Working Paper 170
November 1983

THE EFFECTS OF WHEEL CLAMPS IN CENTRAL LONDON: RESULTS OF THE BEFORE SURVEYS

by

A D May, D A Waring and P M Weaver

CONTENTS

ABSTRACT

This report presents the results of a before study of some effects of the introduction of wheel clamps in Central London. Park and visit, vehicle following, registration number and business interview surveys were conducted in two areas of Central London: Mayfair in which wheel clamps were to be introduced, and Bloomsbury where they were not. The surveys were designed to determine the availability of parking spaces, the extent to which vehicles searched for parking spaces, the time spent doing so and gaining access to destinations, the level of through traffic, and the parking problems perceived by businesses. They were complementary to a series of surveys conducted by consultants for TRRL.

The report describes the design and piloting of the surveys, presents the results of the surveys, identifies the levels of change which it will be possible statistically to detect and makes recommendations for the after surveys. In particular it recommends that the park and visit and vehicle following surveys be repeated, and also presents arguments in favour of repeating the business survey and conducting a survey on trade.

1. INTRODUCTION

1.1 Background

In September, 1982, the T.R.R.L. awarded a contract to the Institute for Transport Studies at the University of Leeds, whose objective was the development of survey and analysis techniques to aid in determining:-

i) the costs of non-compliance with on street parking regulations;
ii) the effects of new enforcement strategies on compliance levels, and hence on the costs in (i);
iii) the cost-effectiveness of alternative enforcement strategies.

Four survey methods were developed for use as part of the before surveys for the experiment with the use of wheel clamps which were introduced in Central London on May 16th 1983. They were designed to complement the more traditional parking activity and travel time surveys conducted for T.R.R.L. by consultants. This final report describes the design and conduct of the four Institute surveys, presents their results, draws conclusions on the survey methods and for the experiment, and makes recommendations for the after survey.

1.2 The Surveys

The Institute's contract involved the conduct of four surveys, which were based on earlier proposals (May, 1982):

- a park and visit survey;
- a vehicle following survey;
- a registration number survey; and
- a business interview survey.

While the parallel surveys by consultants were designed to measure changes in level of on street parking and illegal parking activity, the Institute's surveys were intended to measure some of the first and second order effects of changes in parking activity. Table 1.1 summarises the effects which the surveys were designed to detect and the related contributions of consultants' and T.R.R.L. surveys.

It will be seen that the first three Institute surveys obtain a certain amount of common information. This was intentional, since the success of any one survey was uncertain. The survey approach enabled the different experimental survey methods to be compared with one another.

The park and visit survey was designed to measure time spent searching for parking spaces and walking from them to a final destination. In addition, it provides a measure of the need to search for parking spaces and hence of the amount of searching traffic and also provides an alternative source of journey times on a selected route. The metnod used is a development of one originally used in 1964, and was piloted in November 1982.

The vehicle following survey was designed to detect vehicles searching for parking spaces and record the time which they spent doing so. It also provides information on the amount of through traffic at certain points and an indirect measure of travel time. While the park and visit survey simulates drivers' actions, the vehicle following one records the actual behaviour of a sample of drivers. It was also piloted in November 1982.

Table 1.1 Surveys conducted and effects to be measured

SURVEY ORGANISATION	T.R.R.L./ CONSULTANTS		I.T.S.			
SURVEY METHODS	On Street Parking	Journey Time Surveys Other	Park and Visit	Vehicle Following	Reg. Number Matching	Business Interview
FIRST ORDER EFFECT						
- ON CONGESTION						
Parked vehicles	✓					
Searching traffic			(✓)	✓	✓	
Overall effect		✓	(✓)	(✓)	(✓)	
- ON EASE OF ACCESS						
Time searching			✓	✓	✓	
Time walking			✓			
Perceived costs						✓
Available parking spaces	✓		✓			
- ON ACCIDENTS		✓				
- ON ENVIRONMENT	✓					
SECOND ORDER EFFECT						
Fringe parking	✓					
Off street parking		✓				
Through traffic				✓	(✓)	
Business effects						✓

Key: ✓ Major source of information
(✓) Minor source of information

All four surveys have been conducted in two areas: Mayfair, in which wheel clamps were to be used from 16th May, 1983, and Bloomsbury on the fringe of, but outside the intended area of application. The areas are consistent with those used by the consultants for their journey time surveys, and were two of the areas employed for their parking surveys.

1.3 Outline of the Report

Section 2 of this report describes the methods adopted for the four Institute surveys. Section 3 presents results of the surveys and section 4 discusses the implications of these results for the experiment and for the 'after' survey. Section 5 presents the recommendations for the Institute's 'after' surveys.

2. SURVEY METHODS

2.1 Park and Visit Surveys

Development of the survey method. The basis of the park and visit survey was a method developed by Inwood (1966) to test the effect of meter charge increases in Central London on access time. He selected 31 destinations throughout Central London distributed among areas with and without meter charge increases. Each address was visited 10 times (at unspecified times) and the times taken to find a vacant meter, park the car, walk back and then extract the car were recorded. The search process was 'determined very largely by the restriction of movement to available one-way streets leading to the nearest known meter space, examined in order of their nearness to the address visited'.

Inwood's method was considered to depend too much on the driver's prior knowledge, or knowledge gained during the survey, of potential parking spaces. While the learning process during the survey could be taken to replicate the different degrees of knowledge of parking opportunities (from first time visitor to regular traveller) of Central London parkers it would be difficult to determine how this learning process developed, and differences in the process between before and after surveys could mask real differences in ease of finding spaces. For these reasons a predetermined and fixed survey routing was to be preferred.

On the other hand a driver following a fixed route could be forced to miss readily available spaces, thus exaggerating the problems of finding a parking space, and differences in the allocation of available spaces between streets on and off the route could mask real differences in ease of finding spaces.

In practice a fixed, part 'random' search process was used which combined the best features of both methods. The method developed was piloted in November 1982 and used, with minor modifications, for the main surveys in February 1983.

The method adopted

Four addresses were selected to be visited within the survey area and evenly distributed within it. The locations of the addresses are shown in Appendix 1. Four start points on the periphery of the survey area were selected and each start point was associated arbitrarily with one of the addresses. The locations of the start points are shown in Appendix 1.

Starting from the first start point a route was chosen from the start point to the associated address that would be sensible for a driver seeking somewhere to park. This procedure was repeated for all start points and addresses.

A route was devised to link each address to the next start point shuch that a full tour of four addresses from their corresponding start points, together with the connecting links gave a comprehensive fixed circuit of the survey area. The fixed routes followed on one complete circuit are shown in Appendix 1. Following the fixed route from start point to address, address to next start point, etc., the locations and times of passing every vacant meter space were recorded on a map.

On reaching the address the time was noted. Then the driver used his own initiative and knowledge of the area to search for:

i) the nearest conceivable parking space. This is the sort of parking place that a person might be tempted to use if he or she were only making a call of a minute or two. It was the nearest vacant length of kerb to the address. Double parking was allowed if this was already taking place along this length of road.

ii) the nearest reasonable illegal space. This is the sort of parking place that a person might be tempted to use if he or she were making a longer call and prepared to risk parking illegally. It was the nearest vacant length of single yellow line, a diplomatic space, a disabled driver's space or a resident's space.

iii) the nearest available legal meter space.

The route taken, the time at which each type of space was found and its location were recorded. Up to 5 minutes was allowed after reaching the address to find a meter. In the pilot study 15 minutes had been allowed; this was reduced to 5 minutes when it became clear that this would substantially reduce survey time without significantly reducing the information gained. Having found a legal meter space, (or 5 minutes having elapsed, whichever was the sooner), the survey unit returned to the address in question and continued along a fixed route to the next start point. The procedure was repeated until all the addresses had been visited.

The anticipated start time of each complete circuit was determined according to a timetable to endeavour to ensure that the same stretch of road was surveyed at approximately the same times each day. Circuits were scheduled to start at the following times:

Circuit number	Start time	Comment
1	07.30	Not Monday 21st
2	08.50	Each survey day
3	10.40	Each survey day
4	13.00	Each survey day
5	14.20	Each survey day
6	16.10	Each survey day

The duration of the survey in both Mayfair and Bloomsbury was from Tuesday, 15th February until Thursday 24th February 1983 excluding the weekend. Training of survey staff took place on Monday 16th February.

Two self drive cars were hired of types likely to be still available for hire for the next two years or so. Three survey staff manned each car as driver, travel time recorder and recorder of available parking space.

2.2 Vehicle Following Surveys

Development of the survey method The vehicle following surveys were based on a method developed by Wright (1976) to study routes, origins and destinations in complex road networks. He used London taxis to follow selected vehicles from an initial detection point to their destination or to the point at which they left the study area. In his experience in the City of Westminster, taxi drivers were the only group who could be relied upon to carry out such a task reliably and safely, achieving a 94% success rate in keeping track of target vehicles.

In Wright's study sampling of target vehicles was a substantial problem, since vehicles of interest could be starting within the area or entering it and terminating within it or leaving it. In the present study, with much smaller study areas, and the emphasis on terminating traffic, sampling was somewhat easier. By using small areas, vehicles both starting and finishing in the area could be ignored, since they would be expected to represent a small part of the total terminating traffic. By defining areas within the network of main roads most of the parking search process of interest could be recorded, while keeping the proportion of through vehicles which were of less interest to the study to a minimum.

The major sampling problems then became selection of entry points and of vehicles to be followed. With the help of the November pilot surveys, a technique was adopted in which minor entry points were selected to reduce the coverage of through traffic. In each area three entry points covering different directions of entry were used to obtain a reasonable coverage of the area while maintaining a high sample at each entry. At each entry point vehicles were sampled from different approach directions to avoid bias in favour of any one destination area (for example vehicles from the north at the western entry not searching in the north-west corner).

The method adopted An ordinary black London taxi, registered as a Hackney carriage, was hired on a fixed charge basis for a three hour survey period twice daily from Tuesday, 15th February until Thursday 24th Februrary excluding the weekend. The survey times and locations were as follows:

Date	Location	Times
Tues 15th	Mayfair	09.30 - 12.30, 14.30 - 17.30
Wed 16th	Bloomsbury	09.30 - 12.30, 14.30 - 17.30
Thurs 17th	Mayfair	07.30 - 10.30, 12.30 - 15.30
Fri 18th	Bloomsbury	07.30 - 10.30, 12.30 - 15.30
Mon 21st	Mayfair	09.30 - 12.30, 14.30 - 17.30
Tues 22nd	Bloomsbury	09.30 - 12.30, 14.30 - 17.30
Wed 23rd	Mayfair	07.30 - 10.30, 12.30 - 15.30
Thurs 24th	Bloomsbury	07.30 - 10.30, 12.30 - 15.30

The boundaries of the two survey areas are shown on the maps in Appendix 2. The inner boundary marked the entry points to the specified area. Three of these were chosen as survey starting points on local roads where most of the traffic was assumed to be seeking a parking place. The outer boundary marked the limit of the area within which a car was followed. If a car crossed the outer boundary it was assumed to be leaving the survey area and unlikely to re-enter the area in the course of the same journey.

From a given starting point, a car was selected. If traffic flow was light, the first car that came along, from a given direction, was followed. If the traffic flow was heavy a car in the traffic stream was chosen such that the taxi could join the traffic stream immediately behind the car to be followed.

The time of the start of the run was noted together with details of the weather, the country of registration of the car, and the sex of the driver. The car was followed. The time at which the car being followed passed every convenient junction was recorded using a CASIO CP 10 pocket calculator that printed the time in hours, minutes and seconds onto a paper printout. Also recorded on a map of the survey area was the following information:

i) the exact route being taken;
ii) the exact location of all the points at which the time was being recorded.

The run ended when one of the following events occurred:

i) the car stopped adjacent to the kerb and a passenger alighted or was picked up;
ii) the car parked at an on-street or off-street location and the driver left the car;
iii) contact with the car being followed was irretrievably lost;
iv) the car crossed the outer boundary as defined in 2.2.2 and left the survey area.

At the end of the run the time and location of the end of the run were noted and, if the car was waiting at the kerb or had been parked it was further noted whether the car was:

i) at a parking meter;
ii) on yellow lines;
iii) at a residents' space;
iv) at a disabled persons' space;
v) off street.

At the end of the run the taxi proceeded to the next starting point.

The starting point for each run was chosen such that as little time as possible was taken in driving to the next starting point, while ensuring that at the end of each survey day an equal number of runs had started from each survey point.

2.3 Registration Number Survey

A registration number survey was carried out in Mayfair and Bloomsbury from Monday 11th October until Thursday 14th October 1982 inclusive. The survey times and locations were as follows:

Date	Location	Times
Mon 11th	Mayfair	08.00 - 09.30, 10.00 - 12.00, 13.00 - 15.00, 15.30 - 17.00
Tues 12th	Mayfair	08.00 - 10.00, 10.30 - 13.00, 14.00 - 16.00, 16.30 - 18.00
Wed 13th	Bloomsbury	08.00 - 09.30, 10.00 - 12.00, 13.00 - 15.00, 15.30 - 18.00
Thurs 14th	Bloomsbury	08.00 - 10.00, 10.30 - 13.00, 14.00 - 16.00, 16.30 - 18.00

Training of survey staff took place on Friday, 8th October. The areas of Mayfair and Bloomsbury covered by these surveys are shown in Appendix 3.

At each junction within the survey area an observer (or at busy junctions two observers) recorded the right hand part of a normal British registration on a survey sheet in a column appropriate to the turning movement that the car was making.

Foreign, diplomatic and other unusual registration numbers were recorded in full. The time, at one minute intervals, was also recorded on the survey sheets.

The junctions in Mayfair and Bloomsbury at which data was collected are shown in Appendix 3. Also shown are the turning movements at the junctions by which the data was classified on the survey data sheets. An attempt was made to obtain as comprehensive a pattern of turning movements as possible within the survey budget. Those turning movements omitted were ones which could be determined from data at adjacent junctions and those on roads peripheral to the area.

2.4 Business Interview Survey

In assessing the effectiveness of different enforcement strategies and evaluating benefits and disbenefits it is clearly important to take account of effects on business. With this in mind the survey was intended to collect data to determine the effects on business of the present parking situation and to act as a before study for an assessment of the effects on businesses of wheel clamps, a basis for the design of appropriate after surveys and as an input to the assessment of any subsequent enforcement changes. Based on previous experience with business surveys (Patterson and May, 1981) it was proposed that interviews be conducted both with firms in the study areas and with their suppliers to obtain perceptions of parking problems, resulting impacts on business operations and, in the event of an after survey, agreement to provide retrospective trade statistics, using a technique developed in Leeds (May and Weaver, 1981).

A questionnaire (Appendix 4) was drawn up to solicit information from shops and businesses on the problems affecting business operations, the significance of any transport or traffic

problems and whether these include problems associated with the parking situation both in general and on-street. The questionnaire also asked for precise details about any problems with on-street parking and sought opinions about stricter enforcement of on-street parking regulations, whether this would be a good a bad thing and whether it was believed that stricter enforcement of regulations would affect trade. A slightly modified questionnaire (Appendix 5) was drawn up to solicit comparable information from suppliers but on the transport or traffic problems associated with making deliveries.

Interviewing, at shops and businesses within Bloomsbury and Mayfair, using two experienced professional interviewers, took place during the two week period commencing April 18 and with their suppliers during the first fortnight in May. The late timing of the surveys did not appear to pose any problems since no-one interviewed seemed particularly aware of the then imminent introduction of wheel clamps. However, the timing does have implications for any after surveys which ought ideally to be carried out during the same period next year if any seasonal effects are to be minimised.

3. SURVEY ANALYSIS AND RESULTS

3.1 Park and Visit Surveys

The Surveys The Park and Visit Surveys were carried out from Tuesday 15th February 1983 until Thursday 24th February 1983 excluding the weekend. The extent to which the runs were able to keep to the pre-arranged timetable is shown in Table 3.1. Timekeeping was better in Bloomsbury than in Mayfair because the average run time was less in Bloomsbury which gave more recovery time at the end of each completed circuit.

No real problems were encountered in the running of the survey except for a road closure in Montague Street, on the last two days, caused by a burst water main. The route was diverted via Bedford Place and an alternative address chosen in Bedford Place corresponding to the location of the address in Montague Street which could no longer be reached by car.

More resources should have been devoted to the supervision of the survey. On 10 occasions out of 376 (less than 3%) the random search route was left unrecorded by the survey team. It is felt in retrospect that one person should have been in overall supervision of the survey to check the completed data sheets during the course of the survey, and to carry out spot random checks.

Table 3.1 Park and Visit Surveys - Mayfair

Comparison of actual start times with scheduled start times

Circuit No.	Scheduled start time	Actual start time T	W	Th	F	M	T	W	Th
1	7.30	7 49	7 36	7 38	7 39	-	7 37	7 40	7 54
2	8 50	8 57	8 35	8 43	8 43	8 54	8 34	8 36	8 38
3	10 40	10 45	10 41	10 36	10 26	10 32	10 35	10 25	10 32
4	13 00	13 17	13 07	12 53	12 57	12 55	13 06	12 52	12 49
5	14 20	15 17	14 46	14 29	14 21	14 28	14 37	14 12	14 19
6	16 10	-	16 38	16 17	15 53	16 04	16 00	16 01	16 05

Park and Visit Surveys - Bloomsbury

Comparison of actual start times with scheduled start times

Circuit No.	Scheduled start time	Actual start time T	W	Th	F	M	T	W	Th
1	7 30	7 31	7 29	7 29	7 30	-	7 30	7 31	7 35
2	8 50	8 29	8 42	8 49	8 48	8 50	8 50	8 50	8 50
3	10 40	10 40	10 48	10 38	10 39	10 40	10 39	10 40	10 39
4	13 00	13 00	13 01	12 59	13 00	13 00	13 00	12 59	13 00
5	14 20	14 19	14 20	14 20	14 20	14 19	14 20	14 20	14 20
6	16 10	16 10	16 08	16 10	16 10	16 10	16 10	16 09	16 10

The random search process Each complete Park and Visit circuit comprises 4 random search sections and 3 fixed route sections. For the purposes of analysis the random search sections and the fixed route sections have been treated separately. The random search section of the survey gives information on the route chosen and time taken to find a first "conceivable" space, a first "reasonable" space, and a meter space within a 5 minute search time limit. The definitions of a "conceivable" space and a "reasonable" space are to be found in Section 2.1. From this data, and using 1:1250 Ordinance Survey sheets it was possible to estimate the walking time from parking place to address, assuming an average speed of 4.5 km/h.

It was almost always the case that the first "conceivable" space was to be found immediately outside the address to be visited. This could involve double parking if this was already taking place in the street concerned.

The amount of time taken per circuit to find the first "reasonable" illegal space at each of the addresses on each of the survey days has been tabulated. For Mayfair this information can be found in Table 3.2, and for Bloomsbury in Table 3.3. It was almost always the case that a "reasonable" illegal space could be found immediately outside the address to be visited. This happened in 82% of the occasions in Mayfair, and in 91% of occasions in Bloomsbury. The occasions when a "reasonable" illegal space had to be searched for tended to occur more frequently in the early days of the survey. It may well be that there was a learning effect and that a subconscious change took place in the perception of what was considered to be a "reasonable" illegal space.

Table 3.2 Park and Visit Surveys - Mayfair

Random search time to 1st reasonable space in seconds by circuit number and survey day

	Survey day							
Circuit No.	T	W	Th	F	M	T	W	Th
1	0	0	0	0	-	0	0	0
2	0	0	24	0	0	17	0	0
3	40	0	0	0	0	0	0	0
4	0	0	0	11	0	0	0	0
5	104	48	84	0	0	0	15	0
6	-	-	0	0	0	0	0	0

Table 3.3 Park and Visit Surveys - Bloomsbury

Random search time to 1st reasonable space in seconds by circuit number and survey day

Circuit No.	T	W	Th	F	M	T	W	Th
	0	0	0	0	-	0	0	0
2	0	0	0	0	0	0	0	0
3	64	0	0	0	0	0	0	0
4	0	55	0	0	0	0	0	0
5	130	0	0	0	0	0	0	0
6	33	0	0	0	0	0	0	0

Note: Blank cells indicate circuits not run on that day.

The information on random search times of meter spaces, walking times (when a space could be found), and the combined random search and walking times have been tabulated. For Mayfair this can be found in Table 3.4, 3.5 and 3.6 and for Bloomsbury in Tables 3.7, 3.8 and 3.9. In Mayfair it was easy to find a vacant meter before 9 a.m. It then became very difficult until about 4 p.m. In Bloomsbury conditions were very similar except that it did not become difficult until about 10 a.m. Random search times were lower in Bloomsbury than in Mayfair.

When meter spaces were readily available, proximity of meters inevitably had the greatest effect on search time. In these conditions, search times in Mayfair were lowest in Grosvenor Square and highest in South Street. Grosvenor Street and Grosvenor Square were the two most difficult addresses at which to find a space in terms of occasions when no space could be found within 5 minutes. South Street had the highest walking time and Grosvenor Square the lowest. South Street also had the highest random search plus walking times, the highest being 792 seconds.

In Bloomsbury the easiest address at which to park was Cartwright Gardens, where a meter space could always be found within a short random search time. The other three addresses in Bloomsbury had similar, much higher, maximum walking times and there were a number of occasions when a meter space could not be found at all within the 5 minute period. The highest random search plus walking time was 692 seconds, over 11 minutes, in Great Ormond Street.

Table 3.4 Park and Visit Surveys - Mayfair

Random search time in seconds to find a vacant meter space by address, circuit number and survey day

Circuit No.	T	W	Th	F	M	T	W	Th
1 GROSV SQ	0	0	0	0	-	0	0	0
SOUTH ST	51	43	45	36	-	30	26	36
BERK SQ	0	0	0	0	-	0	0	0
GROSV ST	67	0	0	0	-	0	14	0
2 GROSV SQ	0	0	0	0		0	0	0
SOUTH ST	133	102	186	144	114	50	87	N/S
BERK SQ	0	280	296	30	115	123	0	65
GROSV ST	56	298	N/S	280	51	N/S	178	N/S
3 GROSV SQ	N/S	N/S	N/S	N/S	47	N/S	N/S	N/S
SOUTH ST	N/S	N/S	257	165	121	282	N/S	164
BERK SQ	93	170	0	N/S	190	N/S	N/S	139
GROSV ST	N/S	99	233	196	N/S	N/S	N/S	N/S
4 GROSV SQ	N/S	N/S	122	165	N/S	N/S	0	121
SOUTH ST	179	N/S	N/S	N/S	N/S	253	282	276
BERK SQ	N/S	N/S	N/S	64	N/S	182	N/S	N/S
GROSV ST	N/S	N/S	N/S	N/S	N/S	146	N/S	229
5 GROSV SQ	31	N/S	N/S	92	N/S	129	N/S	N/S
SOUTH ST	184	N/S	87	100	93	84	N/S	N/S
BERK SQ	260	N/S	140	63	50	38	124	N/S
GROSV ST	-	N/S	167	25	0	18	N/S	22
6 GROSV SQ	-	52	36	38	196	78	0	54
SOUTH ST	-	194	N/S	103	86	81	103	N/S
BERK SQ	-	195	180	54	43	204	0	50
GROSV ST	-	-	31	80	38	23	186	125

N/S No space found after 5 mins of Random Search

Table 3.5 Park and Visit Surveys - Mayfair

Time to walk from meter space to address (in secs)

	Survey day							
Circuit no.	T	W	Th	F	M	T	W	Th
1 GROSV SQ	0	0	0	0	-	0	0	0
SOUTH ST	71	120	90	15	-	94	83	86
BERK SQ	0	0	0	0	-	0	0	0
GROSV ST	23	0	0	0	-	0	0	0
2 GROSV SQ	0	0	0	0	0	0	0	0
SOUTH ST	98	90	75	210	120	105	116	N/S
BERK SQ	0	255	180	90	150	128	0	150
GROSV ST	218	146	N/S	338	30	N/S	413	N/S
3 GROSV SQ	N/S	N/S	N/S	N/S	202	N/S	N/S	N/S
SOUTH ST	N/S	N/S	90	210	255	139	N/S	38
BERK SQ	116	150	0	N/S	158	N/S	N/S	161
GROSV ST	N/S	199	416	484	N/S	N/S	N/S	N/S
4 GROSV SQ	N/S	N/S	127	270	N/S	N/S	0	82
SOUTH ST	236	N/S	N/S	N/S	N/S	173	510	413
BERK SQ	N/S	N/S	N/S	146	N/S	191	N/S	N/S
GROSV ST	N/S	N/S	N/S	N/S	N/S	296	N/S	368
5 GROSV SQ	23	N/S	N/S	157	N/S	217	N/S	N/S
SOUTH ST	116	N/S	120	247	225	143	N/S	N/S
BERK SQ	165	N/S	311	180	116	64	169	N/S
GROSV ST	-	N/S	143	60	0	184	N/S	23
6 GROSV SQ	-	157	135	165	90	105	0	45
SOUTH ST	-	142	N/S	202	120	225	251	N/S
BERK SQ	-	266	90	173	71	154	0	169
GROSV ST	-	-	105	165	101	49	270	270

NOTE: N/S No space found after 5 mins random search

Table 3.6 Park and Visit Surveys - Mayfair

Random Search Plus Walking Times by Address, Circuit Number and Survey Day (Seconds)

Circuit no.	T	W	Th	F	M	T	W	Th
1 GROSV SQ	0	0	0	0	-	0	0	0
SOUTH ST	122	163	135	51	-	124	109	122
BERK SQ	0	0	0	0	-	0	0	0
GROSV ST	90	0	0	0	-	0	37	0
2 GROSV SQ	0	0	0	0	0	0	0	0
SOUTH ST	231	192	261	354	234	155	203	N/S
BERK SQ	0	535	476	120	265	251	0	215
GROSV ST	274	444	N/S	618	81	N/S	591	N/S
3 GROSV SQ	N/S	N/S	N/S	N/S	249	N/S	N/S	N/S
SOUTH ST	N/S	N/S	347	375	376	421	N/S	202
BERK SQ	209	320	0	N/S	348	N/S	N/S	300
GROSV ST	N/S	298	649	680	N/S	N/S	N/S	N/S
4 GROSV SQ	N/S	N/S	249	435	N/S	N/S	0	203
SOUTH ST	415	N/S	N/S	N/S	N/S	426	792	689
BERK SQ	N/S	N/S	N/S	210	N/S	373	N/S	N/S
GROSV ST	N/S	N/S	N/S	N/S	N/S	442	N/S	597
5 GROSV SQ	54	N/S	N/S	249	N/S	346	N/S	N/S
SOUTH ST	300	N/S	207	347	348	227	N/S	N/S
BERK SQ	425	N/S	451	243	166	102	293	N/S
GROSV ST	-	N/S	310	85	0	202	N/S	45
6 GROSV SQ	-	209	171	203	286	183	0	99
SOUTH ST	-	336	N/S	305	206	306	354	N/S
BERK SQ	-	461	270	227	114	358	0	219
GROSV ST	-	-	136	245	139	72	456	395

NOTE: N/S no space found within 5 minutes random search.

Table 3.7 Park and Visit Surveys - Bloomsbury

Random search time in seconds to find a vacant meter space by address, circuit number and survey day

	Survey day							
Circuit no.	T	W	Th	F	M	T	W	Th
1 GT ORM ST	0	0	0	0	-	0	0	0
MALET ST	0	0	0	0	-	0	0	0
CART GDNS	85	64	63	40	-	71	54	48
MONTAGUE ST	62		42	24	-	103	23	37
2 GT ORM ST	0		0	14	0	14	0	0
MALET ST	0		0	0	0	0	0	0
CART GDS	82	50	57	54	69	36	51	57
MONTAGUE ST	148		119	115	20	10	154	26
3 GT ORM ST	N/S	N/S	N/S	N/S	239	259	105	167
MALET ST	194	109	66	45	189	0	70	231
CART GDNS	58	77	68	42	49	43	82	45
MONTAGUE ST	30	N/S	25	218	138	269	N/S	193
4 GT ORM ST	202	37	91	N/S	108	N/S	121	243
MALET ST	181	N/S	N/S	90	193	209	N/S	288
CART GRDNS	63	69	39	52	39	64	51	76
MONTAGUE ST	220	N/S	N/S	136	N/S	0	100	N/S
5 GT ORN ST	79	154	272	42	N/S	54	100	235
MALET ST	N/S	78	173	73	134	N/S	N/S	N/S
CART GRDNS	46	53	46	60	56	180	40	51
MONTAGUE ST	30	202	14	99	135	120	N/S	130
6 GT ORM ST	23	N/S	152	27	0	37	23	-
MALET ST	0	196	0	91	64	74	0	-
CART GRDNS	48	80	42	64	45	52	36	-
MONTAGUE ST	99	257	146	182	90	75	66	-

NOTE: N/S no space found after 5 mins. of Random Search.

Table 3.8 Park and Visit Surveys - Bloomsbury

Time to walk from meter space to address (in secs)

	Survey day							
Circuit no.	T	W	Th	F	M	T	W	Th
1 GT ORM ST	0	0	0	0	-	0	0	0
MALET ST	0	0	0	0	-	0	0	0
CART GDNS	128	N/R	128	128	-	128	128	128
MONT ST	49	0	N/R	N/R	-	98	N/R	105
2 GT ORM ST	0	0	0	60	0	15	0	0
MALET ST	0	0	0	0	0	0	0	0
CART GDNS	120	143	128	128	120	120	128	128
MONT ST	109	0	60	248	N/R	N/R	135	113
3 GT ORM ST	N/S	N/S	N/S	N/S	150	397	292	270
MALET ST	38	240	184	23	116	0	64	330
CART GDNS	128	N/R	128	120	128	128	120	120
MONT ST	38	N/S	146	180	158	255	N/S	315
4 GT ORM ST	371	105	412	N/S	382	N/S	412	285
MALET ST	53	N/S	N/S	64	64	413	N/S	56
CART GDNS	128	128	120	128	68	98	128	128
MONT ST	233	N/S	N/S	195	N/S	0	285	N/S
5 GT ORM ST	N/R	450	420	153	N/S	135	390	228
MALET ST	N/S	56	270	173	71	N/S	N/S	N/S
CART GDNS	128	120	N/R	90	128	53	128	128
MONT ST	38	180	N/R	124	315	150	N/S	105
6 GT ORM ST	173	N/S	405	82	0	135	82	-
MALET ST	0	225	0	150	30	71	0	-
CART GDNS	120	113	120	128	128	128	128	-
MONT ST	N/R	195	300	270	105	60	225	-

NOTES: N/S no space found after 5 mins Random Search
N/R location of meter space not recorded.

Table 3.9 Park and Visit Surveys - Bloomsbury

Random search time plus walking time in seconds for each occasion when a meter could be found by address, circuit number and survey day

Circuit no.	T	W	Th	F	M	T	W	Th
1 GT ORM ST	0	0	0	0	-	0	0	0
MALET ST	0	0	0	0	-	0	0	0
CART GDNS	213	N/R	191	168	-	199	182	176
MONT ST	111	0	N/R	N/R	-	201	N/R	142
2 GT ORM ST	0	0	0	74	0	29	0	0
MALET ST	0	0	0	0	0	0	0	0
CART GDNS	202	193	185	182	189	156	179	185
MONT ST	257	0	179	363	N/R	N/R	289	139
3 GT ORM ST	N/S	N/S	N/S	N/S	389	656	397	437
MALET ST	232	349	250	68	305	0	134	561
CART GDNS	186	N/R	196	162	177	171	202	165
MONT ST	68	N/S	171	398	296	524	N/S	508
4 GT ORM ST	573	142	503	N/S	490	N/S	533	528
MALET ST	234	N/S	N/S	154	257	622	N/S	344
CART GDNS	191	197	159	180	107	162	179	204
MONT ST	253	N/S	N/S	331	N/S	0	385	N/S
5 GT ORM ST	N/R	604	692	195	N/S	189	490	463
MALET ST	N/S	134	443	246	205	N/S	N/S	N/S
CART GDNS	174	173	N/R	150	184	233	168	179
MONT ST	68	382	N/R	223	450	270	N/S	235
6 GT ORM ST	196	N/S	557	109	0	172	105	-
MALET ST	0	421	0	241	94	145	0	-
CART GDNS	168	193	162	192	173	180	164	-
MONT ST	N/R	452	446	452	195	135	291	-

NOTE: N/S no meter space found during 5 mins of random search

N/R location of meter space not recorded

The 'random' search process, in which the driver was free to select his own route to search for a parking space, was recorded on maps.

Appendix 6 indicates all the roads used in this process, and provides examples of the different routes used on one day for one Bloomsbury address (Gt. Ormond Street) and on all eight days for one Mayfair address (South Street). These indicate the ways in which the one way street system limits the search area; in two corners of each area none of the roads was searched. They also suggest, however, that the effect of the learning process on search routes and search times is probably unimportant.

Statistical analysis of search times. The data are complicated by the five minute cut-off. A simple statistic which avoids this problem is the percentage of occasions on which a vacant meter space could be found within the 5 minute period allowed. For Mayfair this information can be found in Table 3.10, and for Bloomsbury in Table 3.11. These results are discussed first.

In Mayfair there were 55 occasions out of 183 (30%) when no vacant meter space could be found within 5 minutes. For Bloomsbury there were 22 occasions out of 186 (12%). In Mayfair it was always possible to find a meter space at every address on the first circuit. There was considerable variation with the time of day but little variation between addresses. In Bloomsbury it was always possible to find a space on the first two circuits of the day, and at any time of the day in Cartwright Gardens. At other times of the day there was little variation for the other three addresses.

In Mayfair the percentage of occasions when a meter space was found would have to change by 9.4% for it to be significant (Table 3.10). In Bloomsbury (Table 3.11) a change of 6.8% would be required. Any change at all during the first circuit of the

day would be significant in both areas. These tables also show the confidence limits and minimum significant differences in percentages for all the addresses and all the circuits.*

Footnote*: This and subsequent assessments are based on the need to detect differences which are significant at the 95% confidence level. Their derivation is set out in Appendix 7.

Table 3.10 Park and Visit Surveys - Mayfair

Percentage of occasions on which a meter space could be found within five minutes by circuit number and by address visited.

Circuit Number		Address visited: Grosvenor Square	South Street	Berkeley Square	Grosvenor Street	All Addresses
1	mean	100.0	100.0	100.0	100.0	100.0
	clm					(+-0.0)
	msd					(+-0.0)
		7	7	7	7	28
2	mean	100.0	87.5	100.0	62.5	87.5
	clm					(+-11.7)
	msd					(+-16.5)
		8	8	8	8	32
3	mean	12.5	62.5	62.5	62.5	56.3
	clm					(+-17.5)
	msd					(+-24.8)
		8	8	8	8	32
4	mean	50.0	50.0	25.0	25.0	37.59
	clm					(+-17.1)
	msd					(+-24.2)
		8	8	8	8	32
5	mean	37.5	62.5	75.0	75.0	62.5
	clm					(+-17.1)
	msd					(+-24.2)
		8	8	8	8	32
6	mean	100.0	71.4	100.0	100.0	92.6
	clm					(+-10.1)
	msd					(+-14.2)
		7	7	7	6	27
All Circuits	mean	65.2	71.7	76.1	64.4	69.4
	clm	(+-14.0)	(+-13.3)	(+-12.5)	(+-14.3)	(+-6.6)
	msd	(+-19.9)	(+-18.8)	(+-17.8)	(+-14.3)	(+-20.2)
		46	46	46	45	183

Notes:

1) Top figure: Mean of observed values
2) Upper figure in brackets: Confidence limits for observed mean value
3) Lower figure in brackets: Minimum significant difference of mean value
4) Bottom figure: Sample size

Table 3.11 Park and Visit Surveys - Bloomsbury

Percentage of occasions on which a meter space could be found within five minutes by circuit number and by address visited.

Circuit Number		Address visited: Gt Ormond Street	Malet Street	Cartwright Gardens	Montague Street	All Addresses
1	mean	100.0	100.0	100.0	100.0	100.0
	clm					(+-0.0)
	msd					(+-0.0)
		7	7	7	7	28
2	mean	100.0	100.0	100.0	100.0	100.0
	clm					(+-0.0)
	msd					(+-0.0)
		8	8	8	8	32
3	mean	50.0	100.0	100.0	75.0	81.3
	clm					(+-13.8)
	msd					(+-19.5)
		8	8	8	8	32
4	mean	75.0	62.5	100.0	50.0	71.9
	clm					(+-15.9)
	msd					(+-22.5)
		8	8	8	8	32
5	mean	87.5	50.0	100.0	87.5	81.3
	clm					(+-13.8)
	msd					(+-19.5)
		8	8	8	8	32
6	mean	85.7	100.0	100.0	100.0	96.4
	clm					(+-7.0)
	msd					(+-10.0)
		7	7	7	7	28
All Circuits	mean	82.6	84.8	100.0	86.7	88.0
	clm	(+-11.2)	(+-10.6)	(+-0.0)	(+-10.0)	(+-4.8)
	msd	(+-15.8)	(+-15.0)	(+-0.0)	(+-14.2)	(+-6.8)
		46	46	46	46	184

Notes:

1) Top figure: Mean of observed values
2) Upper figure in brackets: Confidence limits for observed mean value
3) Lower figure in brackets: Minimum significant difference of mean value
4) Bottom figure: Sample size

Further inspection of the search times indicated that it appeared to be negative exponentially distributed. This provided a basis for estimating the mean search time for all runs, which is described fully in Appendix 8. In brief the method involved determining the lower and upper tertiles of the distributions from the data, extrapolating slightly where the upper tertiles exceeded the 300 second cut off, and calculating an estimated mean using the characteristics of the negative exponential distribution. Because certain circuits, particularly in Mayfair, had large numbers of abandoned searches, this method could not be applied to each circuit at each address. Instead all the results for each address were combined.

Table 3.12 presents the results for the means for the eight sites, and for the combined sites in Mayfair and Bloomsbury, together with 95% confidence limits on these estimates and minimum detectable significant differences. The confidence limits and minimum significant differences were calculated as described in Appendix 7. In analysing the results for individual sites, it was clear that data for Cartwright Gardens did not have a negative exponential distribution; it has therefore been omitted from the estimated mean for Bloomsbury as a whole.

There is no significant difference between the values for the Mayfair sites, while it is clear that in Bloomsbury Cartwright Gardens is significantly different from the others. For Mayfair as a whole, the mean search time of $5\frac{1}{2}$ minutes is noticeably higher than the 3 minute mean for Bloomsbury. This difference is significant at the 95% confidence level. The minimum significant differences for the individual sites are little smaller than the means. For Mayfair as a whole it is about 45% of the mean, and would be about 30% of the mean at the 90% confidence level. For Bloomsbury the comparable percentages are 50% and 35%.

A similar analysis was conducted of the combined search and walk times. This analysis is slightly more suspect, because it is possible to combine a long search time with a short walk time, if the meter is finally found close to the destination. This could result in missing values, because of the 5 minute cut-off, which are lower than some

Table 3.12 Estimated Mean Search Times, Confidence Limits and MSDs

Mayfair and Bloomsbury (Predicted Values)

Address	Mean Search time (secs)	95% Confidence limit (secs)	Minimum significant difference (secs)
(a) Mayfair			
Grosvenor Sq.	205	±130	85
South St.	216	±137	90
Berkeley Sq.	222	±141	92
Grosvenor St.	313	±201	131
All sites	310	± 99	63
(b) Bloomsbury			
Gt. Ormond St.	199	±126	83
Malet St.	165	±105	69
Cartwright†	(29)	±(18)	(12)
Montague St.	147	± 93	61
All sites*	193	± 61	40

* Except Cartwright Gardens

† Not negative exponentially distributed

Table 3.13 Estimated Mean Search Plus Walk Times, Confidence Limits and MSDs

Mayfair and Bloomsbury (Predicted Values)

Address	Mean Search and Walk Times (secs)	95% Confidence limit (secs)	Minimum significant difference (secs)
(a) Mayfair			
Grosvenor Sq.	455	±289	189
South St.	454	±288	188
Berkeley Sq.	417	±265	173
Grosvenor St.	834	±535	350
All Sites	772	±246	159
(b) Bloomsbury			
Gt. Ormond St.	555	±356	233
Malet St.	345	±219	143
Cartwright Gdns†	(7)	± (5)	(3)
Montague St.	333	±230	150
All sites*	467	±153	99

* Except Cartwright Gdns.

† Not negative exponentially distributed.

observed values. Inspection of Tables 3.4 and 3.5, and 3.7 and 3.8 however suggests that this problem is a minor one.

Table 3.13 presents the results. There appears to be greater variation between sites than between areas, although none of the differences is significant. The results indicate averages of almost 10 minutes in Mayfair and $7\frac{1}{2}$ minutes in Bloomsbury. Again the minimum significant differences for individual sites are similar to the means, but for the areas as a whole 45 to 50% changes are detectable with 95% confidence and 30 to 35% changes with 90% confidence.

Information from the fixed route sections. The fixed route sections of the Park and Visit circuit give information about the availability of vacant meter spaces, journey times and journey speeds for a route within the survey area which is considered to be representative of the survey area as a whole. The amount of time spent on the fixed route sections of the circuit on each of the survey days has been tabulated. For Mayfair this information can be found in Table 3.14 and for Bloomsbury in Table 3.15.

In Mayfair the total time per circuit on the fixed route varied considerably from a minimum of 35 minutes 50 seconds to a maximum of 75 minutes 51 seconds, the mean being 51 minutes 6 seconds. Both the survey day and the circuit manner had a significant effect on the fixed route time. In Bloomsbury the variation was not so great with a minimum of 27 minutes 19 second, a maximum of 48 minutes 28 seconds and a mean of 35 minutes 31 seconds. Only the circuit number had a significant effect on fixed route time.

In Mayfair a change in the overall fixed route time of at least 161.6 seconds (7%) would be required for the variation to be significant (Table 3.14). In Bloomsbury (Table 3.15) a change of 107.5 seconds (5%) would be needed (see Appendix 7).

Table 3.14 Park and Visit Surveys - Mayfair

Total time on fixed route in minutes and mean speed for all days

Circuit No.	Survey Day T	W	Th	F	M	T	W	Th	All Days mean time (min)	mean speed (km/h)
1	39.8	41.8	48.9	41.8	-	35.8	39.1	37.8	40.7	18.1
2	53.8	46.1	42.8	40.9	46.5	43.3	46.8	53.5	46.7	15.8
3	58.9	63.4	52.1	41.4	45.2	75.9	48.6	58.0	55.4	13.4
4	60.0	61.6	58.6	53.3	52.8	65.5	54.8	54.7	58.4	12.7
5	60.0	56.2	59.9	48.6	49.9	54.0	48.5	51.6	53.5	13.8
6	-	-	49.3	47.1	50.5	63.0	44.0	43.8	49.6	14.8
All Circuits Mean	55.6	53.8	52.0	45.5	48.9	56.2	47.0	49.9	51.0*	14.3

* Confidence limits on the mean ± 2.5 min. s = 8.45 n= 45

Minimum significant difference ± 3.6 min.

Table 3.15 Park and Visit Surveys - Bloomsbury

Total time on fixed route in minutes and mean speed for all days

Circuit No.	Survey Day T	W	Th	F	M	T	W	Th	All Days mean time (min)	mean speed (km/h)
1	35.4	34.6	32.8	28.1	-	30.6	27.3	29.4	31.2	16.3
2	48.5	40.0	35.2	36.8	33.8	30.6	33.1	38.8	37.1	13.7
3	40.6	36.9	37.9	34.5	33.3	36.0	32.4	31.6	35.4	14.4
4	36.5	37.7	43.1	31.9	34.2	32.0	33.3	39.7	36.0	14.1
5	32.4	32.8	30.2	38.4	32.2	43.3	32.5	45.9	36.0	14.1
6	33.9	36.6	35.9	39.7	36.1	43.5	33.7	-	37.1	13.7
All Circuits	35.5	36.4	35.8	34.9	34.0	36.0	32.0	37.0	35.5*	14.4

* Confidence limits on the mean ± 1.3 mins. s = 4.37

Minimum significant difference ± 1.9 mins.

Using fixed route distances of 12.3 km in Mayfair and 8.5 km in Bloomsbury, the mean time for each circuit has been converted into a mean speed, as shown in Tables 3.14-15. These have been compared with the mean speeds from the journey time survey conducted by Halcrow Fox and Associates. In this comparison, HFA's routes 4, 6, 8-12 in their Mayfair/Soho area have been taken as representative of Mayfair; all their Bloomsbury routes have been used. Four comparisons have been made: of circuits 1-3 against HFA time periods 1 and 2, and of circuits 4-6 against HFA time periods 3 and 4 for each area. In all four cases, the speeds in Tables 3.14-15 are between 77% and 82% of the HFA speeds. These lower values are almost certainly due to the tortuous nature of the routes in the present study.

The availability of meter spaces within the survey area was measured by counting the number of vacant meter spaces whilst on the fixed route sections of the circuit. The total number of vacant meter spaces observed on the fixed route per circuit on each day has been tabulated. For Mayfair this information can be found in Table 3.16 and for Bloomsbury in Table 3.17. In both Mayfair and Bloomsbury there were plenty of spaces in the early morning, but after about 9 am in Mayfair and 10.30 am in Bloomsbury a vacant meter space was a rare sight with at the worst one available meter per 4 km of route in Mayfair (circuit 4) and one per 700 m in Bloomsbury (circuit 5). The situation in both areas began to improve after 4 pm. In both areas the availability of spaces varied significantly with the time of day but not with the day of the week.

The frequency of different time gaps between consecutive vacant meter spaces has also been studied. These have been estimated by interpolation from the times at which the survey vehicle passed major junctions on the fixed route. Table 3.16 and Table 3.17 present this information in a simplified form, solely indicating the number of such gaps in excess of five minutes. In practice this information is a little difficult to interpret. The number of long gaps is low both when meter space availability is high and (because there are few vacant meter spaces) when it is low. It is not intended to repeat this analysis in the after studies.

Table 3.16 Total Meter Spaces (and number of gaps between spaces greater than 5 mins) - Mayfair

	Survey Day								
Circuit No.	T	W	Th	F	M	T	W	Th	All Days
1	259	346	291	329	-	312	276	255	295.1
	(0)	(0)	(0)	(1)		(0)	(0)	(0)	
2	57	74	93	92	71	104	82	95	83.5
	(3)	(3)	(1)	(1)	(2)	(2)	(4)	(2)	
3	6	3	6	2	5	1	0	10	4.1
	(3)	(2)	(3)	(1)	(1)	(1)	-	(4)	
4	6	3	4	2	0	0	2	3	2.5
	(4)	(1)	(2)	(1)	-	-	(0)	(2)	
5	27	9	15	9	10	13	11	5	12.4
	(3)	(3)	(3)	(3)	(3)	(4)	(4)	(3)	
6	-	-	24	24	20	12	23	5	18.0
			(3)	(4)	(1)	(3)	(1)	(1)	
All Circuits	71.0	87.0	72.7	56.8	(21.2)	73.7	65.7	62.2	66.6

Table 3.17 Total Meter Spaces (and number of space gaps greater than 5 mins) - Bloomsbury

	Survey Day								
Circuit No.	T	W	Th	F	M	T	W	Th	All Days
1	233	238	228	232	-	243	213	218	224.3
	(0)	(0)	(0)	(0)		(0)	(0)	(0)	
2	187	191	191	184	177	158	176	180	180.5
	(1)	(1)	(0)	(1)	(0)	(2)	(1)	(0)	
3	23	11	28	14	31	14	12	11	18.0
	(3)	(2)	(1)	(2)	(1)	(2)	(2)	(2)	
4	20	10	9	24	11	12	11	18	14.4
	(2)	(3)	(3)	(1)	(2)	(1)	(2)	(2)	
5	14	12	15	18	10	10	5	11	11.9
	(1)	(1)	(1)	(2)	(2)	(1)	(2)	(2)	
6	61	22	40	49	36	46	34	-	41.1
	(0)	(1)	(1)	(2)	(1)	(1)	(0)		
All Circuits	89.7	80.7	85.2	86.8	(53.0)	80.5	75.2	87.6	80.24

3.2 Vehicle Following Surveys. The vehicle following surveys were conducted as described in section 2.2. The same taxi was used for both the morning and the afternoon survey periods but a different taxi was used each day. The method of vehicle following by taxi was as successful as the pilot surveys predicted with only 5% of vehicles being lost. Even though the survey areas were congested, up to six runs per hour were possible. This was higher than the pilot surveys because, at the end of the run, the taxi proceeded to the nearest start point if this could be done while still maintaining an equal number of runs from each start point. Only a few motorists seemed to realise they were being followed.

For each run, the reason for ending the run has been cross-tabulated against the start point. For Mayfair this information can be found in Table 3.18 and for Bloomsbury in Table 3.19. Of the 144 vehicle following runs in Mayfair a total of 10 ended with the vehicle being lost. This rather high loss rate of 8% was, in part, a result of the nature of the area with its narrow streets and many junctions. On one of the survey days a high loss rate was sustained because the taxi driver was rather timid and the taxi had poor acceleration. The loss rate in Bloomsbury was only 3%. This can partially be attributed to the wide streets where overtaking is possible and the straight grid pattern of roads where visibility is good.

The proportion of through traffic to total vehicles followed was significantly higher in Bloomsbury than Mayfair. In Mayfair it was 21%, and varied from 18.8% in Half Moon Street to 28% in Conduit Street. In Bloomsbury the proportion of through traffic was 49%. Guilford Street had the highest level of through traffic at 55% and Museum Street the lowest at 42%. It seems unlikely that entry points to Bloomsbury could have been found where the proportion of through traffic would have been lower.

Types of parking space. Of the vehicles parking, the proportion that parked at a meter was not significantly different between the two areas. In Mayfair the proportion was 17% with Half Moon Street having the highest proportion at 22% and Conduit Street the lowest at 10%. In Bloomsbury it was 15%. Yellow line parking

("All other On-Street" in the tables) predominated in both areas, representing 55% of parking runs in Mayfair and 69% in Bloomsbury. Again there was no significant difference between areas.

In Mayfair a difference in meter parking of 11 runs from the observed total of 17 runs (65%) would be required for a change to be significantly different (Table 3.18). For "Other On-street" parking a difference of 17 runs from the observed total of 58 runs (29%) would be needed. For through traffic a difference of 14 runs from the observed total of 30 runs (47%) would be necessary. In Bloomsbury a difference in meter parking of 9 runs from the observed total of 10 runs (90%) would be required for the chance to be significant (Table 3.19). For "Other On-street" parking a difference of 16 runs from the observed total of 45 runs (36%) would be necessary. These tables also show the confidence limits and minimum significant differences for each start point treated separately. (See Appendix 7 for derivation of confidence limits.)

TABLE 3.18 VEHICLE FOLLOWING SURVEYS - MAYFAIR

NUMBER OF VEHICLE FOLLOWING RUNS BY START POINT AND BY TYPE OF END OF RUN

Reason for ending run	Start Point: Half Moon St.	Deanery St.	Conduit St.	All Start Points
Lost Contact	2 (4.2%) (+-2) (+-4)	5 (10.2%) (+-4) (+-6)	4 (8.5%) (+-3) (+-6)	11 (7.6%) (+-6) (+-9)
Through Traffic	9 (18.8%) (+-5) (+-8)	8 (16.3%) (+-5) (+-8)	13 (27.7%) (+-6) (+-9)	30 (20.8%) (+-9) (+-14)
Meter Parking	8 (16.7%) (+-5) (+-8)	5 (10.2%) (+-4) (+-6)	4 (8.5%) (+-3) (+-6)	17 (11.8%) (+-7) (+-11)
Other On-Street Parking	20 (41.7%) (+-6) (+-10)	18 (36.8%) (+-6) (+-10)	20 (42.6%) (+-6) (+-10)	58 (40.3%) (+-11) (+-17)
Off-Street Parking	9 (18.8%) (+-5) (+-8)	13 (26.5%) (+-6) (+-9)	6 (12.8%) (+-4) (+-7)	28 (19.4%) (+-9) (+-14)
Total for each Start Point	48	49	47	144

Notes:
1) Top figure in brackets: Observed total as a percentage
2) Middle figure in brackets: Confidence limits for observed total
3) Lower figure in brackets: Minimum significant difference in total

TABLE 3.19 VEHICLE FOLLOWING SURVEYS - BLOOMSBURY

NUMBER OF VEHICLE FOLLOWING RUNS BY START POINT AND BY TYPE OF END OF RUN

Reason for ending run	Start Point: Judd St.	Guilford St.	Museum St.	All Start Points
Lost Contact	1 (2.1%) (+-1) (+-3)	2 (5.0%) (+-2) (+-4)	1 (2.1%) (+-1) (+-3)	4 (2.9%) (+-3) (+-6)
Through Traffic	24 (50.0%) (+-6) (+-10)	22 (55.0%) (+-6) (+-9)	20 (41.7%) (+-6) (+-10)	66 (48.5%) (+-11) (+-17)
Meter Parking	5 (10.4%) (+-4) (+-6)	2 (5.0%) (+-2) (+-4)	3 (6.3%) (+-3) (+-5)	10 (7.4%) (+-5) (+-9)
Other On-Street Parking	15 (31.3%) (+-6) (+-9)	9 (22.5%) (+-5) (+-8)	21 (43.8%) (+-6) (+-10)	45 (33.0%) (+-10) (+-16)
Off-Street Parking	3 (6.3%) (+-3) (+-5)	5 (12.5%) (+-4) (+-6)	3 (6.3%) (+-3) (+-5)	11 (8.1%) (+-9) (+-6)
Total for each Start Point	48	40	48	136

Notes:
1) Upper figure in brackets: Observed number as percentage
2) Middle figure in brackets: Confidence limits for observed total
3) Lower figure in brackets: Minimum significant difference in total

The runs were also tabulated by time period and by reason for ending the run. This information for Mayfair is to be found in Table 3.20and for Bloomsbury in Table 3.21. There is no significant difference between time periods.

TABLE 3.20 VEHICLE FOLLOWING SURVEYS - MAYFAIR

NUMBER OF VEHICLE FOLLOWING RUNS BY TIME OF DAY AND BY TYPE OF END OF RUN

Reason for ending run	Time Period 0730-1030	0930-1230	1230-1530	1430-1730	Total All Day
Lost Contact	1	3	5	2	11
Through Traffic	8	8	6	8	30
Meter Parking	5	3	3	6	17
Other On-Street Parking	16	17	14	11	58
Off-Street Parking	16	7	1	4	28
Total for each Start Point	46	38	29	31	144

TABLE 3.21 VEHICLE FOLLOWING SURVEYS - BLOOMSBURY

NUMBER OF VEHICLE FOLLOWING RUNS BY TIME OF DAY AND BY TYPE OF END OF RUN

Reason for ending run	Time Period 0730-1030	0930-1230	1230-1530	1430-1730	Total All Day
Lost Contact	0	0	3	1	4
Through Traffic	17	17	16	16	66
Meter Parking	5	3	1	1	10
Other On-Street Parking	14	11	8	12	45
Off-Street Parking	5	4	0	2	11
Total for each Start Point	41	35	28	32	136

Duration of search processes. For each start point the runs were broken down by duration of run. This information is to be found in Table 3.22 for Mayfair and Table 3.23 for Bloomsbury. Statistical analysis of the run times show that neither the survey day nor the start point had any significant effect on the mean run times. Tables 3.24 & 3.25 show the mean run times by start point and by reason for ending the run for Mayfair and Bloomsbury respectively. For both areas the reason for ending the run does have a significant effect on mean run time. This is because the mean run time for through traffic runs is approximately twice that for runs parking within the survey area. If through traffic runs are excluded then there is no significant difference in mean run time between the differing types of parking.

In Mayfair a change in mean run time of at least 1.75 minutes (55%) would be required for meter parking runs for a change to be significant. For "Other On-street" parking runs the change would need to be at least 1.04 minutes (34%). For through traffic a change of 1.30 minutes (20%) would be necessary. Correspondingly higher percentage changes would be needed for each start point treated separately.

In Bloomsbury a change in mean run time of at least 2.08 minutes (109%) would be required for meter parking runs for a change to be significant. For "Other On-street" parking runs the change would need to be at least 0.93 minutes (35%). For through traffic a change of 0.8 minutes (15%) would be necessary. Correspondingly higher percentage changes would be needed for each start point treated separately. (See Appendix 7 for derivation of confidence limits.)

TABLE 3.22 VEHICLE FOLLOWING SURVEYS - MAYFAIR

NUMBER OF PARKING VEHICLES FOLLOWED BY START POINT AND DURATION OF RUN

Duration of Run (mins)	Start Point: Half Moon St.	Deanery St.	Conduit St.	All Start Points
0 - 1	10	11	5	26
1 - 2	10	7	10	27
2 - 3	6	4	4	14
3 - 4	1	5	2	8
4 - 5	6	4	0	10
5 - 10	4	4	9	17
>10	0	1	0	1
Total for each Start Point	37	36	30	103

TABLE 3.23 VEHICLE FOLLOWING SURVEYS - BLOOMSBURY

NUMBER OF PARKING VEHICLES FOLLOWED BY START POINT AND DURATION OF RUN

Duration of Run (mins)	Museum St.	Judd St.	Guilford St.	All Start Points
0 - 1	9	9	1	19
1 - 2	5	4	3	12
2 - 3	5	5	6	16
3 - 4	3	1	3	7
4 - 5	0	2	0	2
5 - 10	5	2	3	10
>10	0	0	0	0
Total for each Start Point	27	23	16	66

TABLE 3.24 VEHICLE FOLLOWING SURVEYS - MAYFAIR

MEAN RUN TIME IN MINUTES BY START POINT AND BY END OF RUN

Reason for ending run	Start Point: Half Moon St	Deanery St	Conduit St	All start Points
Through traffic	7.39	6.27	5.93	6.46
	(±1.48)	(±2.32)	(±1.57)	(±0.92)
	(±2.10) (9)	(±3.29) (8)	(±2.22) (13)	(±1.30) (30)
Meter parking	2.44	4.17	3.41	3.18
	(±1.66)	(±3.97)	(±3.52)	(±1.23)
	(±2.34) (8)	(±5.62) (5)	(±4.97) (4)	(±1.75) (17)
Other on-street parking	2.61	3.39	3.17	3.04
	(±0.95)	(±1.89)	(±1.18)	(±0.74)
	(±1.34) (20)	(±2.67) (18)	(±1.67) (20)	(±1.04) (58)
Off-street parking	2.35 (9)	1.99 (13)	3.17 (6)	3.04 (28)
	(±1.61)	(±0.89)	(±2.25)	(±0.34)
	(±2.27)	(±1.26)	(±3.18)	(±0.49)
Mean for each start point	3.47	3.59	3.90	3.65
	(±1.03)	(±1.09)	(±1.20)	(±0.62)
	(±1.15) (46)	(±1.39) (44)	(±1.19) (43)	(±0.71) (133)

Notes 1) Upper figure in brackets: Confidence limits for observed mean value

2) Lower figure in brackets: Minimum significant difference of mean value

TABLE 3.25 VEHICLE FOLLOWING SURVEYS - BLOOMSBURY

MEAN RUN TIME IN MINUTES BY START POINT AND BY END OF RUN

Reason for ending run	Judd St	Guilford St	Museum St	All Start Points
Through traffic	5.19 (+-0.96) (+-1.32) 24	5.64 (+-1.06) (+-1.45) 22	5.73 (+-1.07) (+-1.46) 20	5.51 (+-0.57) (+-0.80) 66
Meter Parking	0.52 (+-0.30) (+-0.35) 5	4.44 (+-26.14) (+-12.53) 2	2.51 (+-5.92) (+-5.40) 3	1.91 (+-1.57) (+-2.08) 10
Other On-Street Parking	2.50 (+-1.05) (+-1.41) 15	2.89 (+-1.18) (+-1.53) 9	2.69 (+-1.22) (+-1.67) 21	2.67 (+-0.66) (+-0.93) 45
Off-Street Parking	2.57 (+-3.30) (+-3.01) 3	2.62 (+-2.46) (+-2.89) 5	1.39 (+-3.38) (+-2.18) 3	2.27 (+-1.09) (+-1.44) 11
Mean for each Start Point	3.67	4.53	3.89	4.00
Sample size	47	38	47	132

Notes: 1) Top figure: Mean of observed values
2) Upper figure in brackets: Confidence limits for observed mean value
3) Lower figure in brackets: Minimum significant difference of mean value
4) Bottom figure: Sample size

Directness of routeing. In order to investigate the directness of routeing through the survey areas, a comparison has been made between the "crowfly" distance from startpoint to end point and the shortest practicable distance bearing in mind the existence of one way streets. The "directness" of the network can be expressed by the ratio:

Directness = (shortest distance - crowfly distance)/crowfly distance (%)

In order to investigate the degree of searching for a parking space a comparison has been made between the actual distance travelled and the shortest practicable distance. The "excess distance" for a space can be expressed by the ratio:

Excess distance = (Actual distance - shortest distance)/shortest distance (%)

Frequency distributions of these measures of routeing behaviour have been tabulated in Tables 3.26 and 3.28 for Mayfair, and Table 3.27 and 3.29 for Bloomsbury. The results for "directness" tend to reflect the extensive one-way system in Mayfair giving a rather poor level of "directness". The Bloomsbury results show a better level of "directness" reflecting the grid pattern of predominantly two-way streets.

The results for "excess distance" have been used to estimate the extent to which searching had taken place. Tables 3.28 and 3.29 suggest that most values lie below 40%, and this has been taken as the threshold above which searching is deemed to have taken place. In Mayfair the proportion of off-street parkers searching was 7%, while in Bloomsbury it was 9%. Of those parking at meters the figures were 22% and 10% respectively, while for all other on-street parkers they were 18% and 19%. Table 3.30 presents these results.

It is interesting that the percentages were no higher for meters than for other on-street parking. One possible explanation is that drivers are prepared to endure a limited amount of searching and will then park at the first legal or illegal space.

TABLE 3.26 VEHICLE FOLLOWING SURVEYS

FREQUENCY DISTRIBUTIONS FOR DIRECTNESS : MAYFAIR

START POINT

	Directness (%)	Deanery St.			Half Moon St.			Conduit St.		
End of Run (1):-		A	B	C	A	B	C	A	B	C
	0	1	0	3	2	2	5	0	3	2
	1-20	6	3	2	0	0	0	1	0	1
	20-40	3	1	5	1	2	7	0	0	2
	40-60	1	1	3	1	2	5	4	1	9
	60-80	1	0	3	0	0	2	0	0	2
	80-100	1	0	0	2	1	0	0	0	0
	100-150	0	1	1	0	0	1	1	0	1
	150-200	0	0	0	2	0	0	0	0	2
	200-300	0	0	0	1	0	0	0	0	0
	300-400	0	0	0	0	1	0	0	0	1

TABLE 3.27 FREQUENCY DISTRIBUTIONS FOR DIRECTNESS : BLOOMSBURY

START POINT

	Directness (%)	Judd St.			Guilford St.			Museum St.		
End of Run (1):-		A	B	C	A	B	C	A	B	C
	0	0	0	2	0	0	0	0	0	6
	1 - 20	2	1	7	0	0	0	2	0	2
	21 - 40	1	4	3	2	0	4	0	1	0
	41 - 60	0	0	0	1	2	4	0	0	6
	61 - 80	0	0	2	1	0	1	0	1	1
	81 - 100	0	0	0	1	0	0	1	1	2
	101 - 150	0	0	0	0	0	0	0	0	1
	150 - 200	0	0	0	0	0	0	0	0	0
	201 - 300	0	0	0	0	0	0	0	0	1
	300 - 400	0	0	0	0	0	0	0	0	2

(1) : A : Off Street. B : Meter C : All other on street

TABLE 3.28

VEHICLE FOLLOWING SURVEYS

FREQUENCY DISTRIBUTIONS FOR EXCESS DISTANCE : MAYFAIR

START POINT

Excess Distance (%)	Deanery St.			Half Moon St.			Conduit St.		
End of Run (1):-	A	B	C	A	B	C	A	B	C
0	10	3	13	7	8	15	5	3	13
1-20	0	0	2	1	0	2	0	0	0
20-40	3	0	1	0	0	1	0	0	0
40-60	0	0	0	0	0	0	0	1	1
60-80	0	0	0	0	0	0	0	0	3
80-100	0	1	0	0	0	0	0	0	0
100-150	0	0	1	0	0	2	0	0	0
150-200	0	0	0	1	0	0	0	0	1
200-300	0	0	0	0	0	0	1	0	0
300-400	0	1	0	0	0	0	0	0	1
>400	0	1	0	0	0	0	0	0	1

(1) : A : Off Street B : Meter C : All other on street

TABLE 3.29

VEHICLE FOLLOWING SURVEYS

FREQUENCY DISTRIBUTIONS FOR EXCESS DISTANCE : BLOOMSBURY

START POINT

Excess Distance (%)	Judd St.			Guildford St.			Museum St.		
End of run (1):-	A	B	C	A	B	C	A	B	C
0	3	4	11	5	1	7	2	2	12
1 - 20	0	1	0	0	0	1	0	0	0
21 - 40	0	0	1	0	0	0	0	1	3
41 - 60	0	0	0	0	1	0	0	0	1
61 - 80	0	0	1	0	0	0	1	0	1
81 - 100	0	0	0	0	0	0	0	0	1
101 - 150	0	0	0	0	0	0	0	0	1
150 - 200	0	0	0	0	0	0	0	0	0
201 - 300	0	0	1	0	0	0	0	0	2

(1) : A : Off Street B : Meter C : All other on street

TABLE 3.30 PROPORTIONS SEARCHING FOR DIFFERENT TYPES OF PARKING SPACE

	Proportion	95% confidence limit	Minimum significant difference	n	s
(a) Mayfair					
Off Street	0.07	±0.09	±0.13	28	0.046
Meters	0.22	±0.19	±0.27	17	0.097
Other	0.18	±0.10	±0.14	58	0.051
(b) Bloomsbury					
Off Street	0.09	±0.17	±0.24	11	0·087
Meters	0.10	±0.19	±0.27	10	0.097
Other	0.19	±0.12	±0.17	45	0.061

Table 3.30 also indicates the 95% confidence limits and minimum detectable significant differences for the percentages searching. For all but 'other' these are larger than the means, which suggests that it will not be possible to detect significant differences unless major changes in meter availability occur.

3.3 Registration Number Survey

Conduct of the Surveys. The Registration Number Survey was carried out from Monday 11th October 1982 until Thursday 14th October 1982 inclusive. The first two days were spent in Mayfair and the last two days in Bloomsbury. The weather was cold with long heavy showers and the perseverance of the survey team in these unpleasant conditions is to be commended.

The coded data for one day from each survey area was transferred to magnetic tape. Computer programs were written to check the validity of the data and to transform it into a format suitable for further analysis at T.R.R.L. using the NOPAP programme. Unfortunately difficulties experienced by T.R.R.L. in the use of this program delayed the start of data analysis. Eventually an attempt was made during May to analyse the data using the NOPAP program. Problems caused by the complexities of the two networks and the volume of data were overcome and some final results obtained. On close examination it was found that these results contained gross errors and inconsistencies that indicated that the NOPAP program was still processing the data incorrectly. Consequently it was decided to postpone indefinitely any further work on this survey.

It was unfortunate that the registration number surveys had to be conducted so early in the study program in order to coincide with the consultants' surveys. In practice experience has confirmed the expectations that data collection would be expensive and data analysis complicated; while the later vehicle following surveys have indicated that the amount of traffic generated in searching is small.

3.4 Business Survey

Conduct of the survey. The questionnaire was administered to a sample of shops and businesses in Bloomsbury and Mayfair. A sampling frame was drawn up using the 1983 edition of Kelly's Directory and the sample chosen to reflect the variety of businesses and locations within each area. Originally, shops were classified into five groups following the classification scheme adopted in the York study (May and Weaver 1981). However, the degree of concentration of activity types within each of the two areas suggested that for sampling purposes a simple two-class system would be sufficient. Accordingly, convenience and apparel shops were combined into one category and stores selling household goods and specialist non-food items were combined into the other together with department and variety stores. The distribution of stores across these categories by area and the distribution of the achieved sample are shown in table 3.31. There was an enormous number and variety of businesses within both areas and it was not practical either to classify these or sample them proportionately. Accordingly a small number of businesses, 8 in Bloomsbury and 5 in Mayfair were approached for information, especially on streets or in parts of the study areas where there were no shops. As far as was possible, the sample was chosen to represent the full range of locations within each area. Approximately half of the shops and businesses for which information was actually obtained were located in the four or five main shopping streets within each area and the remainder scattered across all the other streets reflecting the actual geographical distribution of shops and businesses within each area.

It was hoped to obtain 50 responses from each of the study zones and, with an anticipated response rate of 70%, introductory letters explaining the background to the survey were sent to each of 70 potential respondents within each area. In practice, a higher response rate (almost 80%) was achieved, with 54 completed questionnaires for Bloomsbury and 55 for Mayfair. The quality of the information obtained appeared extemely high and although some respondents held

strong views about the parking situation and its effects on their businesses, the impression given by the interviewers during de-briefing was that repondents generally gave considered answers to the questions being posed.

A total of 14 suppliers, selected from approximately 120 identified during the business surveys in Bloomsbury and Mayfair (see question 27 of the questionnaire presented in Appendix 4), were approached for information. Those selected were suppliers mentioned by more than one respondent, those thought likely to make deliveries into both areas, those thought likely to make many deliveries into Central London and those with bases accessible to our interview staff i.e. within Central London or the Greater London area. All 14 responded and all confirmed making deliveries either to Bloomsbury or to Mayfair. However, only 8 made deliveries to both areas. Again the quality of the information obtained appeared extremely high and the consistency of reponses suggests that respondents generally gave considered and objective answers.

Survey results. Results for the shopkeeper and business surveys are given in table 3.32. The general impression is that results across the two areas are similar, respondents perceiving transport and traffic problems to be some of the most serious problems affecting business operations and considering parking problems to be the most serious of these. Approximately 76% of respondents in Bloomsbury and 82% in Mayfair considered their business operations to be affected to some degree by transport and traffic problems. Around 20% from each area claimed their business operations to be extremely seriously affected by these problems. Some 40% of respondents in each area considered transport and traffic problems to be the most serious problems affecting business operations. Of those claiming to be affected by transport and traffic problems virtually all (90%)in Bloomsbury and 100% in Mayfair) mentioned parking as one such problem.

Parking problems were considered to be slightly more serious in Mayfair than in Bloomsbury (58% of those specifying parking as a problem claiming their business to be extremely or very seriously affected in Mayfair compared to 46% in Bloomsbury) although for both

areas, parking was considered to be the most serious transport or traffic problem. The on-street parking situation was considered to be important to business operations in both areas (important to some degree to 75% of respondents in Bloomsbury and to over 80% in Mayfair) and, again, the extent of this importance was felt to be slightly greater in Mayfair (over 50% of respondents considering the on-street parking situation to be extremely or very important to business operations in Mayfair compared with just less than 40% in Bloomsbury).

Views about stricter enforcement of parking regulations were remarkably consistent between the two areas. Approximately 20% of respondents from each area felt that there were ways in which their business could benefit from stricter enforcement of regulations. The other 80% did not feel that stricter enforcement could be in any way beneficial to their business. On the other hand around 70% of respondents in each area felt that stricter enforcement would adversely affect their business operations. Overall only 17% of respondents from Bloomsbury and 13% from Mayfair thought that stricter enforcement would be a good thing compared with 56% and 60% respectively who thought it would be bad. Around 65% of respondents from each area thought that stricter enforcement of parking regulations would affect their trade/ turnover and almost 90% of the 109 respondents expressed a willingness to assist in assessing such effects were they to be approached in an after survey.

Results for the supplier surveys are given in table 3.32 and 3.33. All 14 suppliers considered their business operations to be affected to some degree by transport or traffic problems and for 10 (71.4%) they were the most serious problems affecting business operations. For 13 suppliers (92.9%) parking was mentioned as a problem and 11 of those affected by parking problems (84.6%) considered these the most serious transport or traffic problems faced. In terms of all transport or traffic problems, the situation in Bloomsbury was considered to be equivalent to that in Central London generally by those able to express an opinion, whereas that in Mayfair was seen

to be slightly worse than in Central London generally. The on-street parking situation was extremely, very or fairly important to the supply operations of all but one of the firms (one supplying premises with off-street unloading facilities) and, as with overall transport or traffic problems on-street parking problems were considered to be worse in Mayfair than in Central London generally. The on-street parking situation in Bloomsbury was again seen to reflect the situation in Central London generally. All but one supplier could visualise benefits to their businesses from stricter enforcement of parking regulations but opinion was divided, roughly equally, on disbenefits and on potential impacts on trade. Overall however, 11 of the 14 suppliers (84.6%) thought that stricter enforcement of parking regulations would be a good thing. Only 2 (14.3%) thought it would be a bad thing and 1 (7.1%) as uncertain. All 14 expressed their willingness to be contacted again and to supply information to enable the effects of stricter enforcement, including effects on trade, to be assessed.

Comparing the business and supplier responses, it is noticeable that the suppliers are more likely to be seriously affected by transport problems generally and more likely to consider the on-street parking situation important to their operations. They are also more willing to accept that stricter enforcement might be of benefit to them. These results confirm that it will be important to treat suppliers as a separate group in any after survey.

Table 3.31 Distribution of shops by type within each study area and within the achieved sample

	Convenience and Apparel Stores	Household goods and specialist non-food stores, department and variety stores	Total
BLOOMSBURY			
- population	63	73	136
- achieved sample	23	23	46
MAYFAIR			
- population	129	73	202
- achieved sample	33	17	50

Table 3.32 Business Interivews: Results

		Bloomsbury		Mayfair		Suppliers	
		No.	%	No.	%	No.	%
Response		54	100·0	55	100·0	14	100·0
How seriously do transport or traffic problems affect business operations?	extremely	10	18·5	11	20·0	3	21.4
	very	10	18·5	11	20·0	5	35.7
	fairly	12	22.2	18	32·7	3	21.4
	not very	9	16·7	5	9·1	3	21.4
	not at all	13	24·1	10	18·2	0	0.0
How many other problems affect business operations more seriously than transport?	0	24	44·4	24	43·6	10	71.4
	1	16	29·6	18	32·7	4	28.6
	2	9	16·7	11	20·0	0	0.0
	3	5	9·3	2	3·6	0	0.0
	4+	0	0·0	0	0·0	0	0.0
Of those affected by transport problems, is parking mentioned as one such problem?	yes	37	90·2	45	100·0	13	92.9
	no	4	9·8	0	0·0	1	7.1
Of those affected by parking problems, how seriously are business operations affected by these problems?	extremely	10	27·0	12	26·7	4	30.8
	very	7	18·9	14	31·1	5	38.5
	fairly	11	29·7	6	13·3	4	30.8
	not very	7	18·9	12	26·7	0	0.0
	not at all	2	5·4	1	2·2	0	0.0
Of those affected by parking problems were these the most serious transport or traffic problems?	yes	36	97.3	45	100.0	11	84.6
	no	1	2.7	0	0.0	2	15.4
How important is the on-street parking situation to business operations?	extremely	15	27·8	14	25·5	6	42.9
	very	5	9·3	15	27·3	4	28.6
	fairly	17	31·5	11	20·0	3	21.4
	not very	4	7·4	5	9·1	0	0.0
	not at all	13	24.1	10	18.2	1	7.1

Table 3.32 cont/d.,

		Bloomsbury		Mayfair		Suppliers	
		No.	%	No.	%	No.	%
Are there any ways in which this business will benefit from stricter enforcement?	Yes	10	18.5	11	20.0	13	92.9
	No	44	81.5	44	80.0	1	7.1
Are there any ways in which this business will suffer from stricter enforcement?	Yes	38	70.3	39	70.9	8	57.1
	No	16	29.6	16	29.1	6	42.9
Overall, would stricter enforcement of parking regulations be a good or a bad thing?	A good thing	9	16.7	7	12.7	11	78.6
	A bad thing	30	55.6	33	60.0	2	14.3
	Neither good or bad	14	25.9	14	25.5	1	7.1
	Don't know	1	1.9	1	1.8	0	0.0
Do you think your trade/turnover might be affected?	Yes	37	68.5	35	63.6	6	42.9
	No/Don't know	17	31.5	20	36.4	8	57.1
Would you be willing to help us assess such effects?	Yes	49	90.7	48	87.3	14	100.0
	No/Don't know	5	9.3	7	12.7	0	0.0

Table 3.33 Suppliers' perceptions of conditions in Bloomsbury and Mayfair relative to those in Central London generally

Conditions relative to those in Central London generally		Bloomsbury	Mayfair
– in terms of transport or traffic problems	much worse	1	0
	worse	0	6
	about the same	10	5
	better	0	0
	much better	0	0
	don't know	0	0
	not applicable	3	3
– in terms of on-street parking problems	much worse	1	0
	worse	0	6
	about the same	9	5
	better	0	0
	much better	0	0
	don't know	0	0
	not applicable	3	3

4. IMPLICATIONS FOR AFTER SURVEYS AND THE EXPERIMENT

4.1 Park and visit and vehicle following surveys.

Results are considered first from the park and visit (PV) and vehicle following (VF) surveys. Referring back to the effects listed in Table 1.1, the results indicate:

- a small amount of searching traffic (VF);
- a small time penalty for those seeking meters with, in 20% of cases, no meters available within 5 minutes of the destination (PV);
- a majority of parkers using yellow lines (VF);
- much higher percentages of through traffic in Bloomsbury than in Mayfair (VF);
- speeds similar to or slightly less than those from the consultant's study (PV).

All of these results are of interest and worth comparing with after conditions. Most of them cannot readily be obtained from the consultant's surveys, and it therefore appears appropriate to replicate the two surveys. Recommendations for doing so, and the implications of statistical tests for these surveys are set out in section 5.

4.2 Implications for the experiment

The results also raise some interesting issues for the experiment itself. If parking violations become considerably less attractive, the amount of yellow line parking is likely to fall, and it may well be that meter parking reductions by current illegal meter parkers will be more than compensated by transfers from yellow lines. If this occurs, there is likely to be an increase in the amount of traffic searching for spaces, and it will be important to check this with the VF survey. Equally, time spent finding and returning from meter spaces may well increase rather than fall; the PV survey should test this. The effects on speeds are by no means certain; speeds may fall if searching traffic increases; or

rise if disruptive illegal parking or terminating traffic fall. Again the PV and VF surveys will help to measure these effects.

4.3 Business Surveys

The business surveys demonstrate the importance which businesses, and to an even greater extent suppliers, place on parking. Transport problems are the most serious for almost half the firms, and in almost all cases parking was their worst problem. Having said that, the majority of businesses were pessimistic about the effect on them of stricter enforcement. The issue is clearly, therefore, a major one for the business community, and it will be important to monitor the reactions of both businesses and suppliers to the experiment.

5. RECOMMENDATIONS FOR THE AFTER SURVEY

5.1 Park and Visit Survey

It is recommended that a park and visit survey identical to that in the 'before' survey be conducted in order to measure, in particular, changes in the time spent searching for, and reaching destinations from, different types of parking space. The survey would also provide a check on other sources of information on the changes in travel times and availability of meters in the survey areas.

As noted in Section 4, it is quite possible that availability of meters and searching times could either increase or decrease as a result of the implementation of wheel clamps. Section 3.1 suggests that a repeat survey could detect differences at the 95% confidence level of ±20% and ±7% (in Mayfair and Bloomsbury respectively) in the chances of finding a meter within five minutes, although search times would have to change by 30% and 35% respectively to be detectable even at the 90% confidence level. A repeat survey would also enable differences of ±5% and ±7% in travel time to be detected at the 95% confidence level.

While there appears to be no significant difference between results from the pilot survey in November and the full survey in February, it is probably wise to avoid the possible source of error involved in surveying at a different time of year. For this reason a direct repeat of the before survey in February 1984 is proposed.

5.2 Vehicle Following Survey

It is recommended that a vehicle following survey identical to that in the 'before' survey be conducted in order to measure changes in the proportions of vehicles searching for parking space, using different types of parking space and driving through the area. The survey would also provide some information on time spent travelling in the survey areas.

It is clear from section 3.2 that larger changes would be required in these statistics for them to be detectable by a direct repeat

survey. For the percentage searching a change of ±9% - 19% would be required. For the percentage using yellow line parking a change of ±29% to 36% would be required. For the percentage driving through the area a change of ±26% would be needed in Bloomsbury, but ±47% in Mayfair (all percentages being expressed as percentages of the 'before' percentages). Similarly, high values would be required for detectable differences in travel time.

However, as noted in section 4, the amount of searching for parking space could change quite considerably if meter spaces become even less available and the risk of yellow line parking is perceived to increase. The vehicle-following surveys provide the only means (given that registration number surveys are abandoned) of checking on this, and also provide a useful insight into the ways in which drivers behave.

For this reason it is recommended that the surveys be repeated using the same procedure, at the same time of the year, as the 'before' surveys. Were a saving to be required, it might be appropriate not to repeat the Bloomsbury surveys, since changes are likely to be less marked there.

5.3 Registration Number Survey

The registration number survey proved to be extremely laborious to conduct and analyse. While the information obtained would have been valuable had searching for parking space been extensive, the vehicle following survey demonstrated that little searching took place. The only justification for conducting a registration number survey in the 'after' survey would be to check the findings of the vehicle following survey. This in turn would only be justified if the amount of searching for space were to rise substantially with the introduction of wheel clamps. On balance it is recommended that the registration number survey should not be repeated.

5.4 Business Interview Survey

The business survey has been successful both in the high success rate (almost 80% for businesses and 100% for suppliers), and

in the high percentages willing to participate in further surveys (89% of businesses and 100% of suppliers). It has also provided a valuable insight into the different perceptions of the businesses and suppliers of the importance of parking as a problem and the value of increased enforcement as a solution.

While there is clearly a danger that 'after' responses to some questions could be influenced by respondents' desire to affect the outcome of the experiment, sufficient of the questions are immune to this problem to ensure that an unbiassed reaction is obtained, and comparisons between Mayfair and Bloomsbury can be used as a further check on bias. Direct evidence of changes in perception of the severity of parking problems or the benefits of enforcement should provide a valuable input to decisions on the experiment, particularly since business has been seen to be extremely concerned by the issue of parking problems.

There is no obvious reason for seasonality in the results obtained, and while the survey should clearly be conducted as late in the 'after' period as possible, it will be necessary to conduct it earlier if results are to be analysed in time. It is therefore recommended that the survey be repeated in January or February, 1984.

The survey plan also envisaged a study of turnover trends to establish objectively whether trade had been affected by the measures. Since 65% of businesses expect that it will, and 89% are prepared to co-operate in such a study, it seems appropriate to proceed with the study, which would be conducted at the same time as the interviews.

REFERENCES

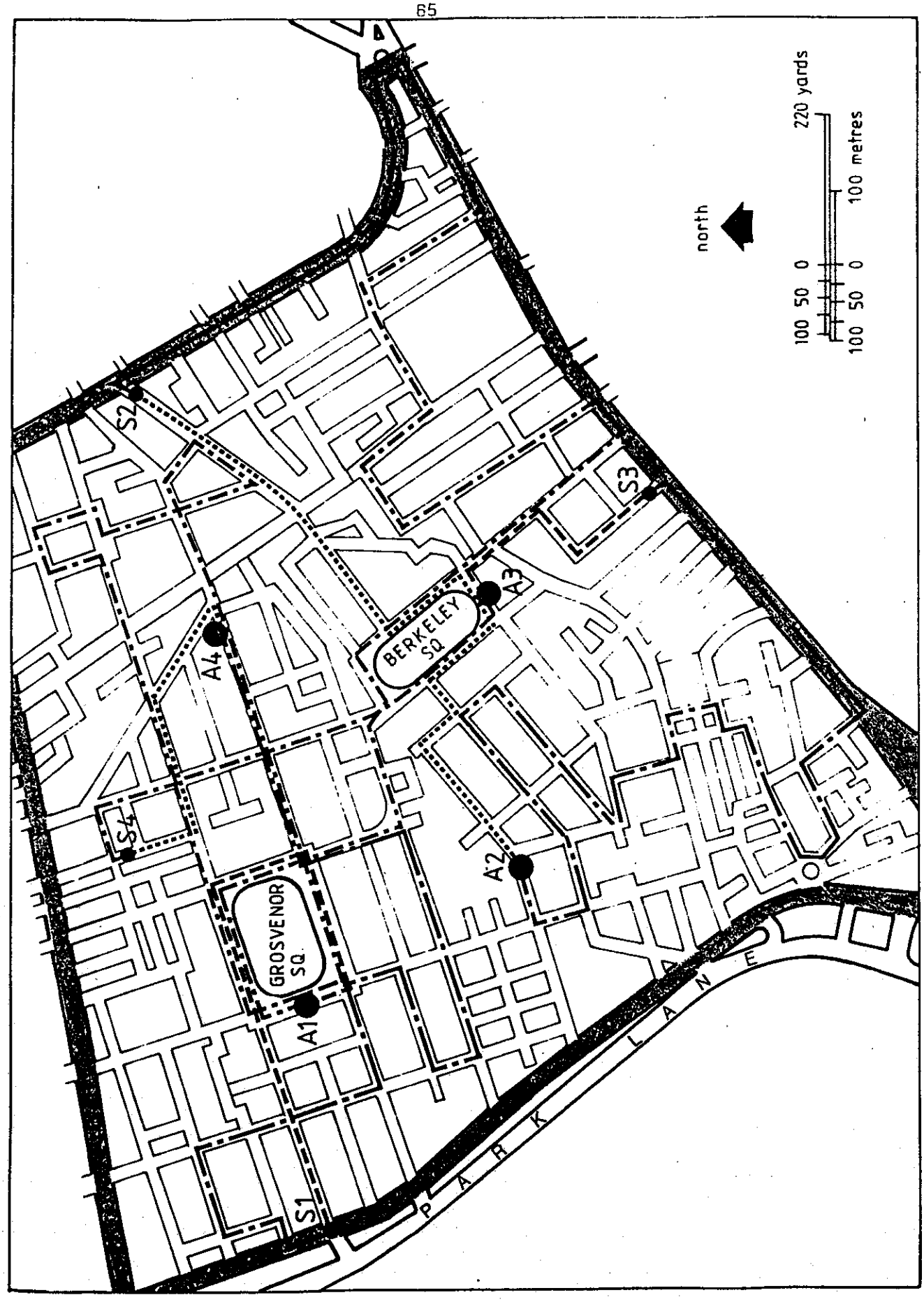
INWOOD, J. Some effects of increased parking meter charges in London, 1965. LRL, RRL, Harmondsworth, 1966.

MAY, A.D. The assessment of the effectiveness of wheel clamps: Initial proposals. TN122, Institute for Transport Studies, Leeds, 1982.

MAY, A.D. and P.M. WEAVER. Comprehensive traffic management in York - the effects on trade. Traffic Engineering and Control, Vol. 22, No. 4, pp. 204-7, 1981.

PATTERSON, N.S. and A.D. MAY. The impact of transport problems on inner city firms: Summary report. WP 152, Institute for Transport Studies, Leeds, 1981.

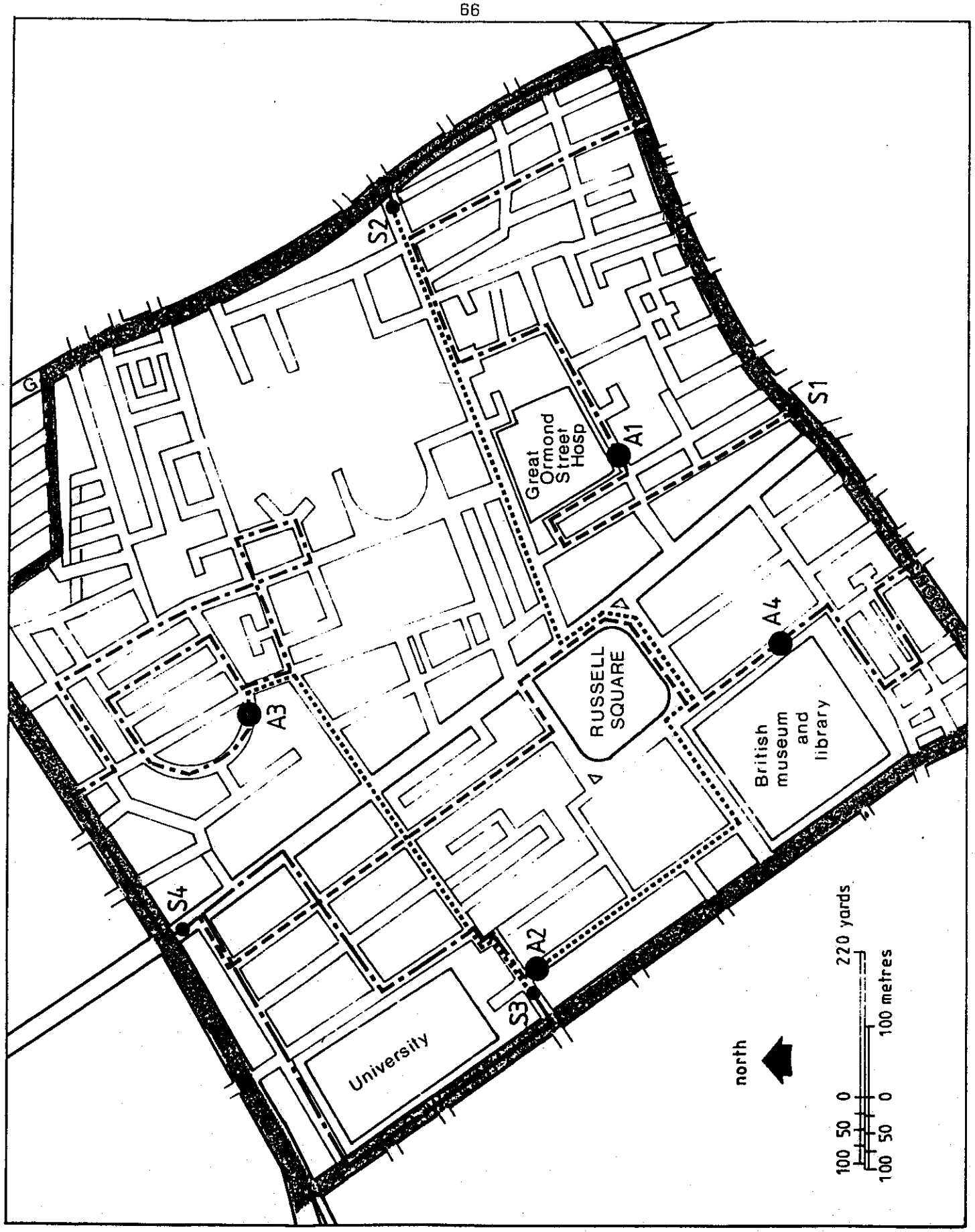
WRIGHT, C.C. and H. ORROM. The Westminster route choice survey: a new technique for traffic studies. Traffic Engineering and Control, Vol. 17, No. 8, pp. 348-54, 1976.



Survey area boundary
S1 Start point
Route to address
A1 Address
Route from address to next start point

APPENDIX 1

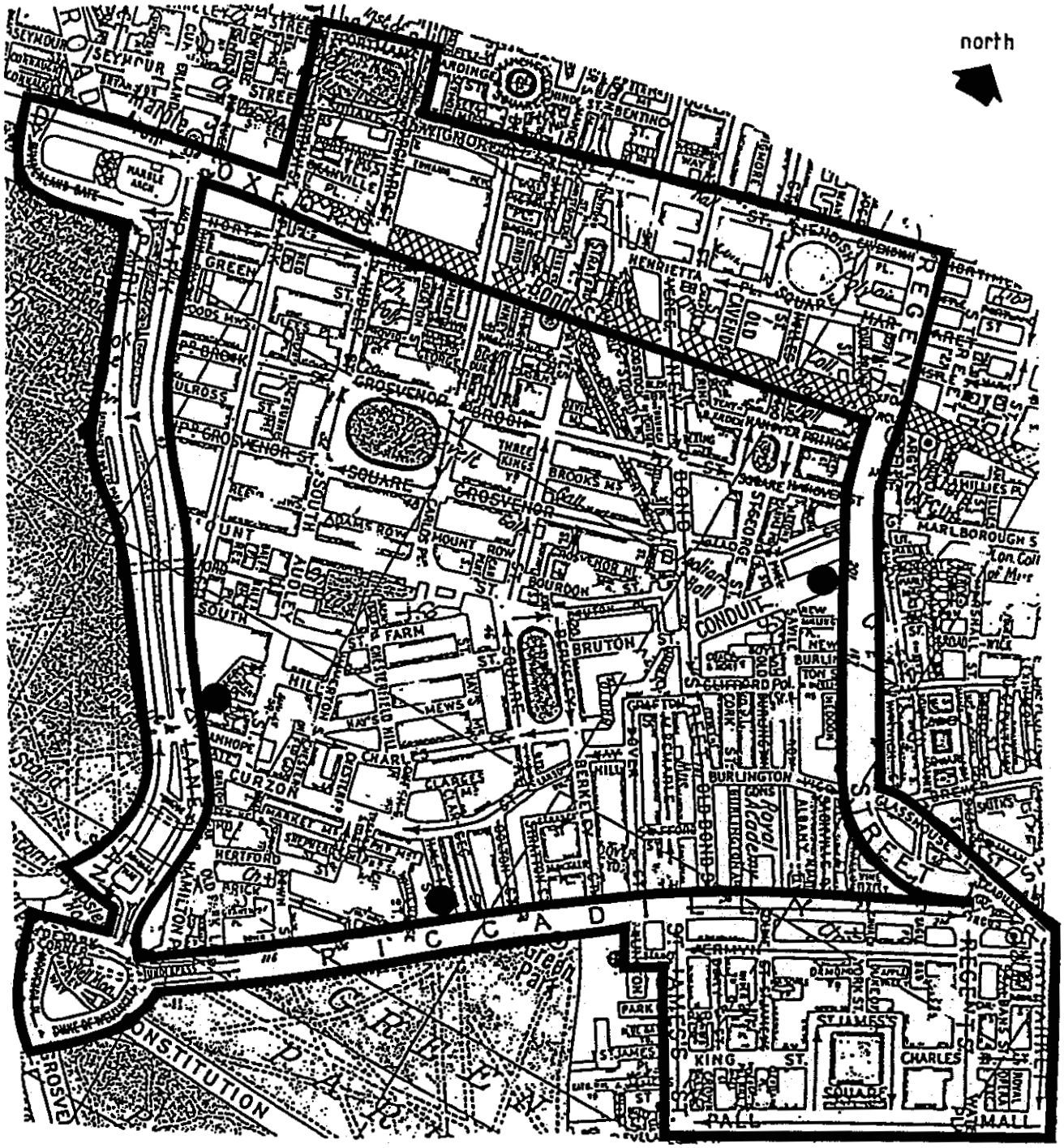
FIGURE 1 PARK AND VISIT SURVEYS - MAYFAIR



Survey area boundary
S1 Start point
Route to address
A1 Address
Route from address to next start point

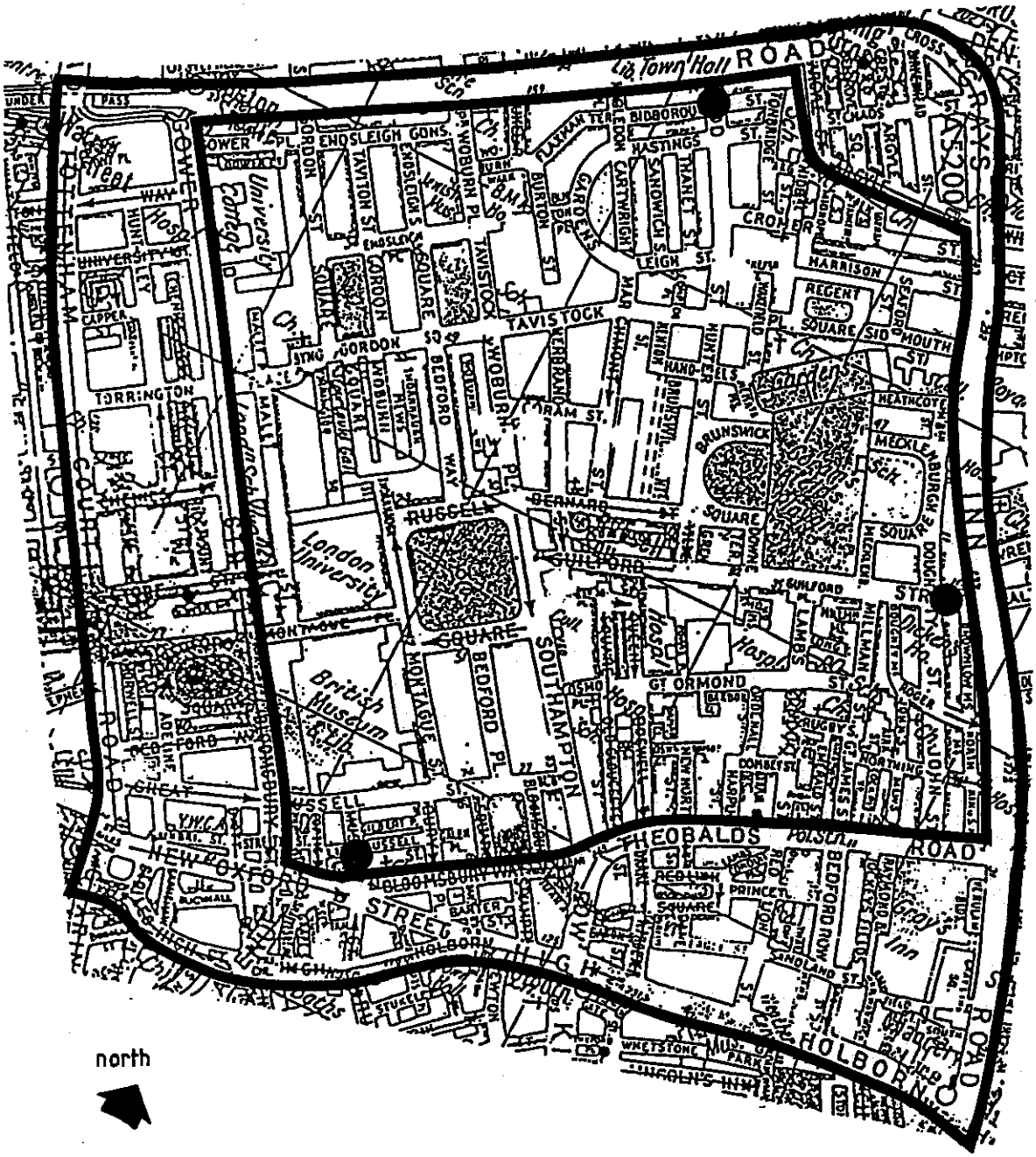
APPENDIX 1

FIGURE 2 PARK AND VISIT SURVEYS - BLOOMSBURY



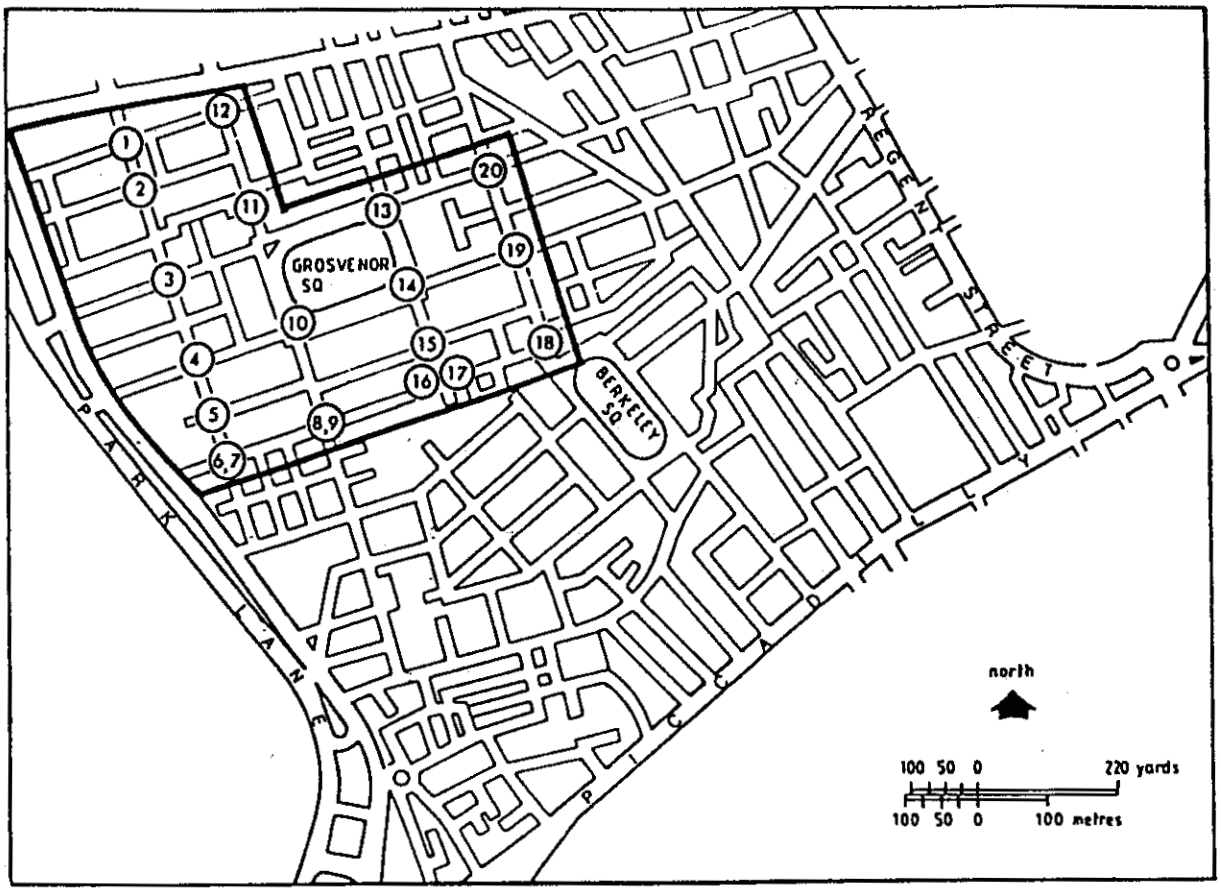
APPENDIX 2

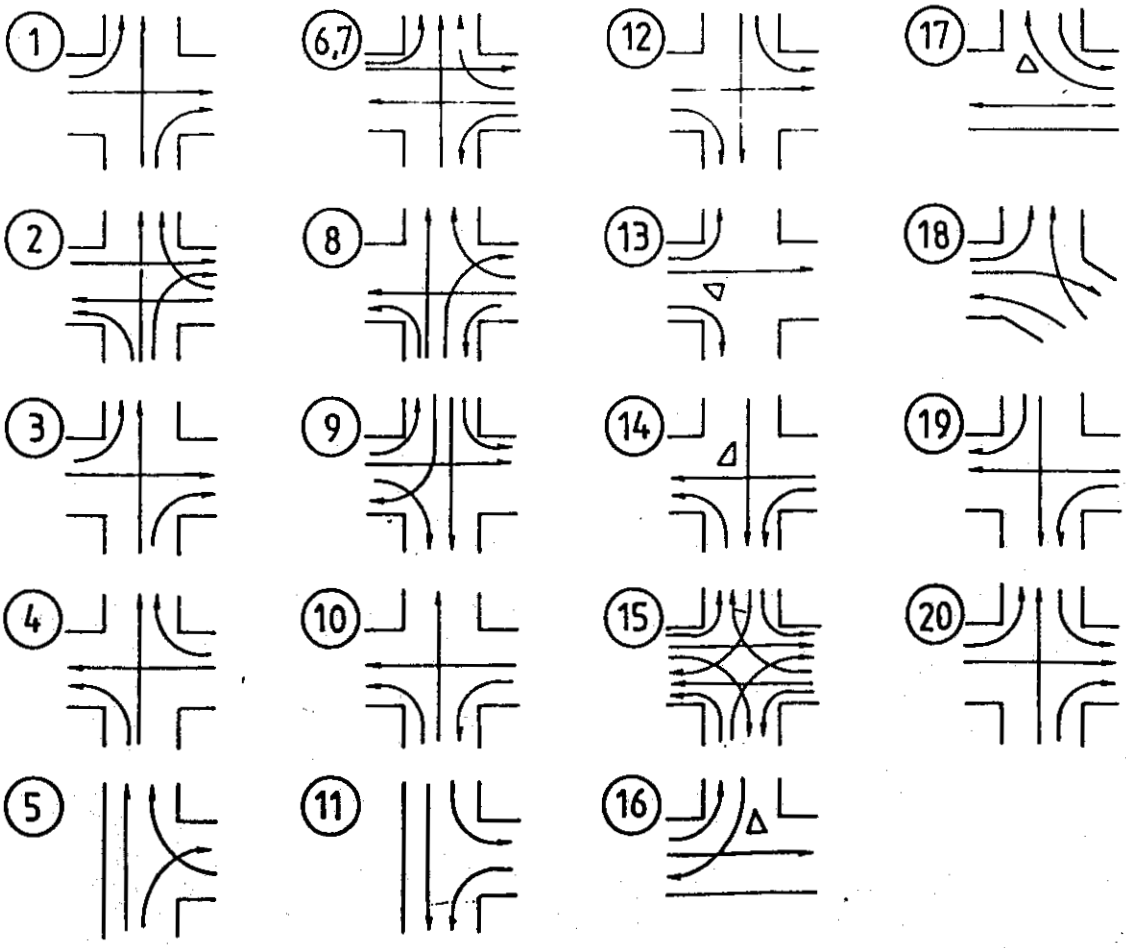
FIGURE 1 VEHICLE FOLLOWING SURVEYS - MAYFAIR



APPENDIX 2

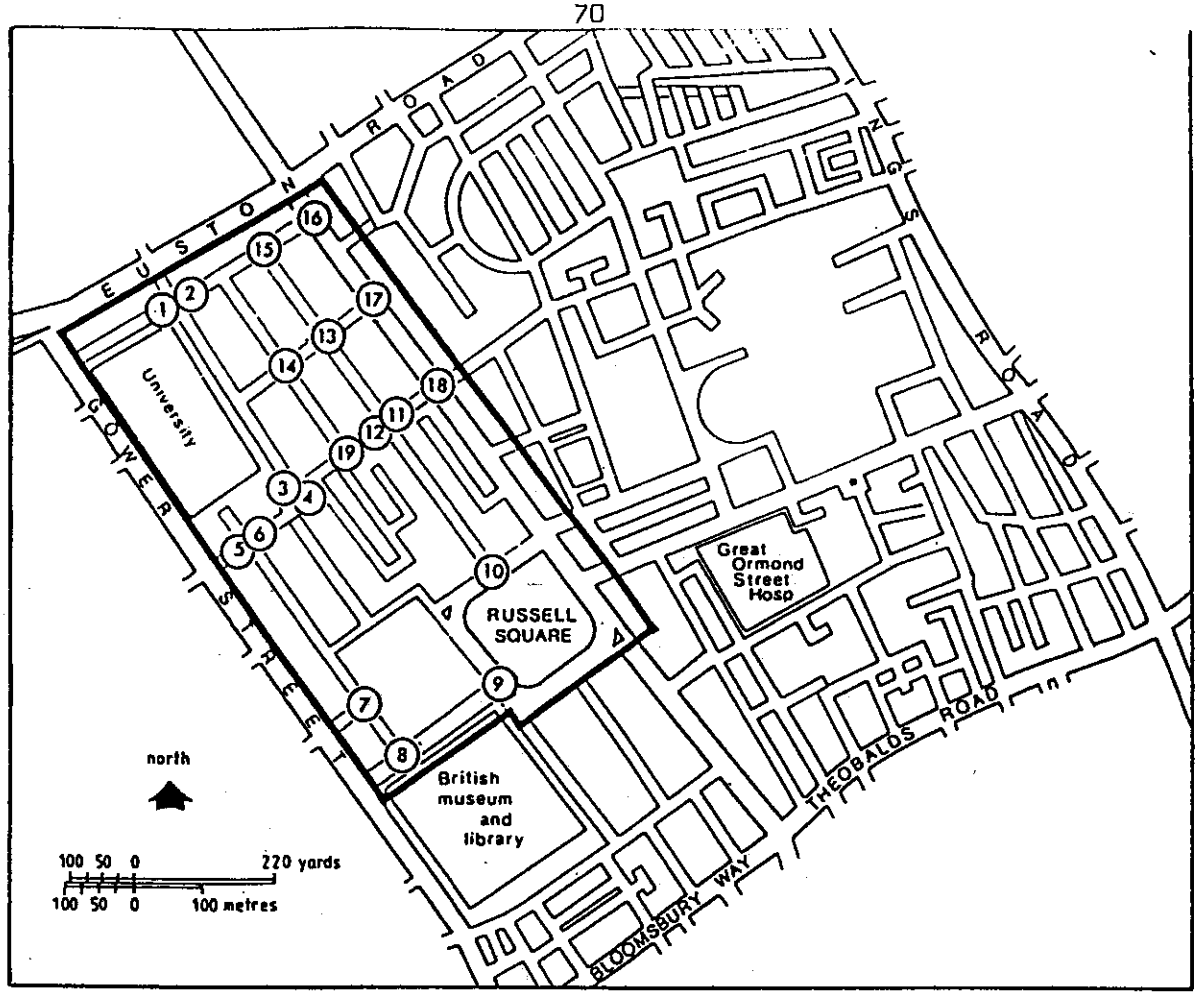
FIGURE 2 VEHICLE FOLLOWING SURVEYS - BLOOMSBURY

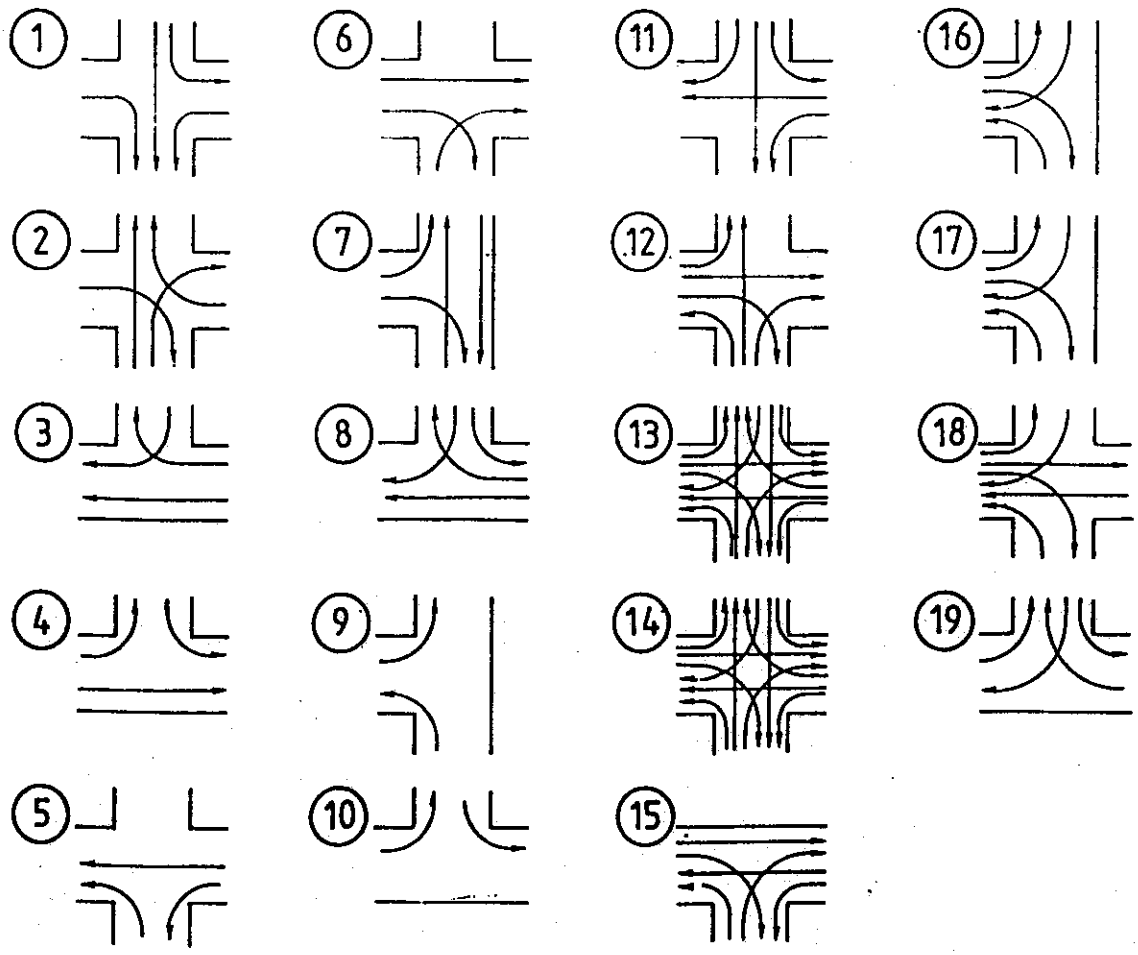




APPENDIX 3

FIGURE 1 REGISTRATION NUMBER SURVEY
SURVEY STATIONS AND TURNING MOVEMENTS
RECORDED - MAYFAIR





APPENDIX 3

FIGURE 2 REGISTRATION NUMBER SURVEY
SURVEY STATIONS AND TURNING MOVEMENTS
RECORDED - BLOOMSBURY

Appendix 4: Business Questionnaire

Name of firm :

Address of firm :

Type of firm :

Name of respondent :

Position of respondent within the firm, (owner, manager, etc.) :

Background information.

1. How long has the business been trading from these premises ?

2. Does the business have any other premises which are an integral part of the operations carried out here (in terms of supplying or receiving goods etc.) ?

Yes	(go to 3)
No	(go to 5)

3. Where are the other premises located ?

4. and what is their connection with the operations carried out here ?

5. Does the business own or operate any vehicles (including private cars used on company business) ?

Yes	(go to 6)
No	(go to 8)

6. How many vehicles does the business own or operate and of what type are they (show card A)?

Private cars	Company owned or operated cars	A	B	C	D	E

7. During the day where is each of these vehicles parked. What sort of parking is this (show card B) and how far is it from these premises ?

	Type of vehicle	Types of parking space	Distance from premises.
Vehicle 1			
Vehicle 2			
Vehicle 3			
Vehicle 4			

8. How often does the business receive supplies of goods :

(a) delivered by a supplier ?

(b) brought to the premises by an employee ?

9. Where are the goods off-loaded and, if this is not on site, how are they brought from there to the premises ?

10. Who are your main suppliers, and from where are deliveries made/goods fetched ?

Supplier	Source of goods	Delivered or fetched.

11. Excluding trips to fetch supplies, how many trips are made from these premises each week on company business ?

What proportion of these are made by private transport ?

12. Excluding trips to deliver supplies, how many trips are made to these premises each week on business (by representatives, regional managers etc) ?

What proportion of these are made by private transport ?

What sort of parking space do they use (show card B) and how far are these from the premises ?

Number of trips | Parking type | Distance from premises.

13. How many people work at these premises

(a) full time (over 30 hours per week) ?

(b) part time (8 - 30 hours per week) ?

What proportion of these come to work by car ?

What sort of parking space do they use (show card B) and how far are these from the premises ?

Number of employees. | Parking type | Distance from premises.

14. How many clients/customers do you have on a typical day ?

What proportion of these come to these premises by car ?

What sort of parking space do they use (show card B) and how far are these from the premises ?

Number of customers. | Parking Type. | Distance from premises.

15. How seriously do transport or traffic problems affect the operation of your business at these premises ? (C)

extremely

very

fairly

not very

not at all (go to 20)

16. Which other problems affect the operation of your business more seriously than transport ?

Looking in more detail at transport and traffic problems:

17. ..... what do you see as the main transport or traffic problems associated with the operation of your business at these premises ?

1.

2.

3.

4.

5.

6.

18. ..... taking each of these in turn, how seriously are your business operations affected by these problems ? (C)

	extremely	very	fairly	not very	not at all
problem no. 1.					
problem no. 2.					
problem no. 3.					
problem no. 4.					
problem no. 5.					
problem no. 6.					

19. .....and, for each, what effects does it have on business operations ?

effects

1.

2.

3.

4.

5.

6.

20. How important is the on-street parking situation to the operation of your business at these premises ?

(a) extremely

(b) very

(c) fairly

(d) not very

(e) not at all (go to Q.25).

21. In what ways is the on-street parking situation important to the operation of your business at these premises ?

22. ..... what do you see as the main problems of on-street parking associated with the operation of your business at these premises ?

1.

2.

3.

4.

5.

23. ..... taking each of these in turn, how seriously are your business operations affected by these problems ? (read list).

problem No.	extremely	very	fairly	not very	not at all.
1.					
2.					
3.					
4.					
5.					

24. .....and, for each, what effect does it have on business operations ?

effects

1.

2.

3.

4.

5.

25. What do you see as the main problems of on-street parking associated with the supply of goods to these premises by your suppliers ?

1.

2.

3.

4.

5.

26. .....taking each of these in turn, how seriously are your suppliers affected by these problems ?

	extremely	very	fairly	not very	not at all
problem no. 1.					
2.					
3.					
4.					
5.					

27. Can you suggest the name and address of a major supplier whom we could approach to discuss these problems ?

Thinking, for the moment, only of this business

28. .....are there any ways in which you think that this business might benefit from stricter enforcement of parking regulations ?

29. .....are there any ways in which you think that this business might suffer from stricter enforcement of parking regulations ?

30. .....overall, as far as this business is concerned, do you think that stricter enforcement of parking regulations would be :

(a) a good thing

(b) a bad thing

(c) neither good nor bad

(d) don't know.

31. .....do you think that your trade/turnover might be affected by stricter enforcement of parking regulations ?

Yes No

32. .....and, would you be willing to help us assess any such effects by providing us with further information in the future ?

Yes No.

Thank you for your assistance.

Interview comments:-

Appendix 5: Suppliers' Questionnaire

Name of firm: _____

Address of firm: _____

Name of respondent: _____

Position held within firm: _____

1. How long has the business been trading from these premises? _____ years.

2. What functions are performed here?
   - Manufacturing ☐
   - Warehousing ☐
   - Distribution ☐
   - Office ☐
   - Other (specify) _____

3. What are the major products or materials which you supply?

   _____

4. How many other bases relevant to your supply operations do you have in the London area? _____

5. How many vehicles, including your own and those on long-term hire or contract normally operate from your London base(s)? Include cars normally used for company business. (Show card A)

Private Cars	Company owned or operated cars	A	B	C	D	E
____	____	____	____	____	____	____

6. Each week approximately how many deliveries are made from your London base(s) by

   - your own vehicles _____
   - specialist hauliers _____
   - customers' vehicles _____
   - other (specify) _____

7. Of all deliveries by your own vehicles, how many each week are to Central London? _____

8. Of these, how many are to

   - the Bloomsbury area _____
   - the Mayfair area _____ (Show maps)

9. When making deliveries to Central London do you use the full range of vehicles available to you?

   ☐ Yes ☐ No

   If no - why is this? _____

   and - which vehicles do you use when making deliveries to Central London? (Show card A)

Private Cars	Company owned or operated cars	A	B	C	D	E
____	____	____	____	____	____	____

10. How seriously do transport or traffic problems affect your supply operations? (Show card C)

    a) extremely ☐
    b) very ☐
    c) fairly ☐
    d) not very ☐
    e) not at all ☐

11. Which other problems affect your supply operations more seriously than transport?

    _____

12. What do you see as the main transport or traffic problems associated with making deliveries to Central London?

    1. _____
    2. _____
    3. _____
    4. _____
    5. _____
    6. _____

13. Taking each of these in turn how seriously are your business operations affected by these problems? (Show card C)

	extremely	very	fairly	not very	not at all
Problem No. 1	☐	☐	☐	☐	☐
Problem No. 2	☐	☐	☐	☐	☐
Problem No. 3	☐	☐	☐	☐	☐
Problem No. 4	☐	☐	☐	☐	☐
Problem No. 5	☐	☐	☐	☐	☐
Problem No. 6	☐	☐	☐	☐	☐

14. And, for each, what effects does this have on your business operations?

effects

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

15. In terms of transport or traffic problems would you consider the situation in Bloomsbury relative to that in Central London generally to be

a) much worse
b) worse
c) about the same
d) better
e) much better
f) don't know

16. And, would you consider the situations in Mayfair relative to that in Central London generally to be

a) much worse
b) worse
c) about the same
d) better
e) much better
f) don't know

17. How important to your supply operations is the on-street parking situation in Central London?

a) extremely
b) very
c) fairly
d) not very
e) not at all

18. In what ways is the on-street parking situation in Central London important to your supply operations?

_____

_____

19. What do you see as the main problems of on-street parking associated with making deliveries to Central London?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

20. Taking each of these in turn, how seriously are your business operations affected by these problems? (Read list)

	extremely	very	fairly	not very	not at all
Problem No. 1					
Problem No. 2					
Problem No. 3					
Problem No. 4					
Problem No. 5					
Problem No. 6					

21. And, for each, what effect does this have on your business operations?

effects

1. _____
2. _____
3. _____
4. _____
5. _____

22. In terms of on-street parking problems would you consider the situation in Bloomsbury relative to that in Central London generally to be

a) much worse
b) worse
c) about the same
d) better
e) much better
f) don't know

23. And, would you consider the situation in Mayfair relative to that in Central London generally to be

a) much worse
b) worse
c) about the same
d) better
e) much better
f) don't know

24. Are there any ways in which you think that this business might benefit from stricter enforcement of parking regulations in Central London?

_____

_____

_____

25. Are there any ways in which you think that this business might suffer from stricter enforcement of parking regulations in Central London?

_____

_____

_____

26. Overall, as far as this business is concerned, do you think that stricter enforcement of parking regulations in Central London would be:

1) a good thing ☐
2) a bad thing ☐
3) neither good nor bad ☐
4) don't know ☐

27. Do you think that your trade might be affected by stricter enforcement of parking regulations?

☐ Yes ☐ No

28. And, would you be willing to help us assess any such effects by providing us with further information in the future?

☐ Yes ☐ No

Thank you for your assistance.

Interview comments:

APPENDIX 6. THE 'RANDOM' SEARCH PROCESS

Coverage of the Areas

Figures 1 and 2 indicate the roads in Mayfair and Bloomsbury respectively which were covered by the fixed and 'random' search routes over the eight-day survey periods. Start points and addresses are also shown. It can be seen that in both areas the majority of through streets were covered during the survey but that in both substantial sub areas were omitted. In Mayfair the two main areas were the SE and SW corners. The former is only accessible from the remainder of the area by the New Bond Street-Clifford Street route or via Savile Row, and the main area can only be re-entered directly via Hay Hill. The latter is only directly accessible from two narrow side turnings from Curzon Street and the one-way street system makes searching difficult. In Bloomsbury one large and three smaller areas were omitted. The first, in the NE corner, is largely separated by barriers and access restrictions, as is the Lamb's Conduit Street area. The area south of the British Museum is only accessible via Bloomsbury Street. The only surprising omission is the Marchmont Street/Coram Street area, which is probably explained by its remoteness from all addresses except that at Cartwright Gardens, where parking spaces were relatively easy to find. It appears therefore that with this one exception the areas as a whole were covered as fully as traffic management schemes would permit.

Randomness of the Search Process

In order to determine whether the searchers followed fixed routes or were influenced in their search process by earlier successes and failures, a study was made of the routes followed on successive visits. Such analyses are not necessarily appropriate for all addresses, since for some (particularly Cartwright Gardens) spaces are easy to find, and for others the search process is largely dictated by the one-way street system. Figure 3 illustrates the latter point. The survey car travelling eastwards along Gt. Ormond Street is restricted to turning left into Lamb's Conduit Street or Millman Street, or alternatively searching in the narrow streets to the south. In practice the three runs on the day illustrated which failed to find a space in Great Ormond Street turned left into Lamb's Conduit Street since this provided a greater choice of search points. Searching routes only varied in the Mecklenburgh Square area.

Figures 4 a-h present the eight days' search routes for one address where several failures occurred : South Street Mayfair. There is no obvious pattern to the search process, and no indication of later searches being influenced by earlier successes and failures. Table F.1 illustrates this by indicating the pattern of choices at the first choice point : the South Street/South Audley Street junction.

TABLE 1 : NUMBERS OF CHOICES OF ALTERNATIVE ROUTES AT SOUTH STREET/SOUTH AUDLEY STREET JUNCTION

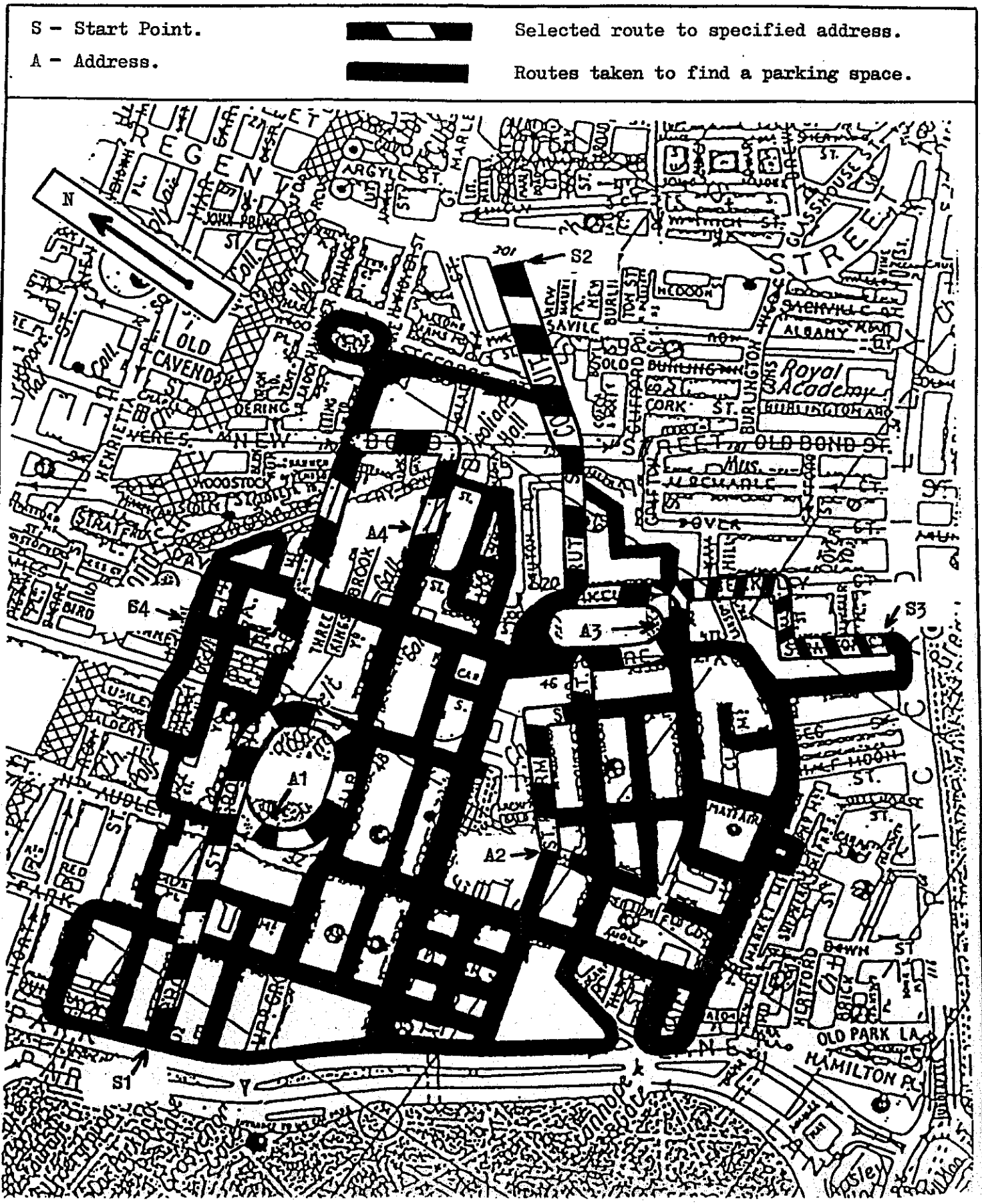
Choice made :	Straight		Left		Right		N/A(1)
Meter found ?	Y	N	Y	N	Y	N	-
Day 1	2	0	2	1	0	0	0
Day 2	1	1	3	1	0	0	0
Day 3	3	0	1	2	0	0	0
Day 4	1	0	3	1	0	0	1
Day 5	1	1	2	0	1	0	0
Day 6	3	0	1	1	1	0	0
Day 7	2	0	2	1	1	0	0
Day 8	1	1	2	1	0	0	1
Totals	14	3	16	8	3	0	2
Percentage of total	31	6	36	17	6	0	4

(1) Meter found before reaching South Audley Street.

It can be seen that the left turn was the most popular, but also the least successful manoeuvre. There is no evidence however, of this manoeuvre becoming less popular during the survey. Conversely, the rarely used but always successful right turn did not increase in usage after first being tried on Day 5. It may well be that traffic conditions at junctions determine choice more than the learning process. It might be useful in the after-survey to record conditions at junctions and different reasons for the routes taken.

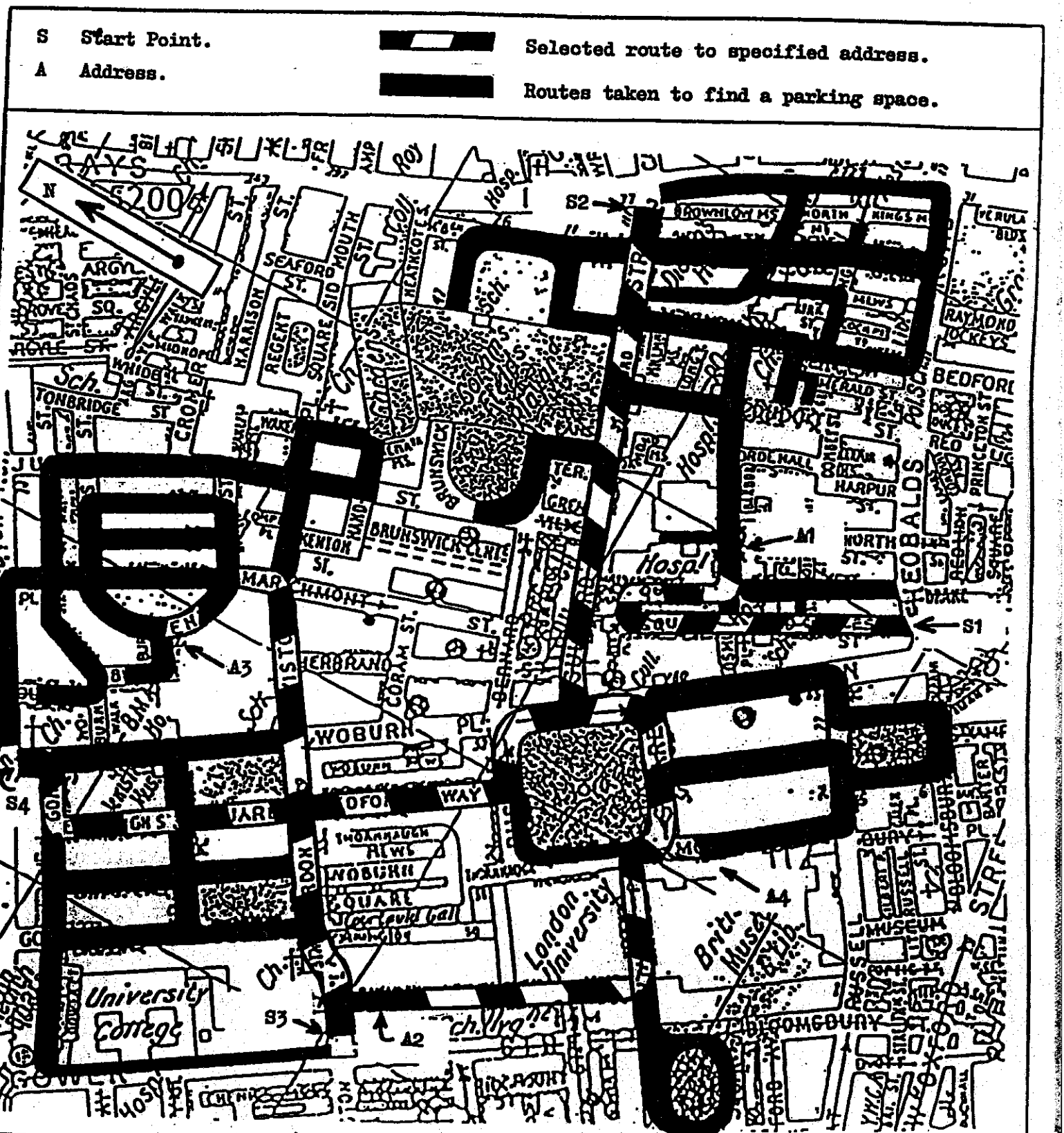
Appendix 6:

Figure 1: Roads used at any stage in the park and visit survey : Mayfair



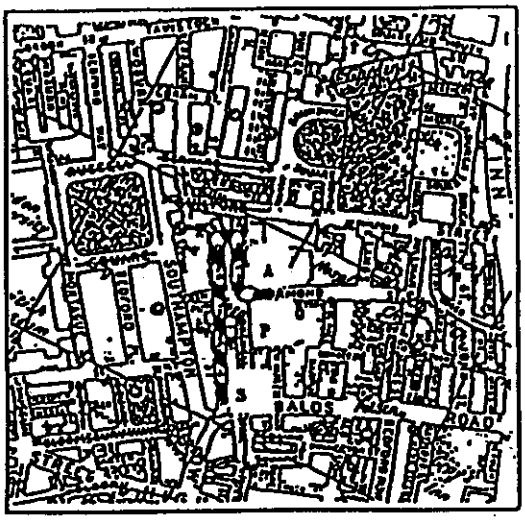
Appendix 6.

Figure 2: Roads used at any stage in the park and visit survey : Bloomsbury

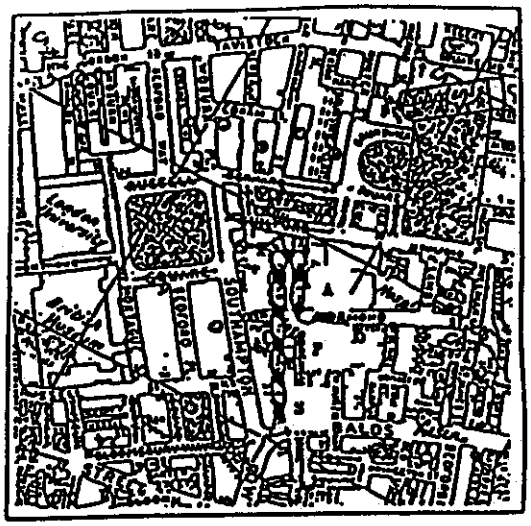


Appendix 6

Figure 3: Search routes for Great Ormond Street, Bloomsbury 23.2.83

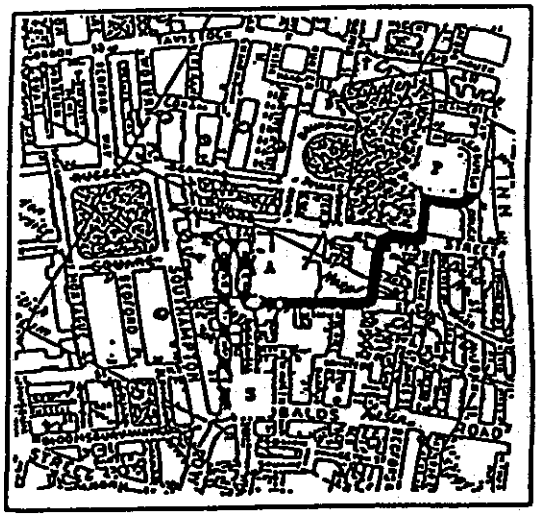


Time : 7.31 am

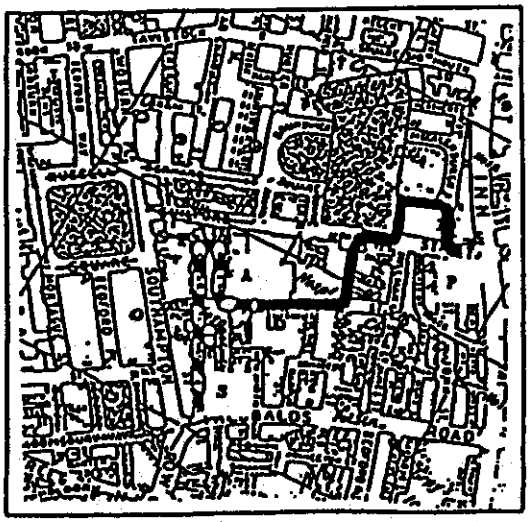


Time : 8:50 am

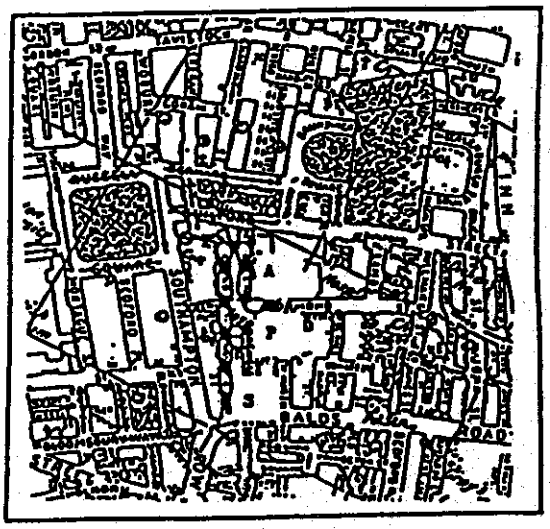
Time : 10.40 am



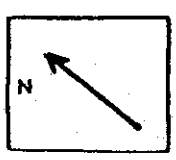
Time : 12.59 pm



Time : 2.20 pm

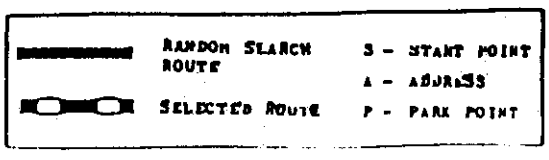


Time : 4.05 pm



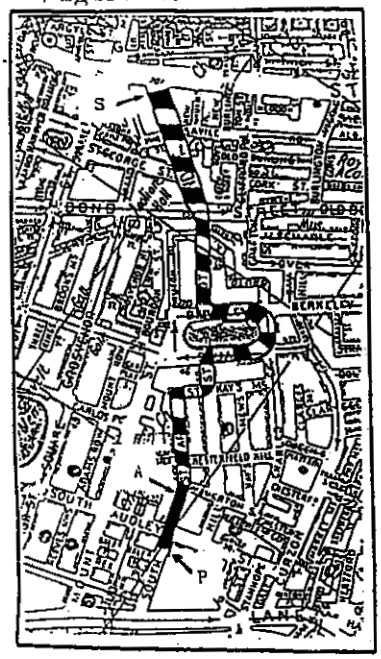
PARK AND VISIT SURVEYS

BLOOMSBURY : 23/2/83, address 1

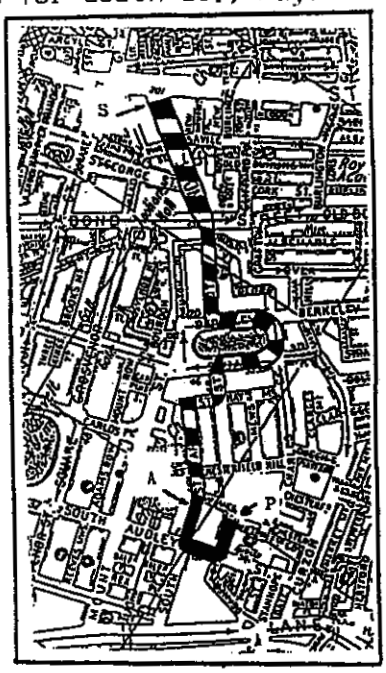


Appendix 6

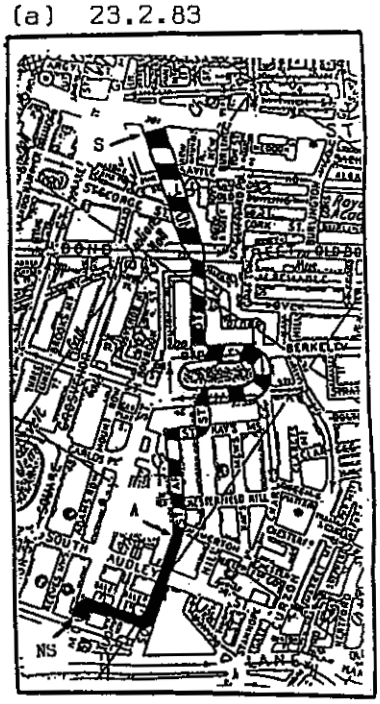
Figure 4. Search routes for South St., Mayfair. (a) 23.2.83



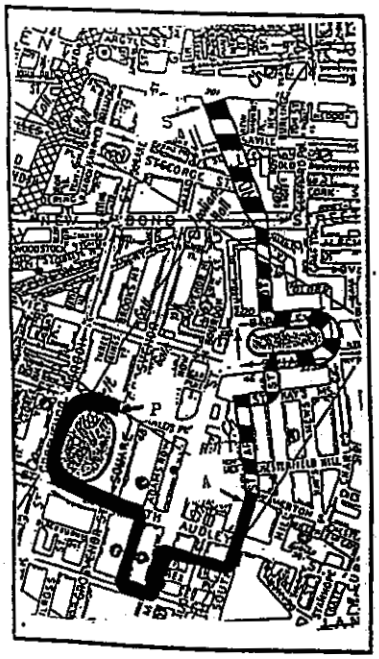
Time : 8.04 am.



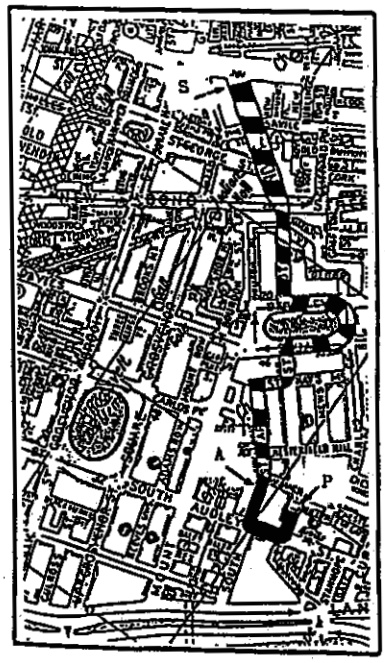
Time : 9.22 am.



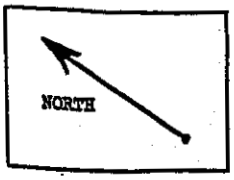
Time : 11.09 am. (NS)



Time : 1.50 pm.

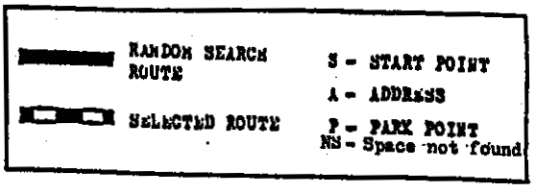


Time : 3.39 pm.



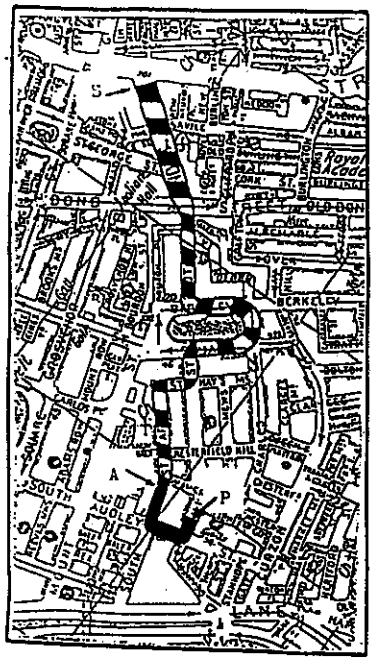
PARK AND VISIT SURVEYS

MAYFAIR : 15/2/83 address 2.

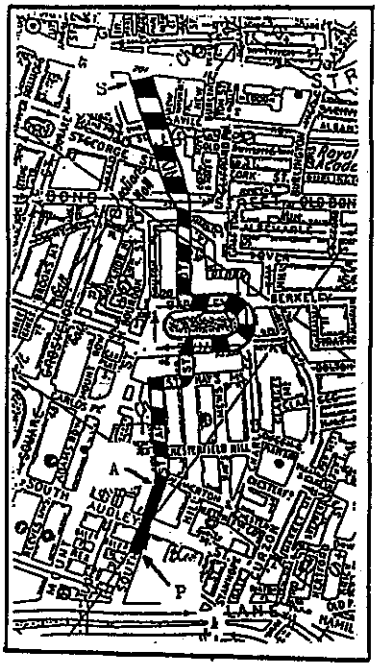


Appendix 6.

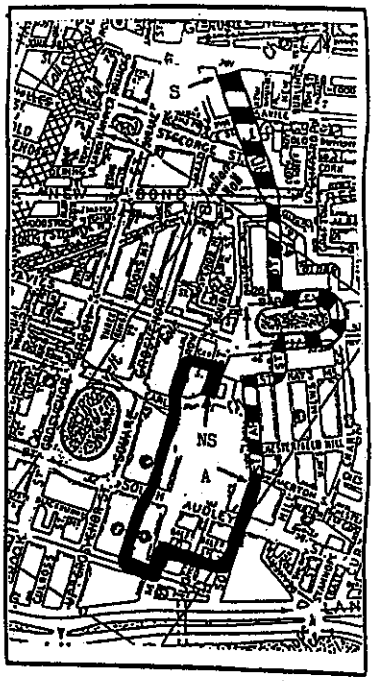
Figure 4 (b). 16.2.83



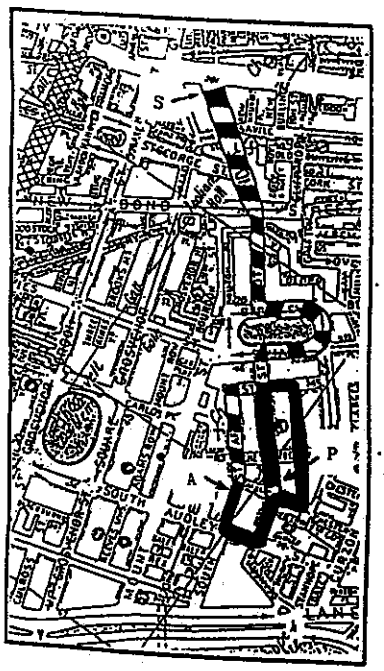
Time : 7.49 am.



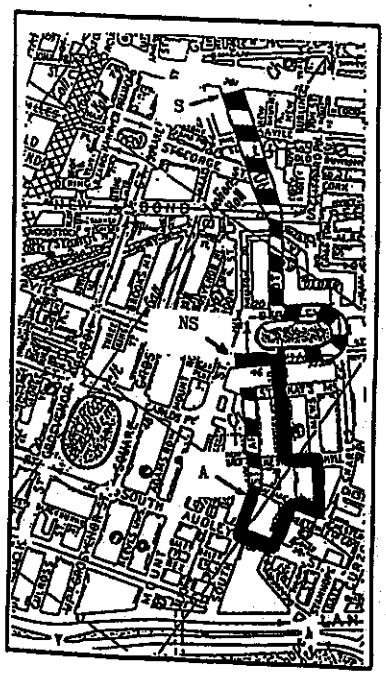
Time : 9.18 am.



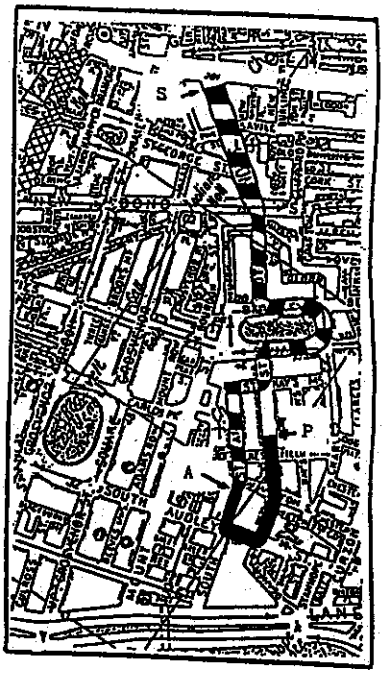
Time : 11.14 am. (NS)



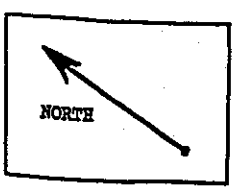
Time : 1.42 pm.



Time : 3.16 pm. (NS)

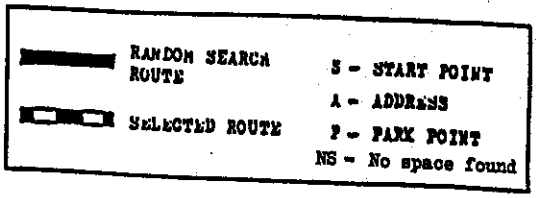


Time : 5.00 pm.



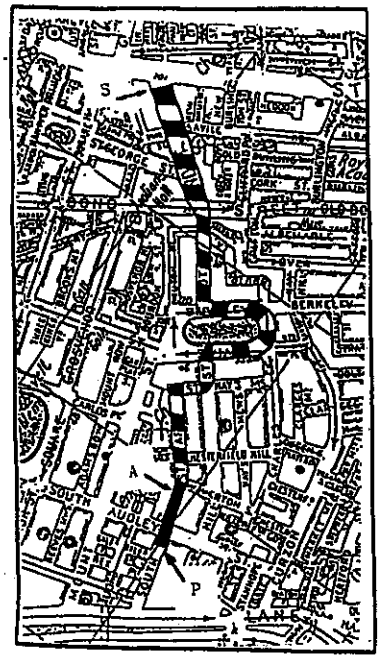
PARK AND VISIT SURVEYS

MAYFAIR : 16/2/83, address 2.

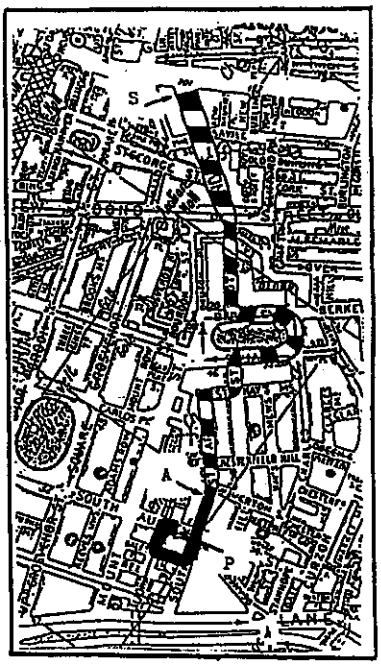


Appendix 6.

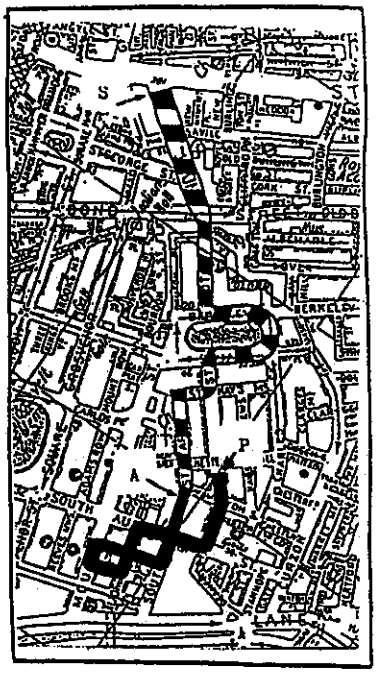
Figure 4(c) 17.2.83



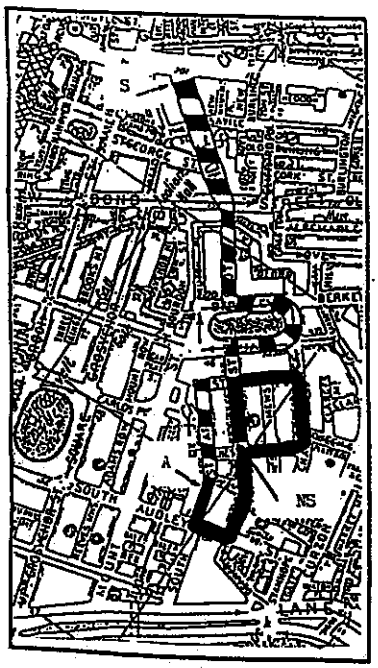
Time : 8.02 am.



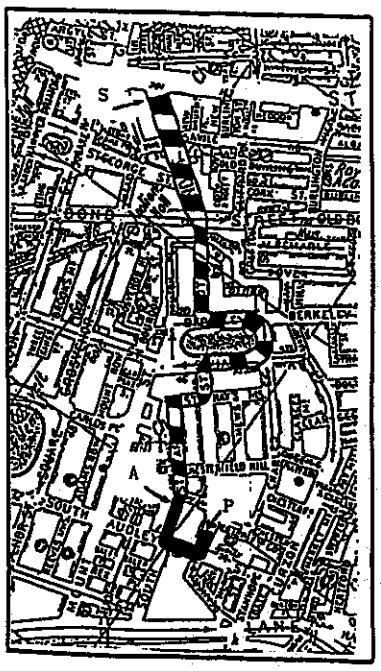
Time : 8.56 am.



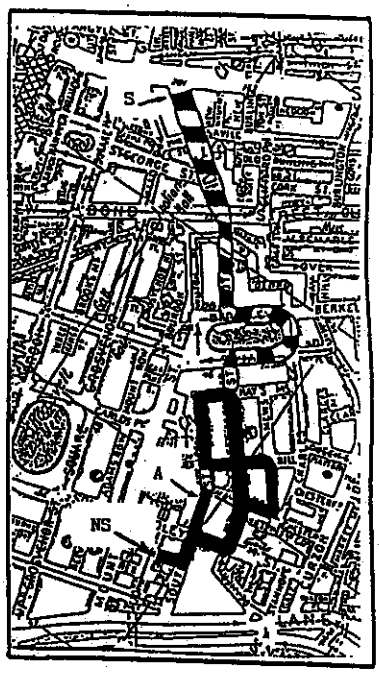
Time : 10.57 am.



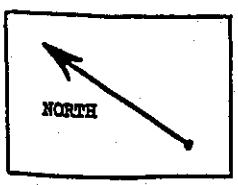
Time : 1.22 pm. (NS)



Time : 2.52 pm.

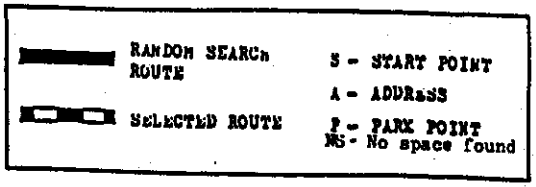


Time : 4.54 pm. (NS)



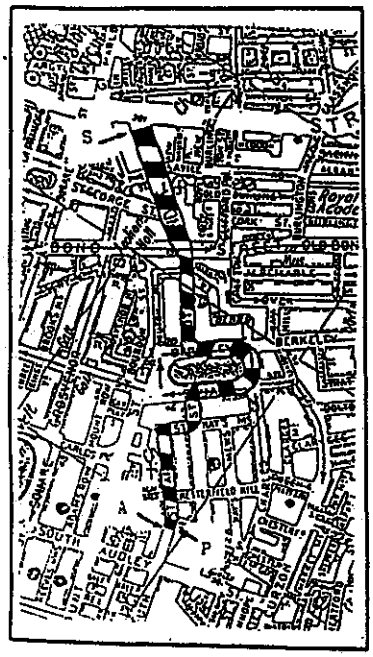
PARK AND VISIT SURVEYS

MAYFAIR : 17/2/83, address 2.

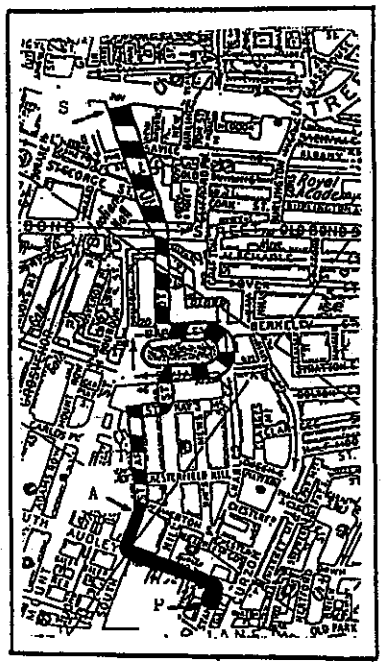


Appendix 6.

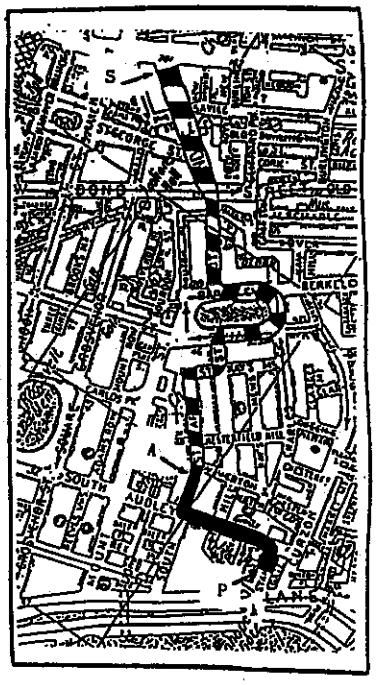
Figure 4 (d). 18.2.83



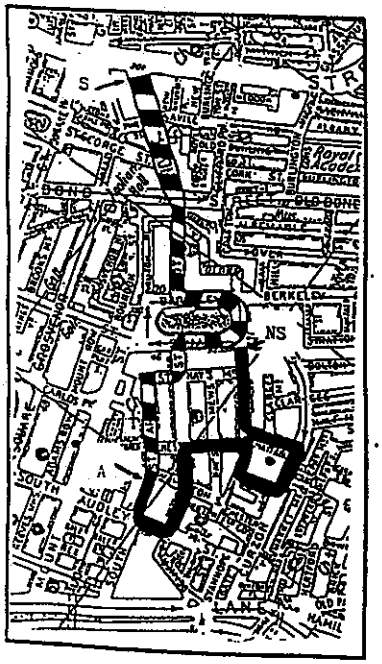
Time : 7.57 am.



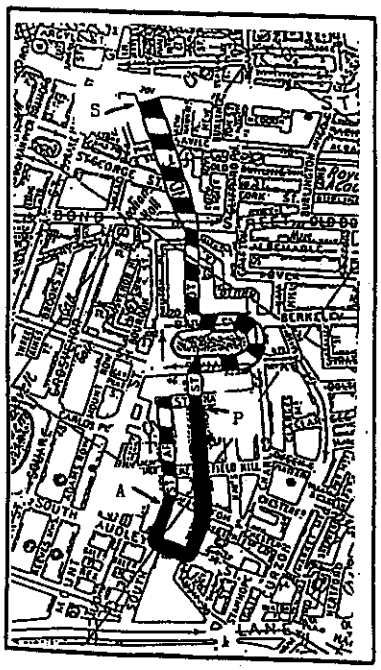
Time : 8.45 am.



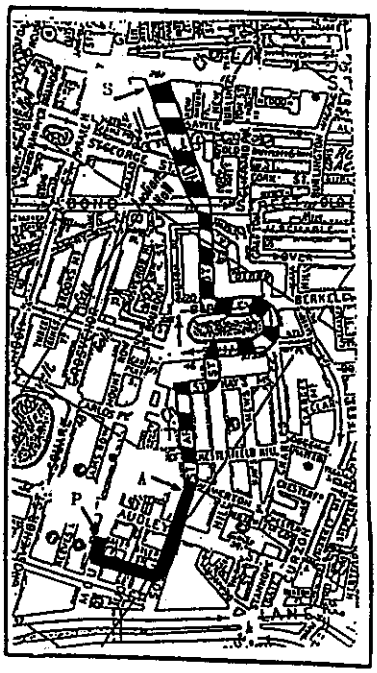
Time : 10.28 am.



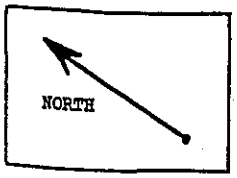
Time : 12.57 pm. (NS)



Time : 2.21 pm.

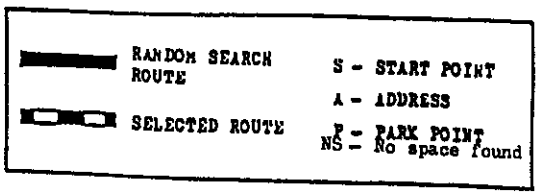


Time : 3.55 pm.



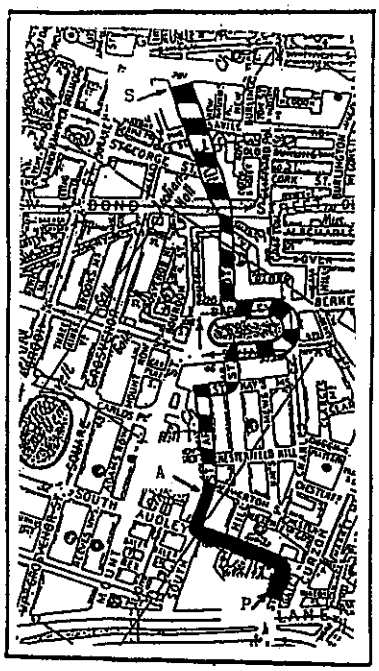
PARK AND VISIT SURVEYS

MAYFAIR : 18/2/83, address 2.

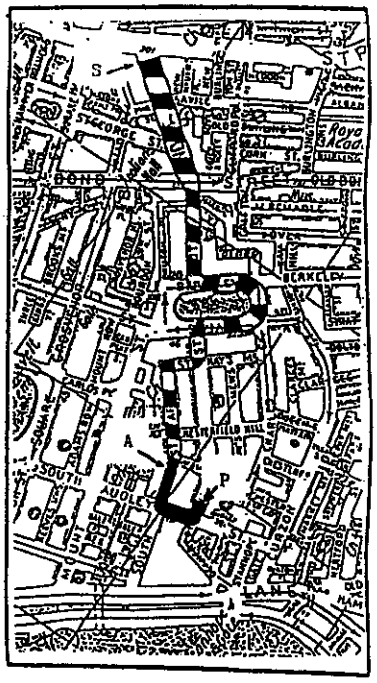


Appendix 6.

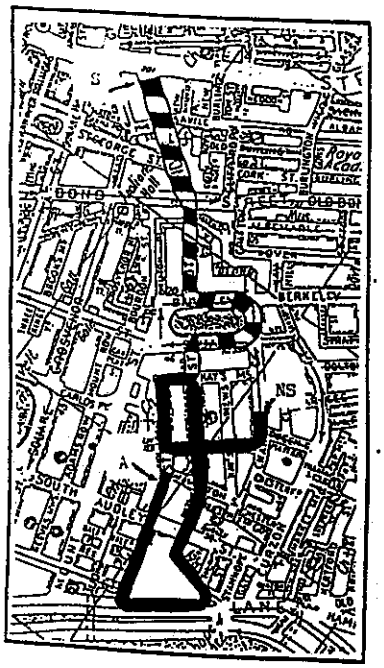
Figure 4 (e) 21.2.83



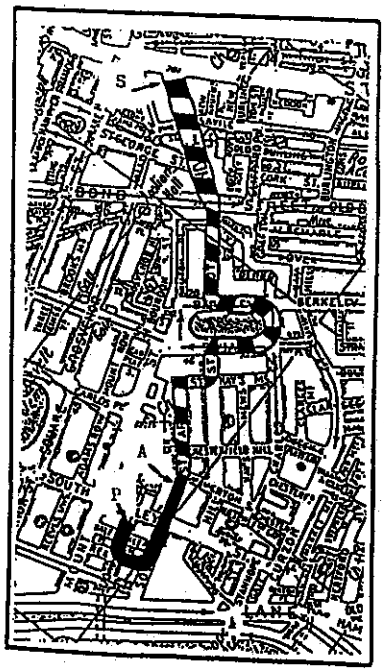
Time : 8.56 am.



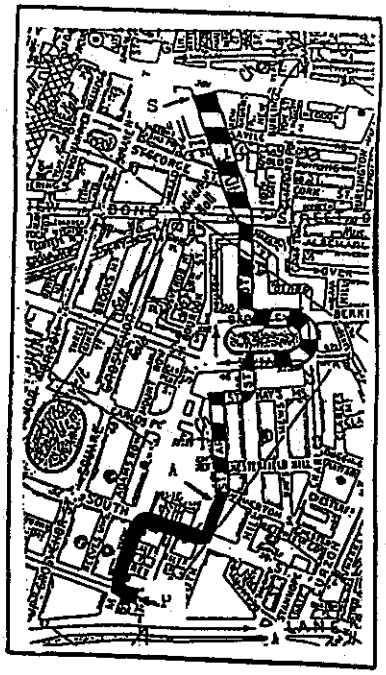
Time : 10.32 am.



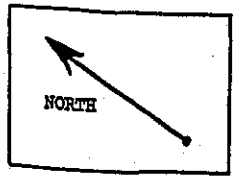
Time : 1.27 pm. (NS)



Time : 2.52 pm.

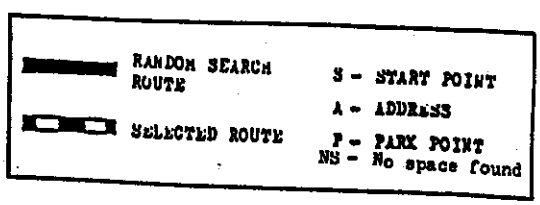


Time : 4.31 pm.



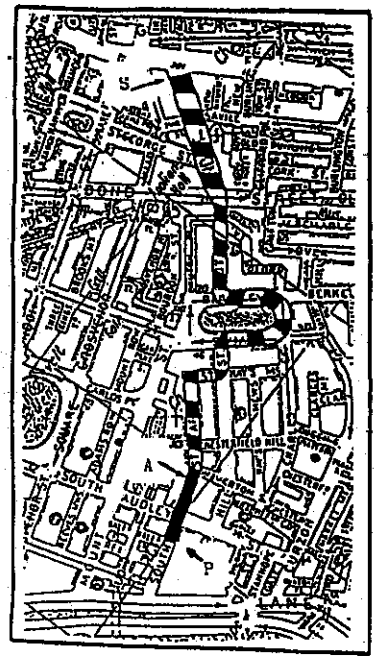
PARK AND VISIT SURVEYS

MAYFAIR : 21/2/83, address 2.

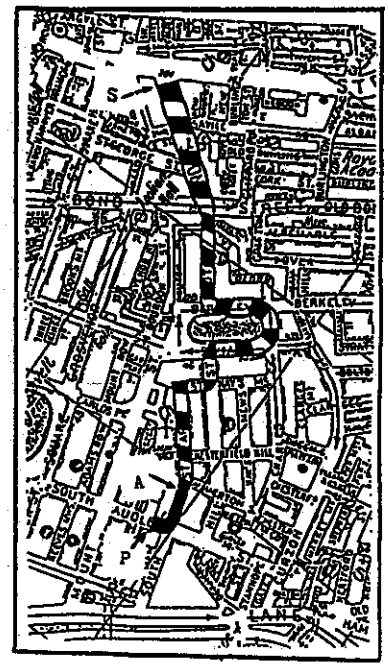


Appendix 6.

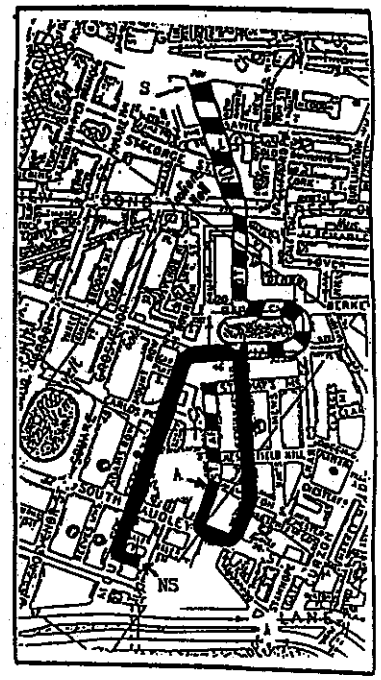
Figure 4 (f) 22.2.83



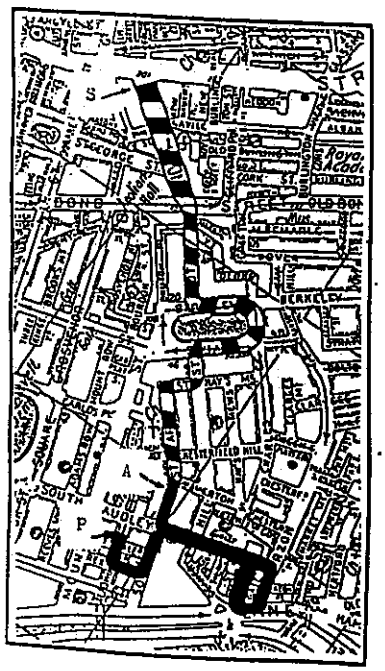
Time : 7.51 am.



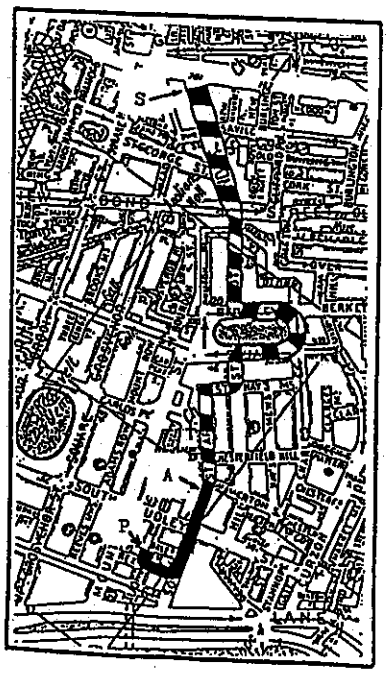
Time : 8.46 am.



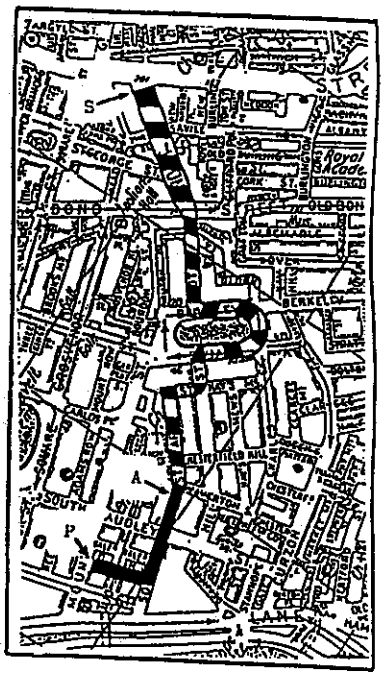
Time : 11.08 am. (NS)



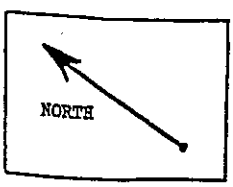
Time : 1.45 pm.



Time : 2.58 pm.

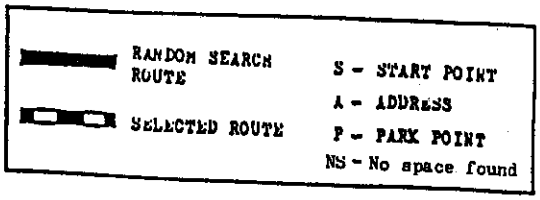


Time : 4.26 pm.

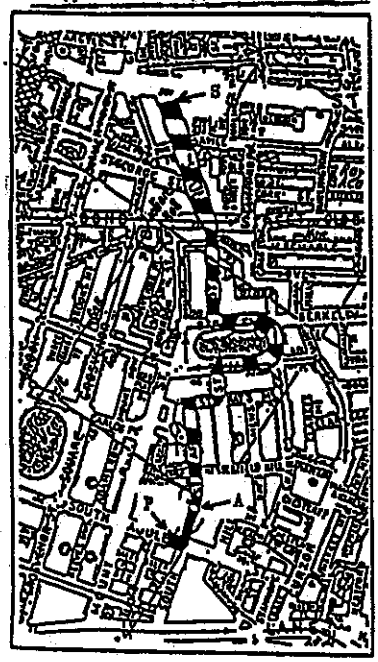


PARK AND VISIT SURVEYS

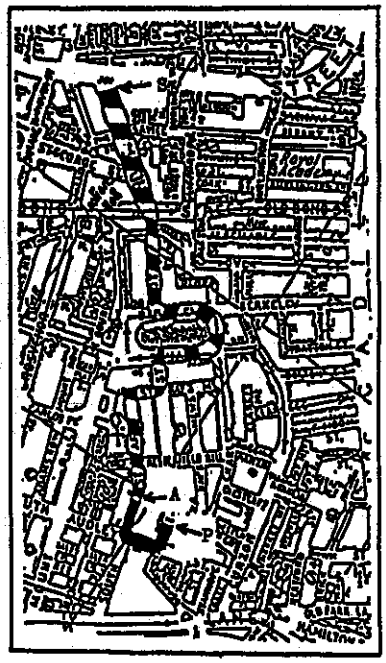
MAYFAIR : 22/2/83, address 2.



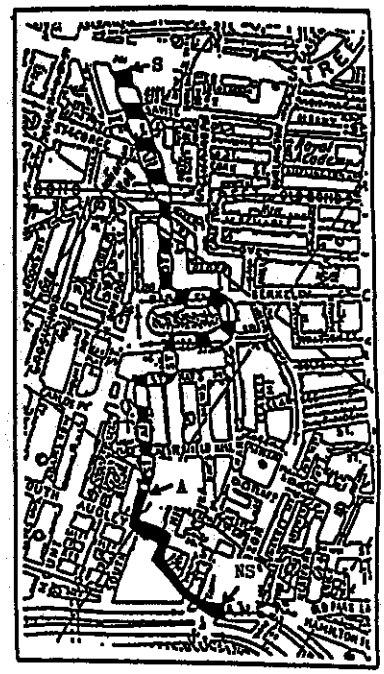
Appendix 6
Figure 4 (g) 23.2.83



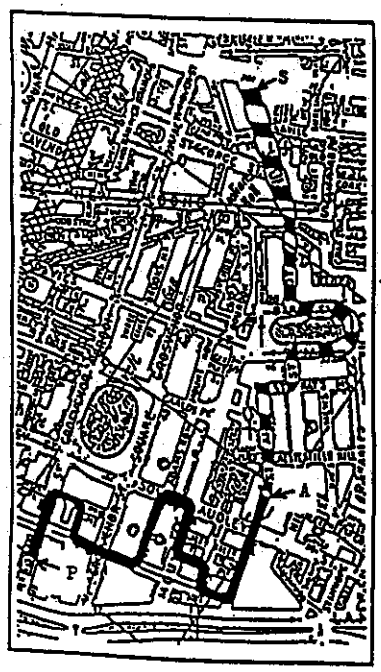
Time : 7.52 am



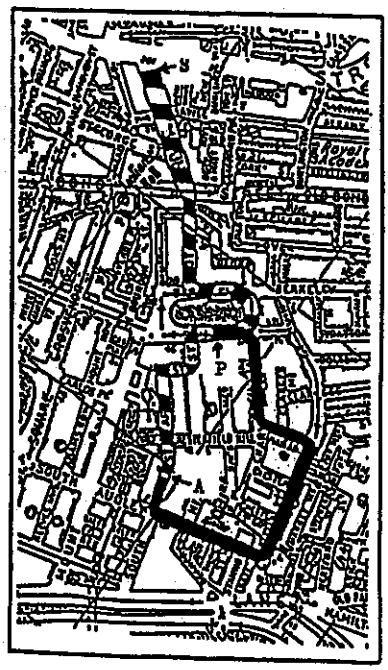
Time : 8.52 am



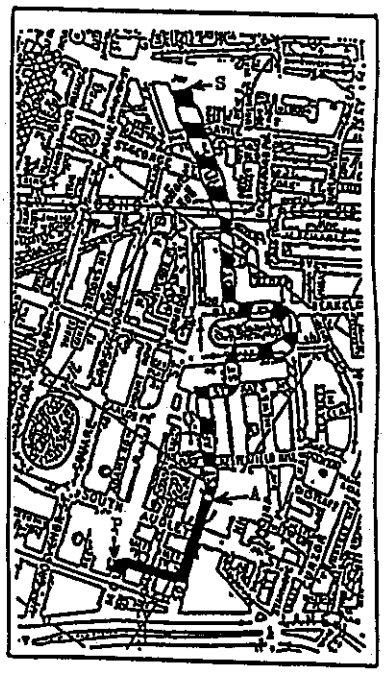
Time : 10.48 am (NS)



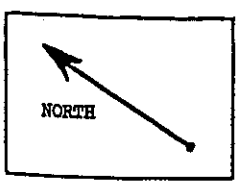
Time : 1.17 pm



Time : 2.31 pm

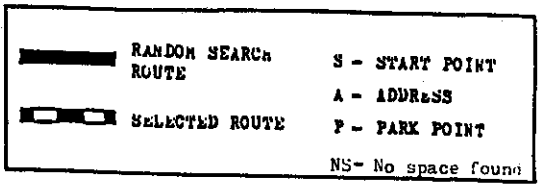


Time : 4.16 pm



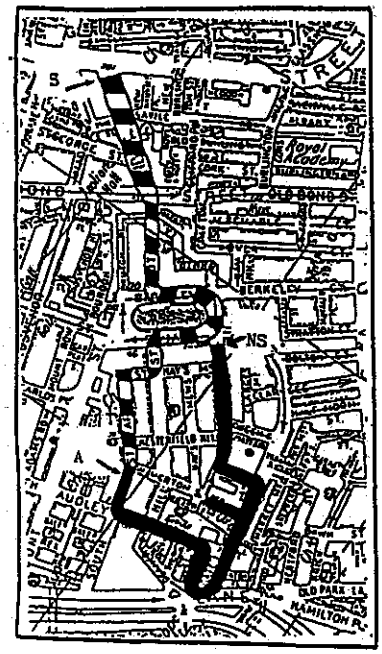
PARK AND VISIT SURVEYS

MAYFAIR : 23/2/83, address 2.

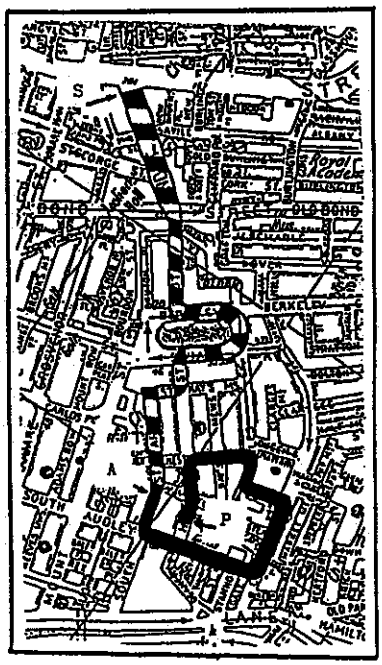


Appendix 6

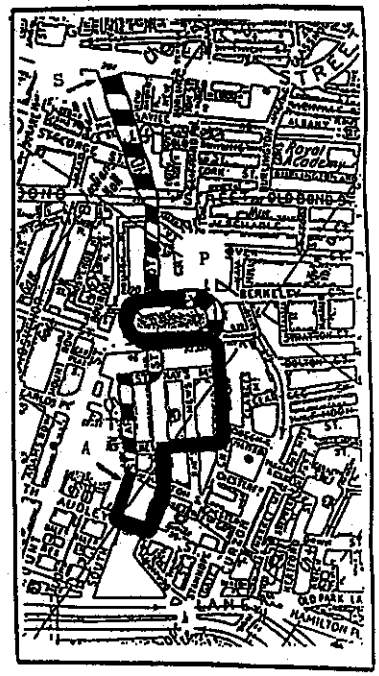
Figure 4 (h) 24.2.83



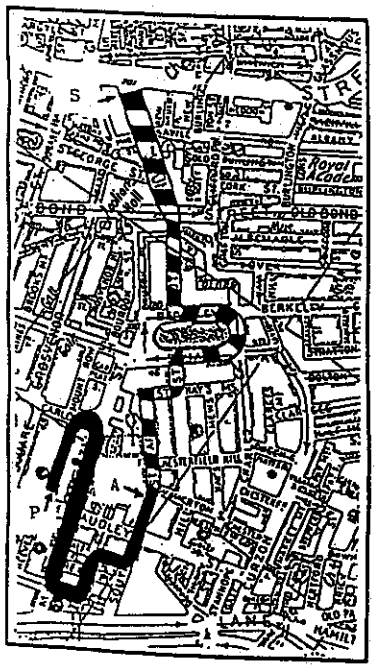
Time : 8.02 am. (NS)



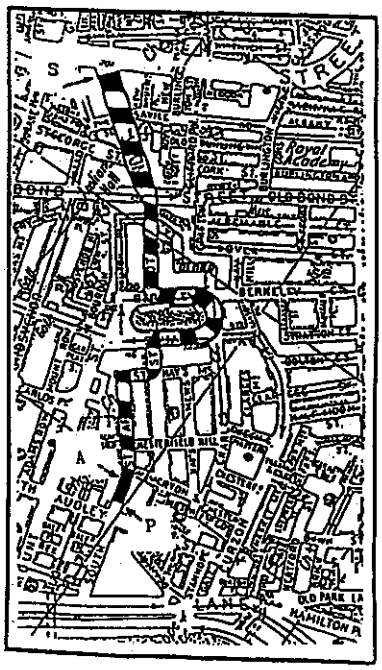
Time : 9.00 am.



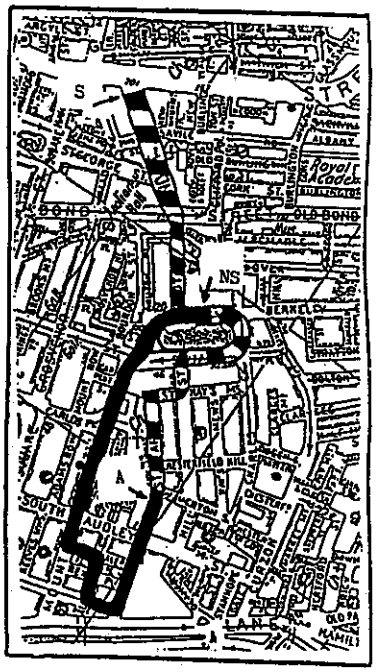
Time : 10.57 am.



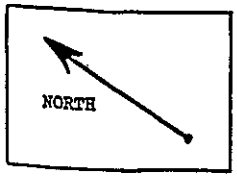
Time : 1.13 pm.



Time : 2.40 pm.

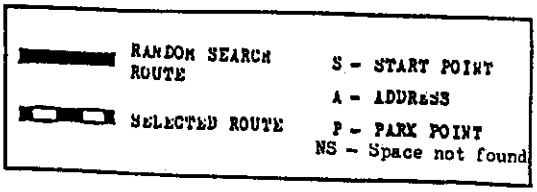


Time : 4.22 pm. (NS)



PARK AND VISIT SURVEYS

MAYFAIR ;24/2/83, address 2.



APPENDIX 7

Formulae used in Statistical Analysis

1. Means

1.1 Standard deviation

$$s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

x = observed times

$\bar{x}$ = mean of observed times

n = sample size

s = sample standard deviation

1.2 Confidence limit around mean

$$CLM = \bar{x} \pm t \times \frac{s}{\sqrt{n}}$$

where t is the appropriate 2 tailed statistic at 95% confidence for (n-1) degress of freedom.

1.3 Minimum significant difference in the mean

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{S^2_p}{n_1} + \frac{S^2_p}{n_2}}} \qquad (1)$$

where

$$Sp^2 = \frac{(n_1 - 1)S^2_1 + (n_2 - 1)S^2_2}{n_1 + n_2 - 2}$$

Suffix 1 indicates "before" data

Suffix 2 indicates "after" data

μ = population mean

Sp^2 = pooled variance.

Assuming that the value of S is the same for before and after data

$$Sp = S_1 = S_2$$

Assuming that the same procedure is adopted in the after survey as in the before then

$$n_1 = n_2$$

If the population means are assumed to be the same before and after then

$$(\mu_1 - \mu_2) = \phi$$

The equation (1) then becomes

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{2\ Sp^2}{n}}}$$

$$(x_1 - x_2) = t \times Sp \times \sqrt{\frac{2}{n}}$$

i.e. the minimum significant difference in mean $= t \times Sp \times \sqrt{\frac{2}{n}}$

where t is the appropriate 2 tailed statistic at 95% confidence for (2n - 2) degrees of freedom.

2. Proportions

2.1 Standard deviation

$$Sp = \sqrt{\frac{\hat{p}\ (1-\hat{p})}{n}}$$

where Sp = population standard deviation

$\hat{p}$ = sample proportion as an estimate of population proportion

n = sample size

2.2 Confidence limits around proportion

$$CLP = \hat{p} \pm 1.96 \sqrt{\frac{\hat{p}\ (1-\hat{p})}{n}}$$

2.3 Minimum significant difference in proportion

$$z = \frac{(p_1 = p_2) - (\pi_1 - \pi_2)}{\sqrt{\frac{\pi_1(1-\pi_1)}{n_1} + \frac{\pi_2(1-\pi_2)}{n_2}}}$$

where suffix 1 indicates "before" data

suffix 2 indicates "after" data

π = population proportion

p = sample proportion

n = sample size

Assuming that the population is the same

$$\pi_1 = \pi_2$$

$$\therefore \quad (\pi_1 - \pi_2) = 0$$

$$\therefore \quad 2 = \frac{(p_1 - p_2)}{\sqrt{\frac{\pi_1(1 - \pi_1)}{n_1} + \frac{\pi_2(1 - \pi_2)}{n_2}}}$$

Assuming that $p_1 \backsim \pi_1$ and $p_2 \backsim \pi_2$ and that

$$n_1 = n_2$$

$$\therefore \quad Z = \frac{(p_1 - p_2)}{\sqrt{\frac{2_p(1 - p)}{n_1}}}$$

$$\therefore \quad p_1 - p_2 = Z \times \sqrt{\frac{2_{p_1}(1-p)}{n_1}}$$

Minimum significant difference in proportion $= 1.96 \sqrt{\frac{2_{p_1}(1 - p_1)}{n_1}}$

APPENDIX 8. DISTRIBUTION OF SEARCH AND SEARCH PLUS WALK TIMES

Figure 1 presents the distributions of search times for all sites and circuits in Mayfair and Bloomsbury. These have the appearance of a negative exponential distribution, with a long positive tail represented by the "no space" values for searches abandoned after 5 minutes. The shape of the distribution is confirmed by the Mayfair pilot distribution, in which the cut off was 15 minutes. The form of the distribution is not unexpected, since, ignoring the distribution of meters themselves, free meters in short supply can be expected to be randomly distributed.

The existence of the long positive tail makes estimation of the mean difficult, and adds weight to the decision to use the simple statistic of the proportion of runs on which meters were found within 5 minutes. However, the mean may be estimated from the property of the negative exponential distribution that the probability of a value being greater than x,

$$p\,(x > x_1) = e^{-x_1/\mu}$$

where μ is the mean.

Whence for two values x_1, x_2

$$\frac{p(x > x_2)}{p(x > x_1)} = \frac{e^{-x_2/\mu}}{e^{-x_1/\mu}}$$

$$= e^{-(x_2 - x_1)/\mu}$$

Thus $$\hat{\mu} = \frac{(x_2 - x_1)}{\log_e (p(x > x_1)/p(x > x_2))}$$

This relationship was originally used with x_1, x_2 as the quartiles, for which

$$\hat{\mu} = \frac{Q_3 - Q_1}{\log_e 3}$$

This, however, involves extrapolation for three of the four Mayfair sites. Figure 2 indicates that, in the area of extrapolation, the relationship between cumulative number of observations and time is roughly linear, and this was used as the basis for extrapolation.

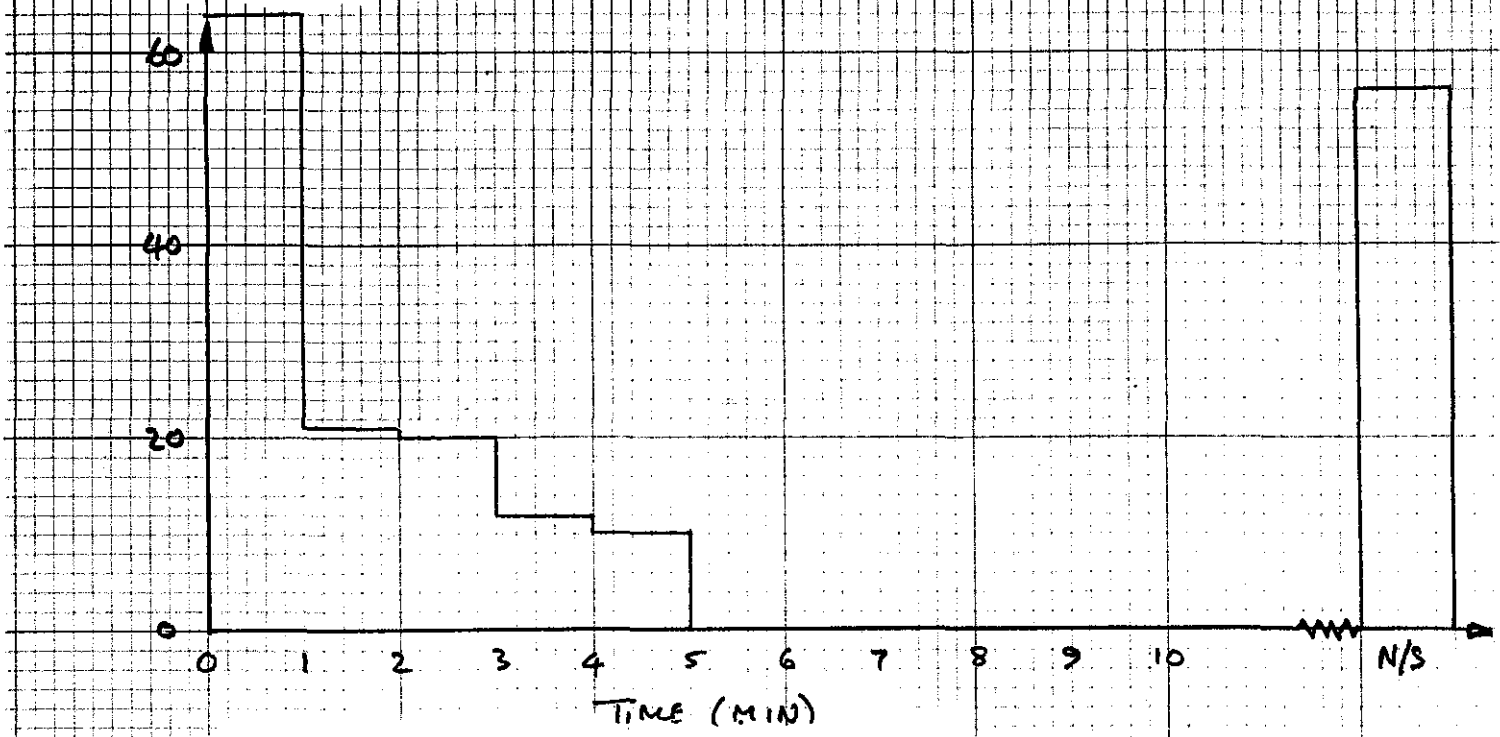
However, use of the tertiles, with

$$\hat{\mu} = \frac{T_2 - T_1}{\log_e 2}$$

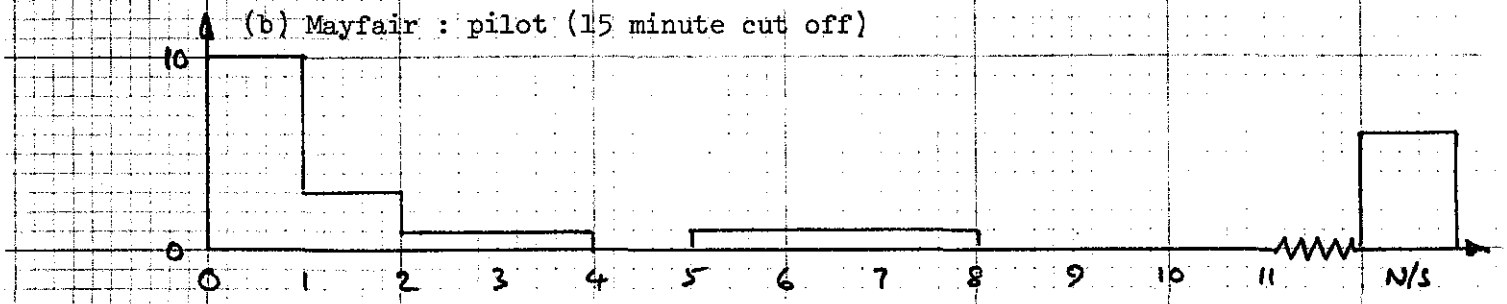
involved only one extrapolation of only one observation, and was considered preferable.

All calculations were based on this estimate of the mean, which is also the standard deviation of the distribution. Calculations for error estimates and minimum significant differences followed the procedure in Appendix 7.

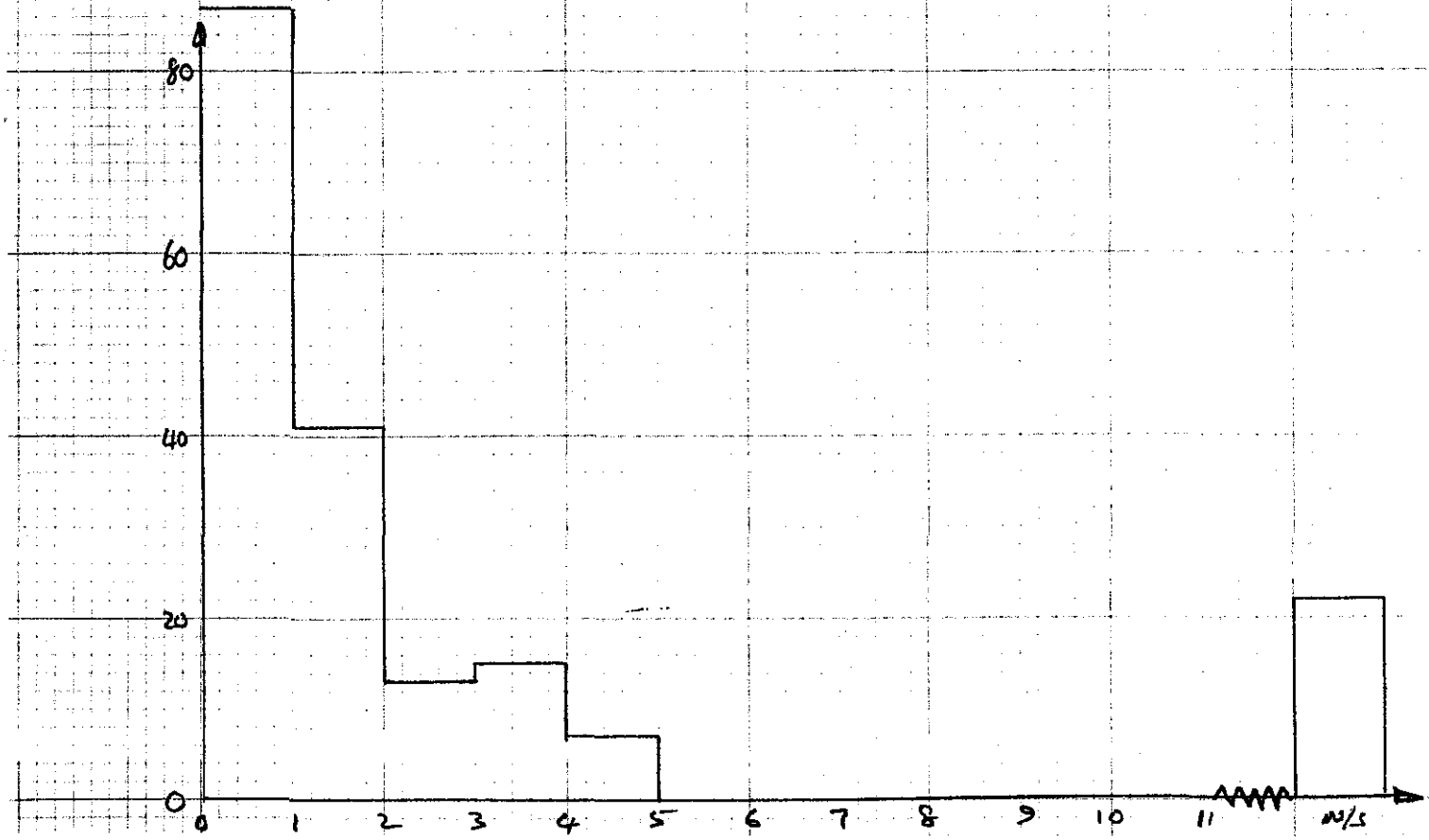
(a) Mayfair : main survey (5 minute cut off)



(b) Mayfair : pilot (15 minute cut off)



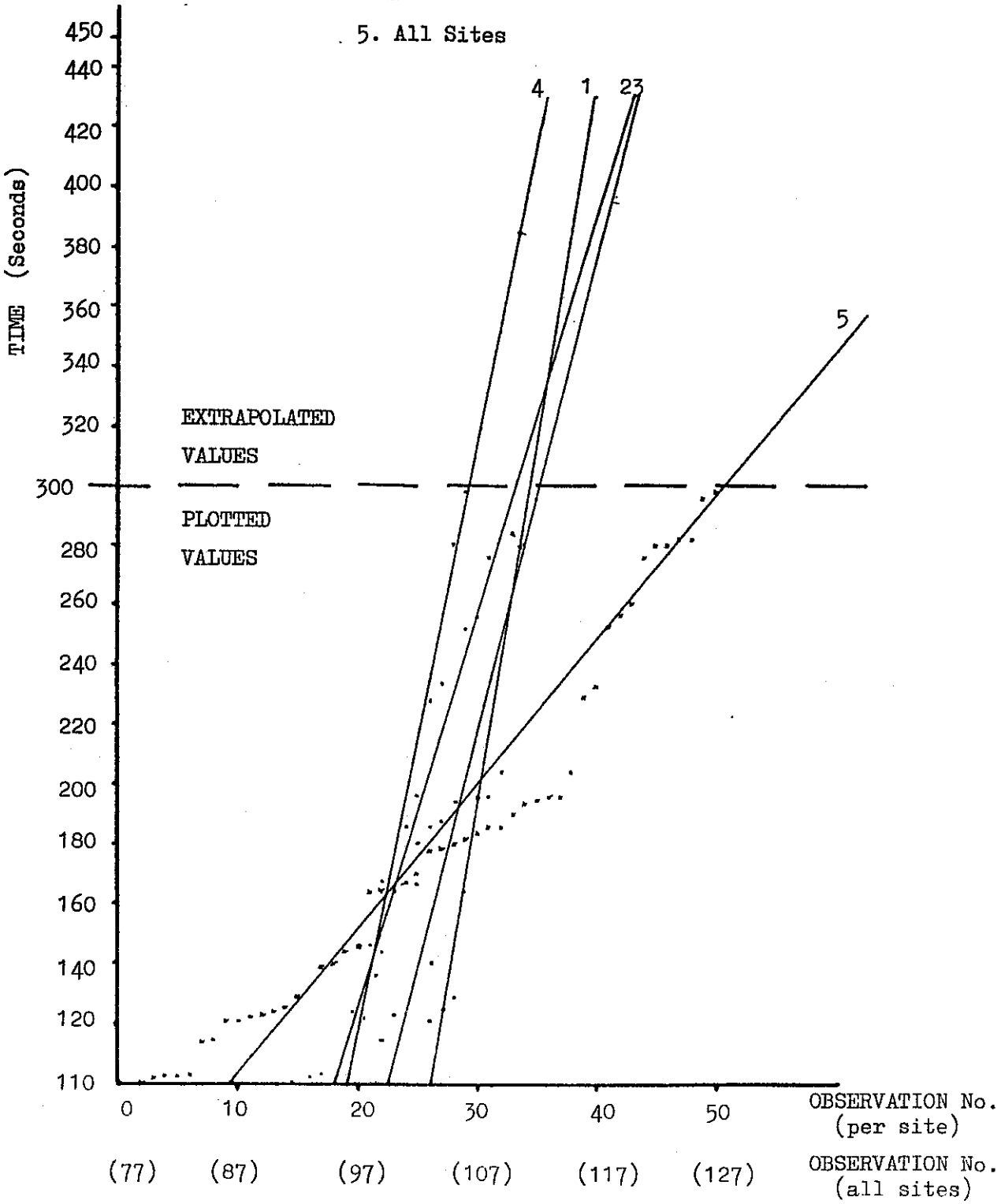
(c) Bloomsbury : main survey (5 minute cut off)



GRAPH OF ORDERED OBSERVATIONS AGAINST RANDOM SEARCH TIME TAKEN TO FIND A VACANT METER SPACE IN MAYFAIR (14/2/83 - 23/2/83).

* NOTE *

1. Grosvenor Square
2. South Street
3. Berkeley Square
4. Grosvenor Street
5. All Sites



Appendix 8 - Figure 3