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A SURVEY OF MULTIPLE FATALITY INCIDENTS, 1960 - 1966

by

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SUMMARY

The annual incidence of multiple death fires has been increasing over the last few years. In the period 1960 - 66, fire brigades reported 373 such incidents and 368 of the reports were used in this survey. There were 302 fires in buildings (237 occurred in dwellings); outdoor incidents numbered 66. One hundred and forty two of the incidents were in dwellings built before 1910.

About two-thirds of the incidents occurred between October and March; the period of severe weather in the first three months of 1963 alone gave rise to 31 multiple death fires.

Nearly 36 per cent of the fires were of unknown cause; smoking materials accounted for nearly 13 per cent and oil space heating about 10 per cent. In nearly 23 per cent of the fires furniture or furnishings were ignited; the proportion of these increased during the seven year period.

Of the 1000 people who died in the incidents, 59 per cent were asphyxiated and 31 per cent received fatal burns. These incidents also gave rise to about 500 non-fatal casualties.

Nearly sixty per cent of the victims were males. Three hundred and fifty nine children aged five and under died and 82 fatalities were recorded in the over-65 age group.

It is likely that in at least one third of the incidents in dwellings a major factor in assisting the spread of fire and toxic gases was the failure to keep doors shut.

Multiple death fires occur most frequently in areas in which multiple occupancy if dwellings is common and this, together with the fact that furniture and furnishings are often the materials ignited first, indicates overcrowding as an important factor.

MINISTRY OF TECHNOLOGY AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

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INTRODUCTION

Every year something like a thousand[1,2,3] lives are lost through fire. Fire brigades attend a large proportion of the incidents in which these deaths occur and certainly most of those in which there is more than one death. The annual incidence of these multiple fatality incidents has been increasing since 1960 and this survey was undertaken to examine the reasons for the trend.

Sources of data

Two main sources of data exist which give information on deaths by fire: the Registrars General[1,2,3] tabulate the causes of all deaths, and reports of fires received by the Joint Fire Research Organization are used to compile the United Kingdom Fire Statistics[4] . The numbers of deaths reported by these two sources are shown in Table 1.

Table 1. Deaths by fire, 1960 - 1966

Source	1960	1961	1962	1963	1964	1965	1966
Joint Fire Research Organization (UK deaths)	529	572	667	818	681	703	780
Registrars General (UK) (Classification E.916)	800	804	962	1076	918	925	**

** Not yet available

Figures from both of these sources show an upward trend in fire fatalities since 1960. Table 2 shows the numbers of fatalities in fires attended by fire brigades which provide the bulk of the material used for the analysis.

Table 2. Numbers of fatalities in fatality fires attended by fire brigades

No of fatalities		1960	1961	1962	1963	1964	1965	1966
1		414	456	553	655	564	525	570
2		22	16	30	50	32	43	53
3		7	14	5	9	9	15	13
4		1	3	4	2	4	8	4
5		2	2	1	4	2	3	3
6 - 9		1	-	1	1	-	-	5
10 or more		2	1	1	-	-	-	-
Total incidents	Multiple death fires	35	36	42	66	47	69	78
	All fatality fires	449	492	595	721	611	594	648
Percentage of fatality fires with multiple deaths		7.8	7.3	7.1	9.2	7.7	11.6	12.0
Total fatalities		529	572	667	818	681	703	780

There were 373 multiple death fires during the seven year period. There is a lack of information of five of these incidents (2 in 1960, 3 in 1962) and this survey is based on the remaining 368. It is unlikely that the fires omitted will affect the general conclusions of this report.

Occupancies and times of occurrence

In trying to find the reason for the upward trend in multiple fatality incidents it is first necessary to know where and when they occur. Table 3 shows the occupancy in relation to time of day; this is also depicted graphically in Fig.1.

Table 3. Occupancy and time of call

Occupancy	Time of call								Total
	Midnt-2.59am	3.0-5.59	6.0-8.59	9.0-11.59	Noon-2.59pm	3.0-5.59	6.0-8.59	9.0-11.59	
IN BUILDINGS									
Industry	2	1	1	6	6	6	3	2	27
Transport and public utilities	1	-	2	1	1	1	2	-	8
Financial and professional services, administration	2	1	1	-	2	1	2	1	10
Clubs, hotels, etc	2	3	1	1	1	1	1	2	12
Distributive trades	2	-	2	1	1	-	-	-	6
Dwellings-houses	22	33	27	26	13	17	10	16	164
-flats	6	7	8	12	15	10	7	8	73
Others	1	-	-	-	-	-	1	-	2
Total	38	45	42	47	39	36	26	29	302
NOT IN BUILDINGS									
Vehicles	6	1	1	2	2	2	1	9	24
Aircraft	-	-	-	2	1	3	3	-	9
Ships, houseboats	-	-	-	4	4	1	-	1	10
Caravans	4	-	1	2	2	1	-	5	15
Other	-	-	-	2	2	3	1	-	8
Total	10	1	2	12	11	10	5	15	66
TOTAL	48	46	44	59	50	46	31	44	368

Of the 302 fires in buildings, 237 (78 per cent) occurred in dwellings, 27 in industry and 12 in clubs and hotels. Nine per cent of the multiple-fatality incidents in buildings occurred in industry, compared with only 4.6 per cent of all fatalities in 1966. The proportions of multiple death incidents in caravans and means of transport were also higher than for the 1966 fatality incidents.

In houses, the early morning hours seemed to be the most vulnerable period. The fires discovered at these times are often of a smouldering nature and may in fact have started late at night. Flats appear to be most dangerous during the mid-day period. When considered in relation to the

numbers of fires in houses and flats the risk of a fire becoming a multiple death incident is higher in flats (including multiple-occupancy houses) than in houses at all times of the day apart from the early morning. In flats the kitchen seems to be the point at which most multiple death fires start, but living rooms and bedrooms are the danger points in houses. Of the reports on the 302 fires in buildings, 106 gave no information on the place of origin, but, of the remainder, 33 per cent (64) started in living rooms, 28 per cent (55) in bedrooms and bedsitters, 8.5 per cent (17) in hallways and 7.5 per cent (15) in kitchens.

Among the outdoor fires, Table 3 shows that vehicles, mainly crash incidents, are most frequent in the period 9 p.m. to 3 a.m. Caravan fires, in which the victims are often children left along by their parents, are prominent at the same times. The majority of the ship fires occurred when the ships were in for repairs.

The property involved

Of the 302 buildings in which multiple fatality fires occurred, 116 were built before 1900 and another 62 between 1900 and 1910. Old buildings, sometimes with cramped conditions (occasionally even in industry) had more multiple deaths than newer buildings. A similar proportion of old property featured in single death incidents in 1966.

It was, however, in dwellings, that the most marked upward trend in multiple death fires occurred, as indicated in Table 4. The 1963 peak is attributed to the severe winter of that year. The sizes and ages of the dwellings involved are given in Table 5.

Table 4. Occupancy in relation to year

Occupancy	1960	1961	1962	1963	1964	1965	1966	Total
IN BUILDINGS								
Industry	4	2	2	9	2	5	3	27
Transport and public utilities	1	1	-	1	3	1	1	8
Financial and professional services, administration	-	1	3	1	2	1	2	10
Clubs, hotels, etc	-	-	-	3	2	2	5	12
Distributive trades	3	-	1	1	-	1	-	6
Dwellings-houses	14	16	17	29	20	29	39	164
-flats	5	8	8	9	10	17	16	73
Other	-	1	-	-	-	1	-	2
Total	27	29	31	53	39	57	66	302
NOT IN BUILDINGS								
Vehicles	2	4	1	5	2	5	5	24
Aircraft	1	1	1	1	1	3	1	9
Ships, houseboats	1	1	1	1	2	2	2	10
Caravans	1	1	4	5	2	-	2	15
Other	1	-	1	1	1	2	2	8
Total	6	7	8	13	8	12	12	66
TOTAL	33	36	39	66	47	69	78	368

Table 5. Dimensions and Age of Dwellings

Dimensions		Year of Construction									Total
Ground floor area	No. of storeys	Pre 1900	1900-1909	1910-1919	1920-1929	1930-1939	1940-1949	1950-1959	1960 and later	Unknown	
Under 500 sq ft	1 or 2	28	13	1	3	7	4	2	-	5	63
	3 or more	14	7	1	-	-	-	-	-	3	25
	not stated	1	-	-	-	-	-	-	-	-	1
500 - 749 sq ft	1 or 2	9	9	2	3	6	1	-	1	5	36
	3 or more	9	6	-	-	-	-	1	-	2	18
750 - 999 sq ft	1 or 2	2	4	-	2	7	1	3	1	2	22
	3 or more	6	2	1	1	-	-	1	-	2	13
1000 sq ft and over	1 or 2	5	3	1	1	2	-	2	-	2	16
	3 or more	9	3	2	-	-	-	-	-	-	14
Unknown	1 or 2	-	1	-	2	-	2	-	-	-	5
	3 or more	8	3	2	-	5	-	1	-	3	22
	not stated	-	-	-	-	-	1	1	-	-	2
TOTAL		91	51	10	12	27	9	11	2	24	237
Multiple death fires per million dwellings at risk* per year		2.89	3.68	0.75	0.74	1.22	0.33	0.34	-	-	-

*Using J.F.R.O. estimates for numbers of dwellings at risk from data supplied by the Ministry of Housing and Local Government.

It is immediately noticeable that older dwellings, particularly those built before 1910, are more liable than more recent ones to give rise to multiple death fires. Sixty-three of the 142 incidents in these old buildings were in houses of ground floor areas of less than 500 sq ft (in some cases considerably less) and 21 of these had 3 or more storeys. There was multiple occupation of some of the dwellings; this was particularly evident in the London and Birmingham areas.

As might be expected, the multiple death fires occur most frequently in the winter months - this was also true of the 648 fatality incidents in 1966. It is in these months that there is maximum usage of space heating, which will later be shown to be a prominent source of ignition. Of the 66 incidents in 1963, no less than 31 occurred in the period Jan - March during the severe

winter. It is also noticeable that there is a significant upward trend in the numbers of incidents in the winter periods. Of the 368 incidents in the survey, 242 nearly two-thirds occurred between October and March. The numbers in this period for the winters 1960-61 onwards are shown in Table 6.

Table 6. Multiple Deaths in Winter

Winter (i.e. October - March)	No. of incidents
1960 - 61	15
1961 - 62	19
1962 - 63	44
1963 - 64	32
1964 - 65	43
1965 - 66	49
1966 - 67	45 (estimate)

Sources of ignition and materials ignited in multiple death fires

Often in a multiple death fire, the lack of survivors and witnesses or the size of the fire makes it difficult to obtain evidence as to the sources of ignition, and, in 130 incidents (35 per cent) the source of ignition was recorded as unknown, a much higher proportion than the 18 per cent of the 648 fatal fires attended by fire brigades in 1966.

The pattern of known causes in multiple death fires was different from that of all fatality fires in 1966, as Table 7 shows. Of known causes, 47 (13 per cent of total) were reported as smoking materials, 37 (10 per cent) as oil space heating and 33 (9 per cent) each as children playing with fire and as crashes (road, rail or air). If all fatal incidents in 1966 are considered, it will be noticed that electric space heating, fires in grates and smoking materials were more prominent than in multi-death fires, accounting for 63 (10 per cent), 100 (15 per cent) and 156 (24 per cent) respectively of the fatal fires.

Fires caused by oil heaters and by children playing with fire are likely to spread rapidly and this is one of the features which differentiates multiple death incidents from those in which one life is lost.

Table 7. Source of ignition of multiple death fires 1960 - 66 and all fatal fires, 1966

Source of ignition	Multiple death fires							Total multi-death fires		Fatal fires 1966	
	1960	1961	1962	1963	1964	1965	1966	No.	Per cent	No.	Per cent
Smoking materials matches, tapers, naked lights	2	4	7	6	7	9	12	47	12.8	156	24.1
Oil space heating	6	1	5	5	5	9	6	37	10.1	38	5.9
Children playing with fire	3	2	-	7	2	11	8	33	9.0	26	4.0
Crashes (road, rail or air)	4	4	2	6	3	8	6	33	9.0	20	3.1
Fires in grate	2	1	-	4	4	3	3	17	4.6	100	15.4
Electric-space heating	1	1	1	1	2	1	2	9	2.5	63	9.7
-other	1	3	3	3	2	2	5	19	5.2	38	5.9
Other known causes	1	5	8	9	5	4	11	43	11.7	89	13.7
Unknown	13	15	13	25	17	22	25	130	35.1	118	18.2
TOTAL	33	36	39	66	47	69	78	368	100.0	648	100.0

The table shows that smoking materials and children playing with fire became more prominent during the period of analysis. Oil space heating however, although the second most frequent known cause of multiple death fires, remained constant at about 5 or 6 incidents annually. The Ware tragedy in 1958[5] in which five children were killed when an oil heater left near an open door flared up, prompted research and stricter legislation on the safety of oil heaters and received considerable publicity; both the frequency of oil heater fires (about 3500 a year)[4] and the death roll due to this cause have been held at a constant level.

Examination of the nature of the materials ignited first over the seven year period shows that 84 fires (about 22 per cent) were known to have resulted from the ignition of furniture or furnishings. From Table 8 it may be seen that these fires are following an upward trend and account for an increasing proportion of the total (one-third of the fires in 1966). The two most likely explanations of this trend are overcrowding (which might mean that furniture is too near to sources of ignition) and the increasing use of flammable materials in the construction of furniture. There is at present no statistical information which indicates whether or not the latter is an important factor. Some of these occurred in the early hours when fires

has been insufficiently guarded or cigarettes had been carelessly disposed - these fires smoulder and are often discovered several hours later.

In about one third of the multiple death fires in dwellings it is likely that the opening of a door at some stage led to a more rapid fire spread - the opening of the front door of a house when the door of the affected room is already open can cause rapid fire spread and trap occupants who might otherwise have escaped. In about one-half of those instances in which the opening of a door was a feature in the fire development, the fires were discovered between 10.0 p.m. and 9.00 a.m., when people are likely to have been asleep. The most prominent known cause in these fires was smoking materials. During the day-time, however, the most frequent known cause in incidents involving open doors was oil space heating.

The main differences between the frequency patterns for multiple death and single death fires are in the incidents caused by vehicle crashes, those accompanied by explosions and those in which flammable liquids were ignited. Each of these categories forms a higher proportion of the multiple-death incidents than those in which there is one fatality.

As might be expected, the proportion of incidents involving the ignition of clothing is greater in the single fatality group than in the multiple death group. These fires rarely spread beyond the room of origin.

Table 8. Material ignited first in multiple death fires, 1960 - 1966 and all fatal fires, 1966

Material ignited first	Multiple death fires							Total multi-death fires		Fatal fires, 1966	
	1960	1961	1962	1963	1964	1965	1966	No.	Per cent	No.	Per cent
Crash(road,rail or air)	4	4	2	6	3	8	6	33	9.0	20	3.1
Explosion	1	3	1	7	6	6	4	28	7.6	29	4.5
Clothing on person	-	-	1	1	1	2	-	5	1.4	180	27.8
Furniture,furnishings	5	6	8	14	11	14	26	84	22.8	209	32.2
Other textiles	-	2	2	2	2	2	2	12	3.3	17	2.6
Liquids, fats	3	2	4	6	4	6	4	29	7.9	28	4.3
Escaping gas	-	-	-	-	2	-	1	3	0.8	6	0.9
Structural materials	1	1	3	3	-	-	3	11	3.0	29	4.5
Other	3	2	-	1	1	2	4	13	3.5	16	2.5
Unknown	16	16	18	26	17	29	28	150	40.7	114	17.6
TOTAL	33	36	39	66	47	69	78	368	100.0	648	100.0

Of the 28 incidents involving explosions, nearly half (13) occurred in industry. Four of these were in the chemical industry and another six in the metal manufacture and engineering industry. Of the 84 incidents involving the ignition of furniture or furnishings, 78 occurred in dwellings. Twenty-two of the fires in which flammable liquids or fats were ignited occurred in dwellings; this includes the fires in which oil heaters flared up or were accidentally overturned.

Table 9. Extent of fires in buildings in multiple death fires, 1960 - 1966 and all fatal fires, 1966

Extent of fire	Multiple death fires, 1960-1966		All fatal fires, 1966	
	No. of fires	Per cent	No. of fires	Per cent
Confined to casualty	-	-	49	8.3
Confined to room of origin	64	21.2	323	54.9
Cumulative Total	64	21.2	372	63.2
Confined to floor of origin	29	9.6	55	9.3
Confined to building of origin	175	57.9	147	25.0
Cumulative Total	268	88.7	574	97.5
Spread beyond the building of origin	34	11.3	15	2.5
TOTAL	302	100.0	589	100.0

Multiple death fires were generally larger than either fires which involved only one fatal casualty or those which did not involve any deaths. Of all fires in buildings in 1963[6], 56 per cent were confined to the room of origin and only three per cent extended beyond the building of origin. As Table 9 shows, in the 589 fatality fires in buildings in 1966, 49 (8 per cent) were confined to the casualty and their clothing and 372 (63 per cent) to the room of origin. Only 15 of these fires spread beyond the building of origin. However, of the multiple fatality fires in buildings only 64 (23 per cent) were confined to the room of origin and 34 (11 per cent) extended beyond the building of origin. This is an important feature of multiple death fires and emphasizes the importance of trying to keep a fire confined, and of not taking any action likely to encourage fire spread. In about one-third of the multiple death fires occurring out of doors, the fire extended to buildings, whereas less than 10 per cent of all of the outdoor fatality fires in 1966 spread to buildings.

In only 130 of the 368 multiple death incidents in the survey was one of the casualties located at the seat of the fire. There were 95 incidents

in which it was not possible to determine from the fire reports the location of the casualties at the start of the fires. In the remaining 143 incidents the fatalities were away from the seat of the fire, usually in another room, and, in 57 of these, there was definite evidence that the casualties had been trapped - i.e. they could have been saved had rescue been effected in the incipient stages of the fire. As shown in Table 10, some rescues and/or escapes were effected in 157 fires.

Table 10. Rescues and escapes in relation to the location of the fatalities

Location of casualties in relation to the seat of the fire	Some rescues and/or escapes	No rescues or escapes	TOTAL
At least one fatality at the seat of the fire	36	94	130
Fire started elsewhere - no casualties trapped - casualties trapped(either made escape attempt and failed or others escaped in the same fire)	35 40	51 17	86 57
Unknown	46	49	95
TOTAL	157	211	368

Some of the incidents, particularily those in which rescue operations were performed, involved non fatal casualties in addition to the deaths. In ten incidents there were nine or more non-fatal casualties.

About 500 people were saved through rescue operations or escape, but a number of these were injured. In the 368 incidents about 500 non-fatal casualties occurred. Breathing apparatus was employed in 152 incidents, in 84 of which there were rescues and escapes. Resuscitators were used only in eight incidents.

Of the 237 fires in dwellings, only 22 started at above the first floor level. It was thus not possible to assess the effect of height of a building in multiple death fires.

The casualties, cause of death

Over the seven year period, 1000 people, including 25 firemen, died in the 368 multiple death fires in this survey. The appendix lists some of the worst incidents and the circumstances in which they occurred. One feature of these fires was that the age and sex distributions were different from those of all fire fatalities[4]. Young children were more frequently

involved (36 per cent were 5 years old or under) and elderly persons less frequently (8 per cent were over 65). Sixty per cent of the deaths in multiple fire fatalities were males, a higher proportion than in all fire fatalities in 1966 (49 per cent) and the difference was particularly apparent in the 5 years and under age group. There is little difference between the total numbers of male and female children in the 5 and under age group, and the reason for the high proportion of male children among the multiple fatalities is not known. Nineteen members of the fire and salvage services were killed in one incident alone, when they were trapped by a falling wall. Table 11 shows the age-sex distribution of deaths in multiple death incidents in 1960 - 1966 and that for all fatalities at fires attended by fire brigades in 1966. The majority of elderly people who die in fires are alone when the fires occur.

Table 11. Sex and age of fatalities in multiple death fires (1960-1966) and for all fatalities in 1966

Age (years)	Multiple death fires, 1960-1966			All fatalities, 1966		
	Male	Female	Total	Male	Female	Total
5 and under	211(207)	148(147)	359(354)	75(74)	70(70)	145(144)
6 - 15	52(50)	42(40)	94(90)	19(19)	15(14)	34(33)
16 - 40	189(84)	97(85)	286(169)	96(65)	36(31)	132(96)
41 - 65	103(56)	62(54)	165(110)	86(71)	86(81)	172(152)
Over 65	26(26)	56(53)	82(79)	103(100)	192(188)	295(288)
Not stated	14(7)	-(-)	14(7)	2(2)	-(-)	2(2)
TOTAL	595(430)	405(379)	1000(809)	381(331)	399(384)	780(715)

Figures in brackets exclude fire brigade personnel, casualties in crashes and explosion incidents

Nearly 60 per cent of the deaths in the multiple fatality fires were attributed to asphyxiation and most of these casualties were not at the place of origin of the fire, and, therefore not immediately aware of it. The majority of those who were at the scene of the fire died from burning injuries. Table 12 shows the causes of death in relation to the location of the casualties with respect to the fire.

Table 12. Causes of death of fatalities in multiple death fires in relation to the location of the casualities

Location of casualties with respect to the fire	Cause of death				Total deaths
	Burns	Asphyxiation	Other	Unknown	
At least one fatality at the seat of fire	158	105	27	14	304
Fire started elsewhere					
-no casualties trapped	48	198	9	5	260
-some casualties trapped	38	146	28*	7	219
Unknown	61	144	2	10	217
TOTAL	305	593	66	36	1000

*Includes 19 F.B.personnel trapped by a falling wall

Some regional effects

The upward trend in fire fatalities is more pronounced in some parts of the country than others. Upward trends are particularly noticeable in the London area, the Scottish Lowlands, the Midlands and Potteries and North West England. These regions together with the Scottish Highlands, also have the highest death rates in fires attended by fire brigades (see Table 13 and Fig.2)

Table 13. Fatalities in fires attended by fire brigades in relation to region and population, 1960-1966

Region	Pop'n ($x10^3$)	Year							Total (7 yr)	Annual death rate (per million)
		1960	1961	1962	1963	1964	1965	1966		
Scotland - Lowlands	2364	43	21	38	37	39	53	69	300	18.13
Scotland - Highlands	1508	25	12	32	41	24	17	26	177	16.77
North West England	6639	91	93	76	131	97	110	122	720	15.49
Midlands and Potteries	4983	49	72	72	82	75	82	78	510	14.62
London and South East	13496	106	141	183	220	187	202	210	1249	13.22
Northern England	3200	50	31	34	41	35	33	52	276	12.32
Wales(except Glamorgan)	981	11	17	7	12	11	4	17	79	11.50
Glamorgan and Monmouth	1714	13	17	31	20	22	16	12	131	10.92
Scotland-S.Uplands	1336	13	18	10	20	16	11	14	102	10.91
Yorkshire(E & W Ridings)	4276	32	38	51	59	51	42	41	314	10.49
North Midlands	3806	19	30	30	54	45	49	39	266	9.98
Southern England	3277	25	19	46	32	29	34	41	226	9.85
Eastern England	1958	12	22	18	29	14	14	17	126	9.19
Northern England	1440	18	10	11	12	16	10	14	91	9.03
South West England	3338	22	31	28	28	20	26	28	183	7.83
TOTAL	54316	529	572	667	818	681	703	780	4750	12.50

The increase in frequency of multiple fatality incidents is most pronounced in the London Area, North West England and the Scottish Lowlands which, as may be seen from Table 14, together account for more than half of the national increase between 1960 and 1966. (see also Fig 3)

Table 14. Multiple Fatality incidents in relation to region, 1960-1966

Region	Year							Total (1960-66)
	1960	1961	1962	1963	1964	1965	1966	
London and South East	8	10	9	18	17	26	19	107
North West England	3	3	4	11	4	9	12	46
Midlands and Potteries	3	4	3	7	4	5	7	33
Scotland - Lowlands	2	1	2	3	3	4	9	24
Northern England	5	0	5	4	2	3	5	24
Yorkshire (E & W Ridings)	1	3	2	5	4	2	5	22
South West England	2	4	4	2	2	4	4	22
North Midlands	1	2	0	3	5	6	4	21
Scotland - Highlands	2	0	3	4	2	3	3	17
Southern England	3	2	5	1	0	4	1	16
Glamorgan and Monmouth	1	1	4	2	0	2	2	12
Northern Ireland	3	2	1	0	2	0	2	10
Wales (except Glamorgan)	0	1	0	2	1	0	3	7
Scotland-Southern Uplands	1	2	0	3	0	0	1	7
Eastern England	0	1	0	1	1	1	1	5
TOTAL	35*	36	42*	66	47	69	78	373

* Two incidents in 1960 and three in 1962 were omitted from the full survey - see Introduction

The locations of all incidents involving three or more deaths are shown in Fig.4. Both the proportion of fatality fires with multiple deaths and the number of deaths per fatality fire increased during the years under review.

It appears however that the worst problem exists in some of the more densely populated areas where crowded conditions and old property are common; the situation is not eased by the presence of a certain amount of multiple occupancy, both of industrial and of domestic premises.

At the time of the 1961 census[7], 4.48 per cent of the population in England and Wales were living in "shared" households; the figure for the London and South East and Eastern Regions combined was 12.41 per cent, all other regions had a percentage lower than average. Out of nearly 2 million people living in "shared" households in 1961, about two-thirds lived in the London and South East Region. It is possible that the percentages of people in "shared" households have increased in this region and in the

Midlands during the period 1960-66, since it is those regions which have shown the largest population increases. It appears (see Fig.5) that there is a relationship between the percentage of the population of a given region living in "shared" households and the number of multiple fatality incidents in dwellings (including caravans) per million population. There is no certain explanation as to why the Southern Region does not fit into this relationship, but it may be significant that the proportion of very large dwellings in the region is high in comparison with other parts of the country.

One of the worst areas is Lowland Scotland where, although there has been an extensive post-war building programme of flats, most of the affected premises were, in fact, older property which may have been converted into flats. Yorkshire appears to have a low death rate, despite its high industrialisation in the West Riding.

Apart from the Scottish Highlands all the predominantly rural regions e.g. Eastern England, have low death rates. (see Table 13) It has been shown[8] in London, Birmingham and Manchester that a cold spell can lead to an increase both in fires in dwellings and in casualties, which is best explained by the use of more space heating equipment. It is reasonable to assume that the high peak in the Scottish Highlands in 1963 was brought about by severe weather. In an area as large as this with isolated dwellings the chance of being saved by outside agencies would be remote. There are only three full-time fire stations in the area, communications are poor and there is a preponderance of older people, this helps to give a high death rate although the annual prequency of fire deaths in this region is not increasing. The regions which give most cause for concern are London, the North West, the Midlands and the Scottish Lowlands.

Discussion

Many of the incidents which have been analysed in this survey bear a marked similarity to one another, and it is easy to pinpoint some of the factors which led to multiple death fires. Details of some of the more serious incidents appear in the Appendix.

Industrial explosions which caused loss of life were frequently caused by the presence of dust.

There are several lessons to be learnt from domestic accidents. One is the importance of closing doors before going to bed, so that if a fire starts on the ground floor it will be confined and possible discovered before spreading. Careless disposal of smoking materials, unguarded fires and bad positioning of oil heaters all contributed to the multiple fire deaths. Even so, it is sometimes panic on the part of people trying to escape, who leave doors open, and thus assist the fire spread. This is certainly true of some of the oil heater incidents.

The high porportion of vehicle incidents between the hours of 9 p.m. and 3 a.m. corresponds to the general pattern of road accident statistics.

The main differences between multiple and single death fires seem to be their size, and associated with this, a different pattern of causes and materials ignited. A rapid fire spread at some stage in the fire development is often an important factor which leads to people being trapped. The absence of adequate escape routes as in the Bolton tragedy in 1961 (see Appendix), which prompted stricter legislation with regard to Clubs is also an important factor, particularly in older buildings. Often, though, people become trapped through flashover when doors have been left open. This was typical of several fires in the survey.

Conclusions

The annual frequencies of both single and multiple death fires are following upward trends, the situation being worse in some industrial parts of the country than elsewhere. The proportion of fatality fires which resulted in multiple deaths increased in 1965 and 1966.

About three-quarters of the multiple death fires in buildings are in dwellings and more of these are in houses than in flats. Although fire brigades do not always specify whether a building is in multiple occupancy, it sometimes appears probable that this is the case where multiple death fires occur, and that it may be an important factor both because there are likely to be more people exposed to fire than in a single occupancy of equivalent size, and because more furniture and equipment are likely to be available to create conditions conducive to rapid fire spread. A third of the outdoor fires occur in vehicles and about a quarter in caravans. The vehicle fires are heavily concentrated between 9 p.m. and 3 a.m.

The winter months account for about two-thirds of the incidents - thirty one occurred in the first three months of 1963 when the weather was exceptionally severe.

The most prominent of the known sources of ignition in multiple death fires are smoking materials, oil space heating, children with fire and vehicle crashes. Of these causes, smoking materials showed a marked upward trend. In 84 incidents, furniture or furnishings were ignited, the annual incidence having risen from 5 in 1960 to 26 in 1966.

Multiple death incidents tend to be larger than single death fires, and the average fire. Only 21 per cent in the survey were confined to the room of origin, and in 11 per cent of the incidents, the fire spread beyond the

building of origin. Breathing apparatus has to be used in about 40 per cent of the incidents. About 70 people each year are either rescued or escape from fires in which more than one person dies, a number of these receive injuries. The average number of deaths in multiple death fires appears to be about 2.7 per fire.

The age and sex distributions of the casualties in multiple death fires differ markedly from those in fatal fires as a whole; a much higher proportion of the multiple deaths are among young children, while the proportion of old persons is lower. The proportion of males is higher in the multiple deaths fires than in the whole group of fire fatalities.

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APPENDIX

A few Multiple death fires

1960

Bonded Whisky Warehouse

In a congested part of Glasgow, a fire gained a rapid hold and nineteen firemen were killed when a wall collapsed on to their appliances. The fire spread to neighbouring premises. The cause of this fire was unknown.

(Note: Over the seven year period there have been three other multiple death fires that have involved fire brigade personnel).

Departmental Store

In the centre of Liverpool, shortly after mid-day, a fire was started as a result of an electrical fault in a false ceiling. A considerable number of people were unaware of the fire and were trapped. Ten people were asphyxiated and as many again sustained non-fatal injuries.

(Note: A recent fire in a Brussels store gained an exceptionally rapid hold in a congested departmental store. Panic ensued and about three to four hundred people lost their lives.)

1961

Club Above Industrial Premises

A fire started in a Bolton furniture workshop; club premises were situated above the factory, which was an old building with very limited escape routes. It was outside working hours when the fire was thought to have started. The club occupants realised that there was a fire and ten people attempted to escape by jumping out of the building from the third storey level into a small cobbled river bed. Five of these, plus fourteen who did not attempt to escape, perished. This tragedy led to a tightening of the legislation on means of escape.

1962

Aircraft crash

A small aircraft crashed and exploded in thick fog in the cliffs at the south of the Isle of Wight. Eleven people sustained fatal burning injuries. Another six survived.

Tenement Tragedy

In a Clydebank 4-storey, post war block of flats, a faulty oil heater flared up. This was early in the morning and the occupants were accommodating some friends in their flat. It is believed that at least five people were in the room in which the fire started, most of them being in bed.

Of the ten people in the flat, three escaped through a top floor window, the remaining seven were asphyxiated.

1963

Defective Oil Heater

A defective oil heater being used during the severe winter in some Croydon flats became overheated. Seven people, including six children of two different families, were asphyxiated within the building as the fire quickly spread. An eighth person, who tried to escape by jumping from an upstairs window, sustained a fractured skull and died from his injuries.

Caravan Destroyed

In a small caravan, near Leeds, five children were playing late at night, when one of them accidently knocked over a paraffin lamp and the canvas cover was soon on flames. The caravan was destroyed and all five children received fatal burning injuries.

1964

Early Morning Disaster

A fire swept through living accommodation above a launderette in West Ham. The parents and their three children were asphyxiated - the cause of this fire was not established.

Explosion at Corn Flour Manufacturers.

This explosion occurred at Paisley in the early morning. It was not ascertained what actually caused the explosion, but the buildings were destroyed or extensively damaged by the blast. Five employees were killed; another four were injured.

1965

Another Flour Mill Explosion

This East End explosion was caused by heat from electric welding equipment being used for repairs igniting an accumulation of suspended flour dust. The whole building was severely damaged and it also affected craft on the nearby river. Five people were killed, another forty sustained injuries. This fire was a particularly difficult one to fight. Parts of the building were of pre-1900 construction.

Prefabricated House Extensively Damaged

This incident in Oxford was similar to several others in that the fire started on the ground floor and spread to the upper part of the building. One woman was rescued; her husband and four children were asphyxiated. This fire resulted from the ignition of an arm chair.

1966

Multiple Occupancy Premises

This fire originated in a London furniture store shortly after midnight. The cause was not known, but as in other incidents, the fire spread to other floors. Eight persons employed by a taxi-hire firm died; seven were asphyxiated - the eighth tried to escape and died from a fractured skull.

The Open Door

When a fire was discovered in the early morning at a post war house at Hirwaun, (Glamorgan/Brecon border) attempts were made to escape. The fire is thought to have started by means of a spark from a domestic coal fire in the living room. In making the escape, the door of the affected room and the front door were open simultaneously; this caused a rapid fire spread to the upper floor and adjoining property. Five members of a large family were unable to escape by the normal staircase. One tried to escape by jumping from an upstairs window, but, like the other four, he died.

List of fires involving five or more deaths

Occupancy	Time of call	Cause of fire	No.of.deaths
Flat over shop	0115	Unknown	5
Dwelling house	2301	Unknown	5
Departmental store	1423	Electrical fault	10
Whisky warehouse	1915	Unknown	19 (all F.B.)
Explosives factory	1114	Explosion	7
Dwelling house	0043	Spark from fire	5
Ambulance on road	0929	Unknown	5
Furniture manufacturers with club above	2307	Unknown	19
Aircraft	1602	Crash in fog	11
Dwelling house	0647	Short circuit in TV	5
Flats (small block)	2254	Faulty oil heater	7
Shop with flat above	0707	Unknown	5
Aircraft	1920	Crash after take-off	5
House converted into flats - Multiple-occupancy	1246	Faulty oil heater	8
Dwelling house	0800	Spark from fire	5
Gypsy caravan	2323	Paraffin lamp knocked over	5
Laundry with living accommodation above	0642	Unknown	5
Corn flour manufacturers	0640	Explosion	5
Corn flour manufacturers	1005	Dust explosion	5
House above shop	0836	Unknown	5
Dwelling house	0833	Unknown	5
Dwelling house	0203	Spark from fire	5
Hotel	0013	Smoking materials	5
Furniture store and taxi-hirers	0125	Unknown	8
House converted into flats	2053	Oil heater overturned	6
Ship in repair	1400	Welders torch	7
Dwelling house	0458	Spark from fire	6
Dwelling house	0300	Dropped light	7
Hotel	1300	Smoking materials	5

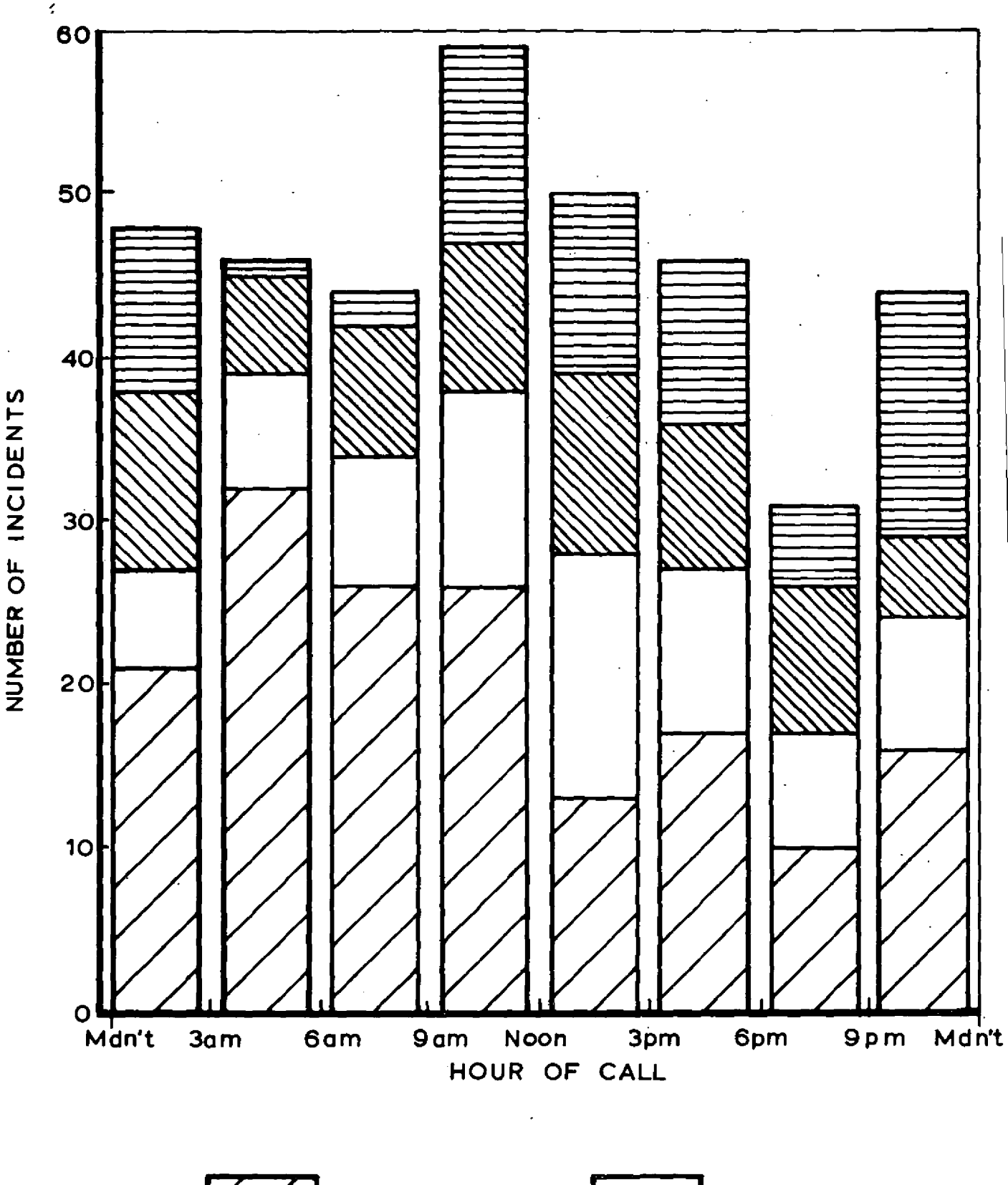


FIG.1. MULTIPLE FATALITY INCIDENTS IN RELATION TO OCCUPANCY AND TIME OF CALL (3-hour periods)

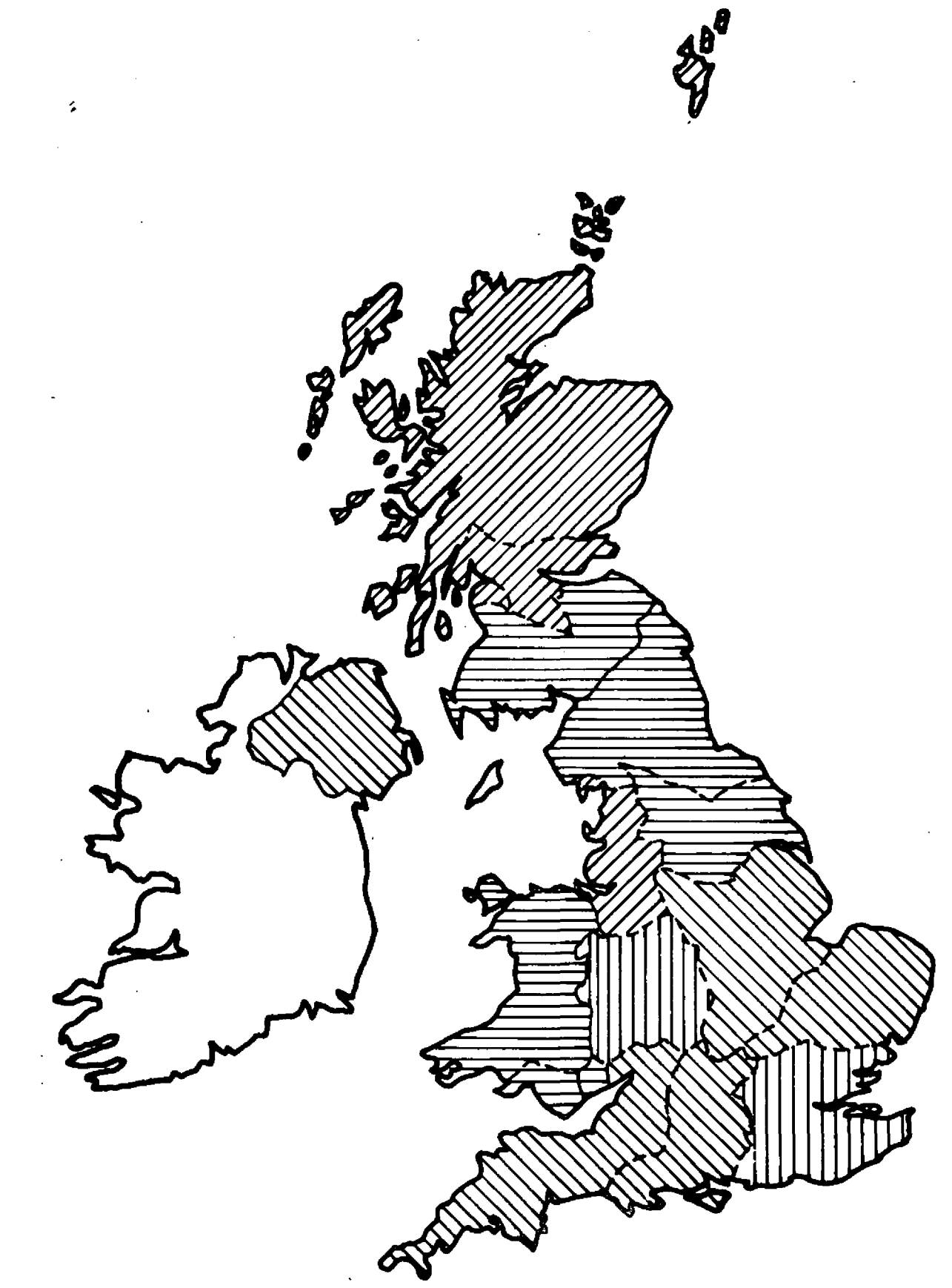


FIG.2. FATALITY RATES BY AREA
(Based on deaths in fires attended by fire brigades, 1960-66)

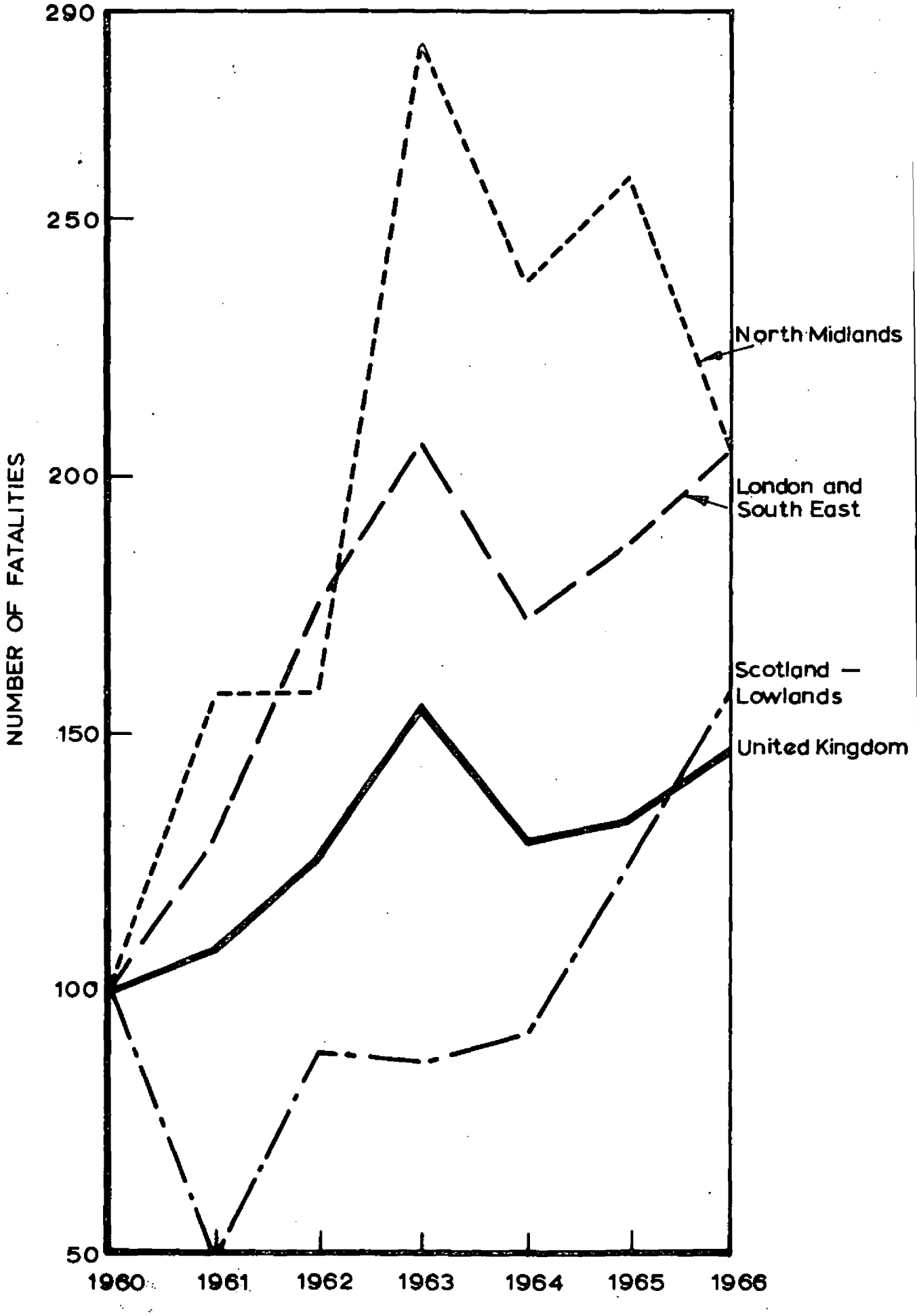
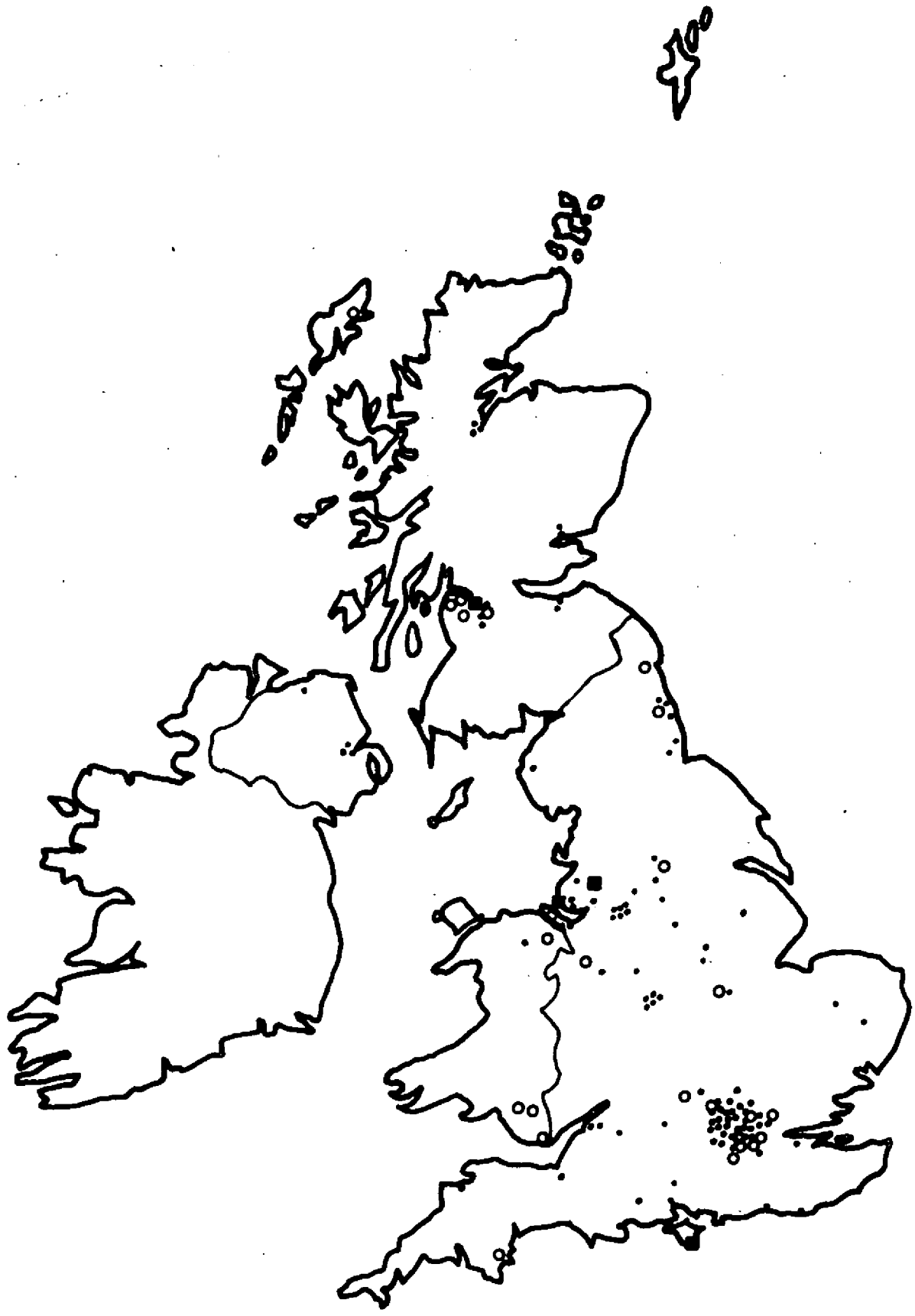


FIG.3. FIRE FATALITIES IN UNITED KINGDOM AND CERTAIN REGIONS RELATED TO 1960



● Fires with 3 or 4 deaths

O Fires with 5 to 9 deaths

■ Fires with 10 or more deaths

(For clarity only fires with 3 or more deaths are shown)

FIG.4. LOCATION OF MULTIPLE FATALITY FIRES, 1960-66

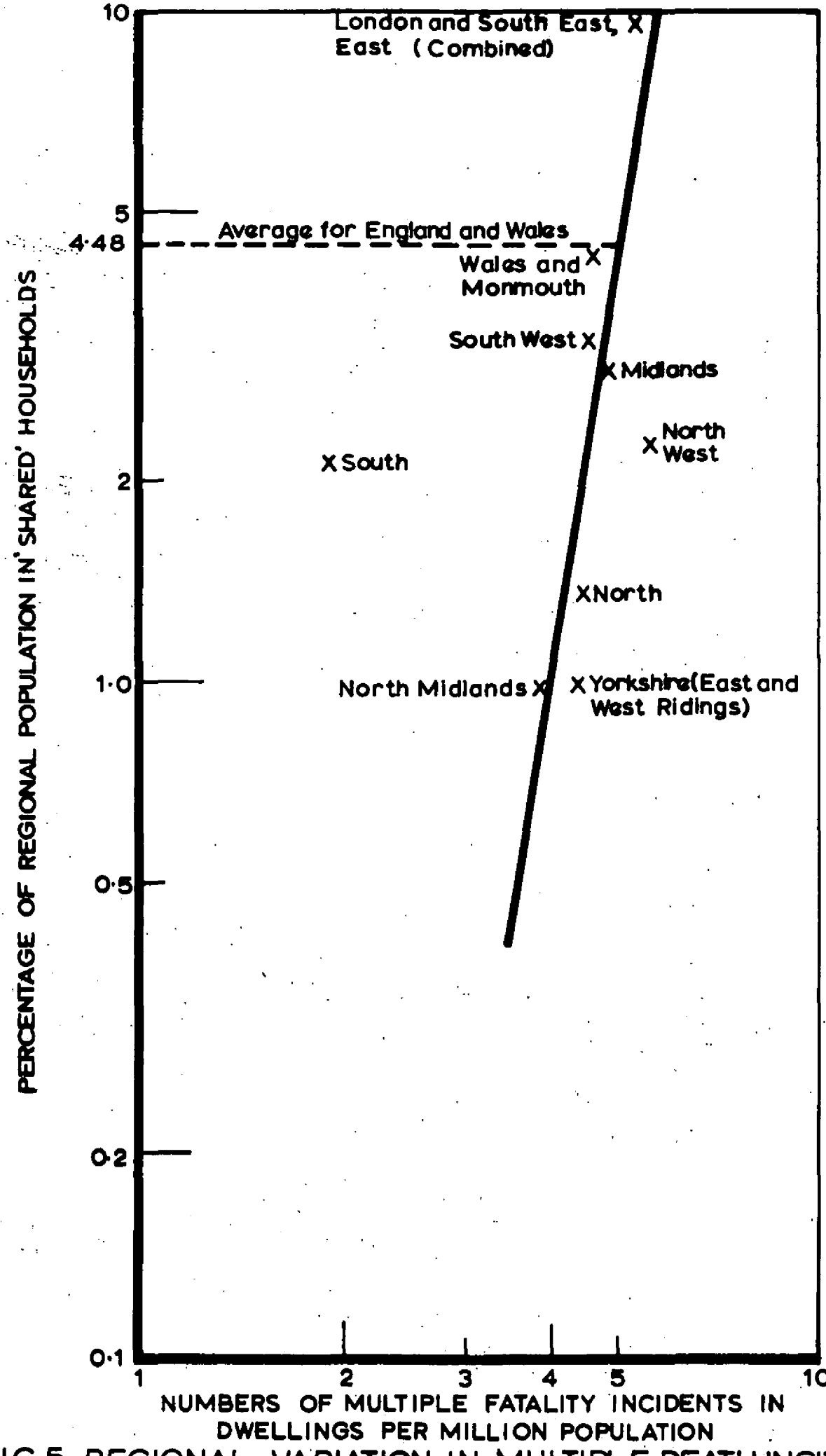


FIG.5. REGIONAL VARIATION IN MULTIPLE DEATH INCIDENTS IN RELATION TO 'SHARED' HOUSEHOLDS