr./Mrs./Miss ..... Age .....
Address .....
Injuries ..... Fat./Ser./Slt. Conveyed to .....
Owner .....
Reg. No. ..... Make ..... 1st Reg'd ..... RFL Expires .....
LICENCES ETC:— IN ORDER/PROCESS - DRIV/PSV/GOODS/T.CERT/RECORDS 'L'/PLATES/ACCOMP.
Ins. Cert. By ..... From ..... To ..... No. .....
HO/RT for Lic./Ins./Test to be produced at .....
Class & Type veh. ..... C.C. ..... UW ..... Seating Cap. .....
Artic/Caravan/Other tow. Skidded/J. Knifed Overturned

Belts.	Dr.	F/Ns	R/Os	R/Ns	No. Passengers	Lights/Side/Head/Full/Dipped/Dim
Fitted					Front	Damaged Front/Rear/N-S/O-S/All/None
Used					Rear	Potential Write Off YES/NO

Damage (State where towed to)
.....
.....
Statement .....
.....
.....
.....
.....
.....
.....
Signature

DURHAM CONSTABULARY - ACCIDENT REPORT

			Letter	No.

Time, Day & Date .....
Precise Location ..... Map Ref. .....
Nature of Accident ..... Fat./Ser./Slt./Damage.
Classification of Road ..... N/A Exchanged YES/NO. Officer Witness YES/NO.
Sign within 50 yards ..... Local Auth. ..... Code No. .....
DAYLIGHT/DARK/STREETLIGHTS LIT/UNLIT/OVER/UNDER/20FT HIGH/NONE.

SCENE VISITED/NOT VISITED VEHICLES THERE/NOT THERE/MOVED/NOT MOVED
WEATHER RAIN/SNOW/FOG/FINE
ROAD SURFACE DRY/WET/SNOW/ICE
ROAD 1-2 WAY-DUAL CARRIAGE-CLEARWAY-OTHER
LANE MARKINGS 1-2-3-4-OFFSET-DOUBLE-NONE
JUNCTION T-Y-X-MULTI ROADS-ROUNDABOUT-OTHER
CONTROL POLICE-LIGHT-STOP-GIVE WAY-NONE
PEDESTRIAN CROSSING ON/WITHIN 50 YDS OF AT/NOT AT JUNCTION
CONTROL POLICE-LIGHT-NONE
MOVEMENT 1-2-3-NONE-TRAV.-SAME-OPP.-DIRECTION ALONG SAME/DIFFERENT ROADS-STATIONARY VEHICLE INVOLVED.
SPEED LIMIT 30/40/50/60/70 **BUS STOP** YES/NO **SKIDDED** YES/NO

SPECIAL CONDITIONS AT SCENE
DOG/ANIMAL/IN CARRIAGEWAY
PARKED VEHICLE CONTRIBUTORY CAUSE
AUTOMATIC LEVEL CROSSING INVOLVED
LAMP POST/TELEGRAPH POLE HIT
OBJECT IN ROAD

PRIMARY	SECONDARY	OTHER

ACTIONS (DRIVERS) TICK OR ENDORSE COLUMNS	1	2	3
OPENING DOOR (INC. PASSENGERS)			
DISOBEYED JUNCTION CONTROL			
DISOBEYED DOUBLE CENTRE OR OFFSET LINE			
FAILED TO GIVE PRECEDENCE AT PED. CROSSING			
ENTERING OR LEAVING LAYBY E/HARD SHOULDER.			
REVERSING			
PARKED			
STOPPING			
STARTING			
TURNING - R - L - AROUND			
STATIONARY TEMPORARY			
OVERTAKING			
GOING AHEAD OTHER			
PROCESS DEFECTIVE TYRES			

ACTIONS OF PEDESTRIANS	1	2	3
CROSSING ROAD AT/WITHIN 50 YDS. OF PED. CROSSING			
CROSSING ROAD ELSEWHERE			
MASKED BY STATIONARY VEHICLE			
IN ROAD NOT CROSSING			
ON FOOTPATH/VERGE/REFUGE/CENTRE STRIP			
PASSENGER BOARDING/ALIGHTING FROM PSV			

INJURED

(1) Mr./Mrs./Miss ..... Age ..... Pass. in F-R of Veh. No. .....
Address ..... Pedestrian
Injuries ..... /Fat./Ser./Slt. Conveyed to .....
Statement .....
.....
..... Signature
(2) Mr./Mrs./Miss ..... Age ..... Pass. in F-R of Veh. No. .....
Address ..... Pedestrian
Injuries ..... Fat./Ser./Slt. Conveyed to .....
Statement .....
.....
..... Signature

WITNESSES (State whether Cyclist, ped. passenger in vehicle No.) .....
.....
.....
.....
.....
.....
.....
DAMAGE TO PROPERTY/ANIMALS .....
OWNERS .....
INFORMED YES/NO

DOCUMENT 13

INJURED

(3) Mr./Mrs./Miss. .... Age........ Pass. in F-R of Veh, No....
Address .... Pedestrian
Injuries .... Fat./Ser./Slt./ Conveyed to ....
Statement ....
....
.... Signature

ROUGH SKETCH OF SCENE OF ACCIDENT

Mark North Point *

(To include Measurements taken or marks Noted).

VEHICLE NO. 3.

Driver/Rider: Mr./Mrs./Miss. .... Age ....
Address ....
Injuries .... Fat./Ser./Slt./ Conveyed to ....
Owner ....
Reg. No. .... Make .... 1st Reg'd .... RFL Expires ....
LICENCES ETC:– IN ORDER/PROCESS - DRIV/PSV/GOODS/T.CERT./RECORDS L/PLATES ACCOMP
Ins. Cert. By .... From .... To .... No........
HO/RT for Lic./Ins./Test to be produced at ....
Class and Type veh........ C.C. .... UW .... Seating Cap. ....
Artic/Caravan/Other tow. Skidded/J. knifed Overturned

Belts.	Dr.	F/Ns	R/Os	R/Ns	No. Passengers	Lights - Side/Head/Full/Dipped/Dim
Fitted					Front	Damaged - Front/Rear/ N-S/ O-S/All / None
Used					Rear	Potential Write Off YES/NO

Damage (State where towed to)
....
....
Statement........
....
....
....
....
....
Signature

By whom reported .... Time & Date ....
Officer reporting .... Station ....
BREATH TEST – NOT/REQUIRED/REFUSED/POSITIVE/NEGATIVE
DRIVER (1) .... (2) .... (3) ....
VEHICLE DEFECTS (LOAD/TYRES/BRAKES/LIGHTS/F or R/BRAKE LIGHTS/TRAFFICATORS/VISION
VEHICLE (1) .... (2) .... (3) ....
EXAMINER .... Call Sign .... Report Requested YES/NO
If Vehicle Potential Write Off Date Form HO/TL/1 Submitted ....
Doctor Attending ....
Offences Committed ....
Warning formula to driver 1/2/3 N.I.P. Served upon Driver 1/2/3.
HOW ACCIDENT HAPPENED - (Give direction of vehicles - additional particulars, recommendation on action to be taken and Supervisory Officers Minutes). ....
....
....
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....

Date .... Chief Superintendent.

DOCUMENT 14:- A Summons Report Form

DOCUMENT 14

DURHAM CONSTABULARY

Annual Process No. .....

Court Sheet No. .....

Summons Report Form

.....Sessional Division

(Adult)
.....(Juvenile) Court held on.....

.....Section. .....DIVISION

(1) PERSON(S) REPORTED Name and address, age and occupation. Date of birth, parents or guardians names and school attending in cases of Juvenile offenders.	
(2) OFFENCE(S) (Quote Act and Section)	(Div. Crime No..... Div. Accident No. .....)
(3) Date and time of offence(s)	
(4) Place committed (Give parish)	
(5) WITNESSES.	
(6) LIST OF PROPERTY Connected with offence	
Signature and address of recipient	Witness to signature Date.....

Form No. 342 submitted .....(date)

.....Rank and No.

APPENDIX

To be used for either of the following purposes :—

1. Additional Offenders.
2. Additional Offences.

STATEMENT OF EVIDENCE

Exam'd and submitted

Sgt. .....

Date .....

Date _____ Signed _____

Rank ..... No. .....

Insp. _____

Date _____

Superintendent's Decision.

Proceedings/Caution/No Further Action.

..... 19 .....

Superintendent.

Issue & Service of Summons(es) Forms (M.C. Act, 1957)	Date issued ..... Date served ..... By whom .....
RESULT OF CASE	

DOCUMENT 15 :- A process Report Card.

DOCUMENT 15

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..... P.C. No. .....

Date / /

To: Insp.	To: Ch/Insp.	To: Supt.	To: Ch/Supt.	Decision
.....	.....	.....	.....	.....
Sgt.	Insp.	Ch/Insp.	Supt.	Ch/Supt.
/ /	/ /	/ /	/ /	/ /

FORM 55.

DURHAM CONSTABULARY REPORT FOR PROCESS.

Division ..... Station .....

Court ..... Date .....

Full name .....

Address .....

.....

Occupation ..... D.o.B. .....(Age).

If Juvenile
School Attended.....

Fathers/Guardians.....
name

Address .....

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OFFENCE .....

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Act & Section .....

Date ..... Time ..... am/pm.

Place.....

Vehicle ..... Type ..... Reg.No. .....

WITNESSES .....

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Police Vehicle Check/Radar Check

Location/Direction of Travel .....

.....

Built up Area/Not Built Up Area.

Legal Speed Limit .....

Distance Followed .....

From: .....

To: .....

Speed attained Max .....mph. Min .....mph.

Reply on Offence pointed out .....

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Verbal Warning Given/Not Given

Reply to Warning Formula .....

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Written Warning Formula Served/Sent - Not Served/Sent

Goods Vehicle - Laden/Unladen

'A' 'B' 'C' Licence Not/In Order

Traffic & Road Conditions .....

.....

Driving Licence - In Order/Not in Order

Insurance - In Order/Not in Order

Test Certificate - In Order/Not in Order

HO/RT 1 - D/L. Ins. T/C at .....

Date Radar Meter Checked .....

Date Speedometer Checked .....

Other relevant details and summary of evidence:

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