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JOINT FIRE RESEARCH ORGANIZATION

CHIMNEY FIRES

by

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Summary

A sample survey of some of the factors involved in chimney fires has been carried out with the co-operation of ten Fire Brigades. There is evidence that the total number of chimney fires attended, which increased up to 1953, levelled off in 1953 and 1954 and this tendency may have continued in 1955, though data on this year are not yet available.

Nearly all chimney fires took place in dwellings; some 60 per cent of them were started by ordinary open fires burning coal. Nineteen per cent of the fires were started by continuous burning open fires with or without back boilers. The estimated proportion of such fires currently in use is between 25 and 30 per cent so there is no evidence that the increase in chimney fires is due to the increasing use of continuous burning fire grates.

There is no evidence that the use of fuels other than coal contributed substantially to the incidence of chimney fires. There were reported to be bends, constrictions or shelves, most of which could be easily cleaned, in nearly 90 per cent of the chimneys involved. Between 35 per cent and 65 per cent of the chimneys involved caught fire within four months of being swept, in the four largest Brigades. This feature has been noticed in independent surveys and suggests that daily cleaning by the householder of the lower part of the chimney when in use may be an important factor in preventing chimney fires.

The most frequent method of cleaning chimneys was reported to be brush sweeping, an average of 82 per cent of the chimneys involved. Eleven per cent of the chimneys involved were cleaned by the vacuum method in conjunction with brush sweeping while only 2 per cent were reported to be cleaned by the vacuum method alone.

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CHIMNEY FIRES

An analysis of survey information obtained from certain Fire Brigades

by

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INTRODUCTION

There has been a widespread and very marked increase in Fire Brigade calls to chimney fires in the United Kingdom in recent years. In 1947 the National Fire Service attended 20 000 chimney fires in England and Wales; by 1952 the number attended by Fire Brigades had increased to 52 000; it reached 58 000 in 1953 and again in 1954.

The size of the problem is shown by the comparable figure of attendances by Fire Brigades to fires in buildings, other than chimney fires; these amounted to 40 000 in England and Wales in 1954. Attendance at a chimney fire not only reduces the number of appliances available to respond to other calls but is expensive and can cause great inconvenience when retained firemen are involved.

The Interdepartmental Fire Prevention Committee met in November 1953 to consider possible reasons for this increase and to suggest measures for dealing with the situation. At the request of the Committee the Joint Fire Research Organization carried out a survey to investigate, as far as possible, the factors affecting the incidence of chimney fires. Ten Fire Brigades co-operated in the survey and, with one exception, completed a special form for every chimney fire attended in their areas, between 1st September, 1954 and 31st August, 1955. The exception was one Brigade which reported only those chimney fires which occurred in the largest city of their area. A copy of the questionnaire form is attached to this report.

GENERAL INFORMATION

There is some general statistical information available on attendancesat chimney fires although the reports on fires attended by Fire Brigades collected by the Joint Fire Research Organization include chimney fires only when they spread beyond the chimney. Some Chief Officers in their Annual Reports have given figures of calls or attendances at chimney fires but these may not be complete or necessarily comparable. The only complete set of figures showing chimney fire attendances by each Fire Brigade are those collected for 1952, 1953, and 1954 by H.M. Chief Inspector of Fire Services. These, in conjunction with some of the figures provided by Chief Officers show that the rate of increase of chimney fires varies widely, some Brigades showing very little increase, while others show considerable increases.

Since nearly all chimney fires take place in dwellings it has been possible to calculate a rate of incidence by relating the number of attendances at chimney fires to the number of dwellings at risk in the Brigade area. It is assumed in doing this that the distribution of chimneys per dwelling is the same over the whole country. This may not be true for London and some of the larger county boroughs, and it is probable that conditions in Scotland, where there is a very large proportion of flats, differ from those in England and Wales but no more promising method of approach has been found. Rates of incidence have been calculated for 1952 (the only year for which sufficient information on housing was available) and grouped into four ranges: (a) County Brigades with rates below 20 chimney fires attended per 10 000 dwellings at risk per year; (b) County Brigades with rates of incidence between 20 and up to 40 chimney fires attended per 10 000 dwellings at risk per year; (c) County Brigades with rates between 40 and up to 60 chimney fires attended per 10 000 dwellings at risk per year, and (d) County Brigades with rates of 60 or more chimney fires attended per 10 000 dwellings at risk per year. An interesting geographical pattern emerges from the study of these rates. Group (a) comprises County Brigades in Northern England and parts of Wales while groups (b) and (c) mainly include the rest of Wales and the Midlands. Group (d) with the highest rate of incidence consists of the Home Counties and Southern England. Subject to the basic assumption that this is a reasonable method of measuring the rate of incidence there is a tendency for the rate of incidence to be higher in the southern part of England than in the north. The rates

for the County Borough Brigades roughly follow the same pattern, though there are some discrepancies between the rates of incidence for certain County Boroughs compared with the counties in which they are situated. The reasons for this pattern are not clear. A possible reason is differences in the type and quality of coal distributed for domestic use in different geographical areas. Smoke emission is known to depend, amongst other things, on the volatile content of coal and it is probably reasonable to assume that differences in soot deposition can depend on differences in volatile content. The volatile content of domestic coal in ordinary use is between 30 and, say, 45 per cent, though there is currently an appreciable but unknown proportion of smokeless fuels in use in slow-burning grates. While differences in volatile content may account for differences in rates of incidence between areas they would not account for the widespread general increase in the overall rate of incidence of chimney fires except on the basis of either a continuous and considerable general decrease in the quality of domestic coal, or a tendency to form hard soot deposits only partly cleaned by ordinary chimney brushes. Such a tendency was noticed in Sweden during the war years(1). Wood was burned in boilers designed for coal or coke. The lower temperatures achieved and the higher moisture content of the fuel lead to the formation of hard deposits and to a very considerable increase in chimney fires. There are not enough data to see if the rates of change of the numbers of chimney fires with respect to time vary between areas, but there are some indications that the increase has affected both high and low incidence Brigades. There is also an indication (see Table 1 below) that the general increase in the numbers of chimney fires levelled off between 1953 and 1954 so there is the possibility of a kind of accumulative effect. This would be based on the premise that the shortage of coal in the post-war era has meant the use of inferior quality coal for domestic and other use in comparison with that used before the war, and the effect of this has been to leave a residual deposit in chimneys. Some such speculation might account for the tendency for the number of fires to increase for a period and then become constant.

Table 1

ATTENDANCES AT CHIMNEY FIRES BY FIRE BRIGADES IN ENGLAND AND WALES 1952-1954

THE NUMBERS OF BRIGADES SHOWING PROPORTIONATE CHANGES IN ATTENDANCES BETWEEN 1952, 1953 and 1954

Percentage change in attendances		1953 compared with 1952 Number of Brigades		1954 compared with 1953 Number of Brigades	
Decrease	-50 to -11 per cent	10	25	24	60
	-10 to -1 per cent	15		36	
Increase	0 to +10 per cent	28	69	34	59
	+11 to +20 per cent	41		25	
	+21 to +30 per cent	18	40	6	15
	+31 to +40 per cent	12		4	
	+41 to +80 per cent	10		5	
		134		134	

MAJOR FACTORS INVOLVED IN THE SURVEY

The ten Fire Brigades co-operating in the survey returned some 15 000 reports. The main information is summarised in Table 2.

Many of the comparisons required to measure the effect of various factors on the incidence of chimney fires were not administratively feasible (e.g. there was no means of assessing the number of chimneys in which a particular factor

was present without a chimney fire occurring). Nevertheless for certain factors some conclusions could be reached.

Premises in which fires took place (Table 3)

Between 93 and 97 per cent of the chimney fires took place in houses or flats. Chimney fires in other premises can therefore be disregarded.

To measure the differences in chimney fire incidence between Brigade areas it has been necessary to assume that the distribution of chimneys per dwelling is the same for all areas. The assumption may not be justified in areas in which there are large numbers of flats and two such Brigades (E and J) took part in the survey. The proportions of chimney fires which occurred in flats in those two Brigade areas were 59 and 82 per cent respectively. The rate of incidence for Brigade E does not differ from the rates for beighbouring Brigades, but that for Brigade J is the highest rate recorded among the Brigades taking part in the survey. Brigade J is situated in a part of Scotland in which there are known to be large numbers of flats.

Type of appliance used (Table 4)

There is some difference between Fire Brigades in the types of solid fuel appliances which started chimney fires and this probably reflects the influence of local conditions, but the pattern is sufficiently regular to calculate the average proportions of the various types of appliance causing the outbreak. Some 58 per cent of the chimney fires were caused by ordinary stool or hearth types of open fire. In a further 11 per cent of the fires back boilers were fitted. Two Brigades (A and J) returned a high proportion, 26 and 31 per cent respectively, of open fires fitted with back boilers. The incidence of chimney fires in Brigade A was low and in Brigade J very high.

Nineteen per cent of the chimney fires were ignited by continuous burning fires with or without back boilers. Included in these were the comparatively few fires fitted with convection systems. The estimated proportion of continuous burning fires in use in the country as a whole is between 25 and 30 per cent. Assuming that the Brigades co-operating in the survey cover representative areas there is no evidence that the use of continuous burning appliances has an adverse effect upon current chimney fire incidence.

The limited information available to the Organization on independent surveys conducted by Chief Officers of certain Fire Brigades tends to confirm this conclusion.

Fuel in use (Tables 5, 6, 7, 8)

Ordinary coal was in general use in the fire grate in a high proportion of the fires attended, in fact in at least 85 per cent of the fires, except for Brigades B and I. The proportions in these two Brigade areas, in each of which there are considerable rural and urban districts, were 54 and 60 per cent. The proportions of chimney fires in these two Brigades in which the fuel generally used was a mixture of coal and wood were 29 and 20 per cent.

Smokeless fuels were in general use in at most 4 per cent of the fires attended. The greatest proportion of fires in which wood was the fuel in general use was also 4 per cent. There were fires reported in which mixtures of fuel (other than coal and wood) were in general use. These were mixtures of ordinary coal and smokeless fuels and were in use to the extent of about 10 to 12 per cent in Brigades B, I and G.

The fuel in use at the time of the chimney fire was the same as that generally used in about 88 per cent of the fires reported. Where coal was the fuel in general use the proportion of fires in which coal was in use at the time of occurrence was 93 per cent.

The condition of the fuel in use was reported to be dry in about 87 per cent of the fires, damp in some 11 per cent and very wet in about 2 per cent.

The incidence of chimney fires does not depend on any changing patterns of domestic consumption of solid fuel. Table 6 shows that about 30 million tons of house coal, 2 million tons of anthracite and boiler fuel and about

3 million tons of coke have been consumed in dwellings every year since 1948. The pattern of relative incidence of chimney fires in 1952 is not likely to have depended on the quantity of fuel burnt. Chimney fire incidence was lower in northern than in southern Fire Brigade areas, whereas the consumption of coal is higher in the north than in the south. For example the maximum allocation of coal in the northern fuel region is 50 cwts. compared with 34 cwts. in the southern region. The Social Survey(2) found that the average quantity of all types of solid fuel obtained per household between 1st May, 1951 and 30th April, 1952 (in urban households living in dwellings of medium and low rateable values) was 49.8 cwts. in the northern fuel region and 33.8 cwts in the southern fuel region. Table 6 gives some estimates, known to be only approximate, of the domestic consumption of smokeless and non-smokeless fuels in nine of the ten Brigades which co-operated in the survey. In terms of quantity burnt per household the figures reflect the differences between consumption in the north and south and also probably between County and County Borough Brigades.

Construction of chimney (Tables 9, 10, 11, 12)

In the survey questions were asked on the form, the material of construction, and the dimensions of the chimney involved. There were difficulties in definition and differences in interpretation so that the answers returned cannot be regarded as very precise.

It can be seen from Table 9 that the proportions of chimneys falling into the various categories did not differ greatly from one Brigade to another and so it is assumed that the answers to the questions on the form of construction of the chimney represented reasonable physical entities and not wholly the opinions of the reporting officers. Only about 13 per cent of the chimneys involved were wholly free from bends, constrictions or shelves. In 22 per cent of the chimneys the bends, constrictions or shelves were not easily cleaned, while in the remaining 65 per cent of the chimneys they were easily cleaned. Comparative proportions for chimneys not involved in chimney fires obviously could not be obtained, but the difference between the proportions of chimneys with bends, constrictions or shelves easily cleaned and those not easily cleaned suggests that laxity in cleaning may well have an effect on chimney fires. In this connection it may be noted that in two other surveys undertaken independently by certain Fire Brigades the general run of chimneys were found to be fairly clean with pockets of soot. It has also been found that a fairly considerable proportion of chimney fires (between 35 and 70 per cent) occur within four months of the chimney being cleaned and this feature also has been noticed in other surveys(3 and 4). This combination of facts suggests that daily cleaning by the householder of the lower part of the chimney when in use may be an important factor in preventing chimney fires, though regular sweeping is still essential.

The material used in the construction of the chimneys involved in the survey was brick in over 95 per cent of the fires except in the case of a Brigade in Wales in which there were a few cast iron (7 per cent) and stone chimneys (4 per cent) involved, and a Brigade in Scotland in which nearly 60 per cent of the chimneys involved were of stone construction. The main form of construction of the chimney therefore has no effect on chimney fire incidence unless stone construction is worse from the point of view of chimney fire incidence in comparison with brick chimneys. There remained the possibility that in post-war building practice less care is taken when pargetting the chimney to render the inside smooth, but while this might contribute to chimney fire incidence it can scarcely account for much of the very considerable increase observed in recent years.

In all Brigades except one the outlet to the chimney was a pot in over 90 per cent of the fires, cowls amounted to at most 7 per cent of the fires and stacks alone to about 3 or 4 per cent, except in one Welsh Brigade where they amounted to 16 per cent. In very few, about 1 per cent, of the chimney fires was there any combustible material in the chimney. There was a constructional fault in about 2 per cent of the fires reported.

Chimney cleaning (Table 13)

The four methods of chimney cleaning distinguished in the survey were brush sweeping, vacuum suction together with brush sweeping, vacuum suction without brush sweeping, and chemical methods. The proportions of chimneys

involved in fires which had been swept by brush varied around an average of 82 per cent, those cleaned by vacuum and brush amounted to an average of 11 per cent, while the average proportion of chimneys cleaned by vacuum suction without brush sweeping was 2 per cent, the maximum proportion in any Brigade being 6 per cent. Chemical methods and miscellaneous or combined methods were unimportant amounting to at most 1 per cent of the chimney fires attended. It was not possible to gather information on methods of chimney cleaning in households in which chimney fires had not occurred so direct comparisons are not possible. The proportion of chimneys cleaned by vacuum and brush at 11 per cent is perhaps rather lower than might be expected.

Cause of fire (Table 14)

The majority of the fires were reported to be due to soot igniting. Except in three Brigades the proportions of fires due to this cause were at least 82 per cent of the fires attended. In the three exceptional areas about 12 per cent of the fires were due to each of the causes "paper or similar material igniting" and "fires drawn up by forced draught".

Spread of fire (Table 15)

Nearly all chimney fires were confined to the chimney.

OTHER FACTORS FOR WHICH INFORMATION WAS RETURNED IN THE SURVEY

There were certain other factors such as the time of outbreak, dimensions of chimney and chimney throat, frequency of chimney cleaning and time since last cleaning on which information was included in the survey. These factors are briefly discussed below. The information in all cases has been tabulated for domestic premises only and in general only that from the larger Brigades has been considered.

Time of occurrence of chimney fires (Figs. 1-11)

Various aspects of the time of outbreak are shown in Figs. 1-4. As might be expected there is a reasonably close inverse relationship between the number of chimney fires per week and the average external temperature in that week (Figs. 5-7) at least in the three Brigades with large numbers of chimney fires for which the temperature data were available. To some extent the number of chimney fires depends on the number of fireplaces in use, but if it is assumed that the majority of fireplaces are in use fairly continuously between November and March, it can be seen from Figs. 9-11 in which chimney fires per week are plotted against outside temperature that there is a reasonably strong inverse relationship between the two. For every degree fall in external temperature there is an average increase of 22.0 chimney fires per week attended by Fire Brigade E. 4.6 fires per week attended by Fire Brigade B and 2.9 fires per week by Fire Brigade J. The relations are statistically significant but there is some difference in the strength of the relationship, that for Brigade E being the strongest.

A supplementary approach is to try and consider the number of chimney fires in relation to the number of fireplaces in use at any given hour of the day. The Social Survey in their enquiry on the use of heating appliances[2] by urban households have shown graphically the proportions of main solid fuel open fires in use. These fires were the main heating appliance for 94 per cent of the households in the sample. The estimated proportions relate to weekday use in January 1952, and are restricted to dwellings of low and medium rateable value occupied by single households. They are not therefore on a strictly comparable basis with the data on chimney fires.

The Social Survey figures have been used to estimate the number of fireplaces in use in the areas covered by Brigades B and I (Figs. 1 and 2). The rates of incidence of chimney fires in relation to the estimated number of fireplaces in use have been calculated for each hour of the day. The calculated figures are approximations based on many assumptions, and suggest that the periods of highest incidence are the hours 9-11 a.m. and 6-8 p.m., presumably when fires are being lighted.

The proportionate numbers of chimney fires attended in domestic premises in each hour of the day by the four largest Brigades do not indicate any important marked difference between the Brigades.

There are slight differences between Brigades in the distribution of chimney fires according to the day of the week but none of importance and the proportions on various days agree with those shown in an independent survey carried out by a Fire Brigade(4). There is a fairly general tendency for chimney fires to be rather more frequent on Saturdays and Sundays than on other days of the week.

Frequency of chimney cleaning and time since last cleaning (Table 16 and Fig. 12)

Information on the frequency of chimney cleaning and the time since the last cleaning was collected. The consistency of the two sets of data was checked, and a general tendency was found for the average time since the last cleaning to increase as the frequency of cleaning increased from once a year to four or more times a year. The data on frequency of cleaning were discarded since the results of an independent survey(4) provided some check on the information returned under the "time since last cleaning" heading.

The data have been plotted in Fig. 12 for chimney fires in houses and flats in the form of cumulative proportions, that is the proportion for a given time interval is the proportion of chimney fires in which the chimney involved had been swept within a time less than or equal to the given interval. This permits easier comparison between Brigades. There are considerable differences between Brigades but there is no evidence from these data that the rate of incidence for a Brigade is related to the distribution of times since last cleaning. In fact the two Brigades with the lowest mean time since last cleaning, Brigades F and J, are also those with the highest rates of incidence. The range of variation in times since last cleaning is large. For example the proportion of chimney fires in which the chimney involved had been cleaned within the four months previous to the fire varied from 35 per cent to just over 70 per cent. The corresponding figures for an interval of 6 months or less were 55 and 90 per cent, and for three months or less the figures varied between 25 and 55 per cent. The evidence collected in an independent survey(3) tends to confirm this picture. The report noted that a considerable proportion of chimneys caught fire within two or three months of sweeping, and also commented on the cases in which receipted accounts had been produced by way of proof.

The mean time since last cleaning has been calculated for the various categories of chimney construction. The figures are shown in Table 10. While there are consistent differences between Brigades there is no evidence of any important differences between the types of chimney construction. The mean time since last cleaning has also been calculated in relation to the type of heating appliance which caused the chimney fire. The figures are given in Table 17.

The mean times adjusted for differences in proportions of each type of appliance between Brigades are 0.6 - 0.7 months lower in chimneys involved in chimney fires fitted with open fires with back boilers, continuous burning grates, or convector fires compared with chimneys fitted with ordinary open fires. The mean times for openable stoves and combination stoves are 1 and 0.6 months higher than the mean time for open fires. The differences are not large and can only be calculated for the population of chimneys involved in chimney fires.

Chimney dimensions (Table 18 and Figs. 13-15)

Information was collected on the approximate width and depth of the chimneys involved in chimney fires and the approximate width and depth of the throats. The former measurements were intended to relate to the cross-section of the interior of the chimney and the latter to the smaller cross section of the flue system. Appropriate sections were provided for circular chimneys. Information was also collected on the approximate height of the chimney involved.

The cross-sectional dimensions are important in two ways; the effect of the throat and chimney dimensions on the air-flow through the fire and the subsequent soot deposition of the fire, and the possibility that the throat

dimensions may hinder chimney sweeping operations. Work done at the Fuel Research Station[5] has shown that the fitting of a throat restrictor to an open fire reducing the throat aperture area to some 6 sq. ins. can reduce the air-flow from a figure of 10 000 - 13 500 cu.ft./h to about 5 000 cu.ft/h. The same investigation showed that smoke emission was related to the volatile content of coal but that for coals in the 32 to 40 per cent range, roughly the region of normal domestic coals, the smoke emission is approximately constant. The effect of a throat restriction on smoke emission was examined and it was found that in this particular experiment the smoke emerging from the top of the chimney was about half the quantity emitted without a throat restriction. A further experiment was done which suggested that the reduction in smoke emission and a similar reduction in soot deposition were due to better combustion in the presence of a reduced air-flow over the fire.

The information obtained in the survey showed that in only a very few fires was the area of the throat below 20 sq. ins, and the most frequently occurring area groups involved in chimney fires were 81-100 sq.ins. and 101-120 sq.ins. The range of throat area measurements was wide, from 20 sq.ins. to over 600 sq.ins. and the data are shown graphically in Fig. 13. The smallest throat areas are those in Brigade J, the highest incidence Brigade, but there are not wide differences between the four Brigades. Similar information on chimney areas is illustrated in Fig.14. Except in one Brigade (E), the most frequently occurring area group was 71-90 sq.ins. There are wider differences between Brigades though the smallest chimney areas still occur in Brigade J. No information was collected on the presence or absence of throat restrictors in improved grates, fires in which amounted to 19 per cent of the total of chimney fires, and it is possible that if these were in use the smallest area would be less than the product of the throat dimensions.

The narrowest dimension has been taken to be the depth of the throat where this was less than the width of throat, and the data are shown in Fig.15. It is perhaps worth noting that in Brigade J, with the highest incidence of chimney fires, the proportion of chimneys with narrowest dimension less than 4½ ins., in which chimney fires occurred was over 16 per cent. It may be relevant to note that this Brigade is situated in Scotland where the usual practice is to sweep chimneys from the top.

The mean depth of throat has been calculated for the different types of heating appliance in chimneys involved in chimney fires, and the results are summarised in Table 18.

The differences between the mean depths of throat when adjusted for differences in the proportions of each type of appliance between Brigades show that the throat depths of open fires with back boilers and of convector fires are on the average 0.8 in. and 0.9 in. smaller than the throat depths of ordinary open fires, while the difference for continuous burning fires is only 0.3 in. The throat depths for stoves are rather larger than those for open fires. These differences presumably reflect differences between the constructions of grates rather than differences connected with chimney fire incidence.

The mean height of the chimney involved has been tabulated (in Table 21) for the various classes of premises. The differences between the mean chimney heights of houses and flats are appreciable only in Brigades E and J in which there are large proportions of flats. Unfortunately no information is available on the numbers of flats in these Brigade areas from which to calculate the incidence of chimney fires. Given a measure of the rates of incidence of chimney fires in houses and in flats it might be possible to see if the height of the chimney had any effect on chimney fire incidence.

ANCILLIARY INFORMATION

At the meeting of the Interdepartmental Fire Prevention Committee it was agreed to undertake certain enquiries which might have a bearing on chimney fire incidence. It was found that it is a general custom on local authority housing estates to make a condition of tenancy that the chimney is swept once a year. It is not possible to say how far this condition is enforced, and it is known that very few authorities carry out the sweeping themselves. The London County Council imposes a similar condition of tenancy but no steps are taken to enforce the condition.

Enquiries made of two contractors provided the following views on chimney fires:-

a. there was difficulty in sweeping chimneys fitted with modern grates with restricted throats of 4 in. narrowest dimension

b. one contractor thought that chimneys are not being swept so frequently and seldom more than once a year, probably because of the high cost, while the other felt that chimneys were being swept twice yearly or more because of the poor quality of fuel

c. the new continuous burning grates deposit more soot. They are also designed to burn coke and smokeless fuel and soot up quickly if coal or rubbish are burned

d. Before the war high grade "named" coal which burned with little soot deposit was available. Very little clean or graded coal is now delivered for domestic use.

GENERAL SUMMARY AND CONCLUSIONS

There has been a very marked increase in chimney fires attended by Fire Brigades in recent years, from about 20 000 attendances in England and Wales in 1947 to 58 000 in 1953 and 1954. There is some evidence that the increase in the numbers is levelling off. There appear to be regional differences in chimney fire incidence subject to the assumption that the distribution of chimneys per dwelling is the same throughout the country, but some low incidence areas have shown much the same rate of increase in numbers of chimney fires as high incidence areas. The low incidence areas are in the northern parts of England and Wales where the consumption of solid fuel per household is highest. The possible bearing of coal quality on chimney fire incidence has been considered. Some experimental work done at the Fuel Research Station has been concerned with the relation of the volatile content of coal to smoke emission which is presumed to be related to soot deposition. It was found that smoke emission was approximately constant in the volatile content range of domestic coals, roughly 32 to 40 per cent. It was also found that throat restrictors which reduced the throat area to about 6 sq. ins. reduced both smoke emission and soot deposition.

Nearly all chimney fires took place in dwellings and about 60 per cent of them were started by ordinary open fires. Eleven per cent of the chimney fires were started by open fires with back boilers and 19 per cent were started by continuous burning open fires with or without back boilers. The estimated proportion of "improved" or continuous burning open fires in use is between 25 and 30 per cent, so there is no evidence that the increase in chimney fires is due to the increasing use of these fires.

There is no evidence that the use of fuels other than coal contributes substantially to the incidence of chimney fires. In none of the ten Brigade areas was wood in general use to any appreciable extent. In two County Brigade areas coal and wood mixtures caused between 20 and 30 per cent of the fires. Smokeless fuels were responsible for at most 4 per cent of the fires attended. In about 11 per cent of the fires the fuel was reported to be damp and in about 2 per cent very wet.

A considerable proportion of the chimneys involved, 87 per cent, were reported to have bends, constrictions or shelves the majority of which were easily cleaned. The proportions of chimney fires in which the chimney caught fire within four months of being cleaned varied between 35 and 65 per cent in the four Brigades with the highest numbers of chimney fires. This feature has been noticed in two independent surveys on chimney fires carried out by Fire Brigades and it suggests that daily cleaning by the householder of the lower part of the chimney when in use may be an important factor in preventing chimney fires, though regular sweeping is still essential. The material used in the construction of the chimneys involved was brick in over 95 per cent of the fires except in two Brigades, in one of which nearly 60 per cent of the chimneys involved were of stone construction. There was no evidence that the type of outlet to the chimney, the presence of combustible material in the chimney, or constructional faults in the chimneys contributed to chimney fire incidence.

The most frequent method of cleaning chimneys reported was brush sweeping;

an average of 82 per cent of the chimneys involved. Eleven per cent of the chimneys involved were cleaned by vacuum suction together with brush sweeping while only 2 per cent were cleaned by vacuum suction alone, the maximum proportion in any Brigade being 6 per cent. Chemical and other methods were unimportant amounting to at most 1 per cent of the chimney fires attended.

Various other secondary factors were considered in particular the time of outbreak, the dimensions of the chimney and chimney throat and the frequency of chimney cleaning and time since last cleaning. It was not administratively possible to obtain similar information in respect to chimneys which were not involved in chimney fires so the information obtained from these data was limited to observing the differences between Brigades and relating such differences to the Brigade rates of incidence. The chimney dimensions, such as the area of chimney and chimney throat, and smallest dimension of the chimney and also the time since last cleaning were smallest for the highest incidence Brigade, though there were no marked differences for the other three Brigades considered.

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3. Private communication from Chief Fire Officer, Cardiff City Fire Service

4. Private communication from Chief Fire Officer, Wiltshire County Fire Brigade

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TABLE 4

HEATING APPLIANCE IN USE (ALL PREMISES)

Heating appliance	Brigade										Total
	B	A	I	E	D	F	H	G	J	C	
Open fire, normal stool or hearth type	650	288	1 686	4 219	290	366	42	168	849	111	8 669
	(51)	(49)	(51)	(70)	(55)	(49)	(61)	(30)	(49)	(53)	(58)
with back boiler	99	154	310	242	51	51	9	89	540	40	1 585
	(8)	(26)	(9)	(4)	(10)	(7)	(13)	(16)	(31)	(19)	(11)
Total non-continuous burning types	749	442	1 996	4 461	341	417	51	257	1 389	151	10 254
	(59)	(75)	(60)	(74)	(65)	(56)	(74)	(46)	(80)	(72)	(68)
Open fire, continuous burning type	177	9	486	652	106	110	1	35	53	26	1 655
	(14)	(2)	(15)	(11)	(20)	(15)	(1)	(6)	(3)	(12)	(11)
continuous burning type with back boiler	127	73	300	215	34	99	10	31	95	26	1 010
	(10)	(13)	(9)	(4)	(6)	(13)	(15)	(6)	(6)	(12)	(7)
with convection system	7	6	4	8	1	4	-	4	7	-	41
	(1)	(1)	(-)	(-)	(-)	(1)		(1)	(-)		(-)
with convection system with back boiler	23	5	34	31	7	7	-	2	26	-	135
	(2)	(1)	(1)	(1)	(1)	(1)		(-)	(2)		(1)
Total continuous burning types	334	93	824	906	148	220	11	72	181	52	2 841
	(27)	(17)	(25)	(16)	(27)	(30)	(16)	(13)	(11)	(24)	(19)
Openable stove, space heating only	25	3	69	108	8	10	2	5	13	-	243
	(2)	(1)	(2)	(2)	(2)	(1)	(3)	(1)	(1)		(2)
with boiler or domestic boiler	45	9	117	147	10	16	-	10	50	4	408
	(4)	(2)	(4)	(2)	(2)	(2)		(2)	(3)	(2)	(3)
Combination stove, heating or cooking	102	34	251	396	19	81	5	219	72	-	1 179
	(8)	(6)	(8)	(7)	(4)	(11)	(7)	(39)	(4)		(8)
Industrial boilers, furnaces, central heating boilers, other appliances	19	2	23	47	1	7	-	4	12	2	117
	(2)	(-)	(1)	(1)	(2)	(1)		(1)	(1)	(1)	(1)
	1 274	583	3 280	6 065	527	751	69	567	1 717	209	15 042

The figures in brackets are percentages

TABLE 6(a)

CONSUMPTION OF SOLID FUEL IN DOMESTIC PREMISES(3)

	1948	1949	1950	1951	1952	1953	1954
House coal(1) ..... (million tons)	29.5	28.7	30.1	30.0	29.9	29.6	30.6
Anthracite and boiler fuel(1).. (million tons)	2.4	2.2	2.3	2.2	2.1	2.1	2.1
Coke(2) ..... (million tons)	3.3	3.4	3.7	3.7	2.6	3.0	3.3

(1) Merchants disposals to domestic consumers including disposals to shops, offices and other establishments partly or entirely non-residential, with an annual consumption of less than 100 tons of coal or coke

(2) From 1952 the figures relate to disposals by merchants and producers to consumers of less than 10 tons a year and represent approximately 90 per cent of the total disposals to such consumers

(3) Source - Annual Abstract of Statistics

TABLE 6(b)

CONSUMPTION OF SOLID FUEL IN DOMESTIC PREMISES(4) - 1952

	County Brigades				County Borough Brigades				Scottish	N. Ireland
	B	A	I	E	D	F	H	G	J	C
Total solid fuel burnt (000 tons)	363	935	1 010	2 045	218	284	115	487	660	---
Smokeless fuel (000 tons) (included in above)	88	335	318	499	16	28	10	34	49	---
Proportion smokeless fuel to total-percentage	24	36	32	24	7	10	9	7	7	---
Estimated quantity of non-smokeless fuel burnt per household (cwts)	19	57	30	28	53	58	57	57	51	---
Estimated quantity of smokeless fuel burnt per household (cwts)	6	32	13	9	4	6	5	4	4	---

6,117
1377

(4) Source - Ministry of Fuel and Power - Statistical Digest 1954.

TABLE 5

TYPE OF FUEL GENERALLY USED (INCIDENTS IN HOUSES AND FLATS)

Type of fuel generally used	Brigade									
	B	A	I	E	D	F	H	G	J	C
Ordinary coal	643 (54)	552 (98)	1 903 (60)	5 310 (91)	432 (85)	655 (90)	45 (69)	486 (89)	1 576 (96)	197 (98)
Smokeless fuels	40 (3)	8 (1)	122 (4)	157 (3)	13 (3)	11 (2)	-	4 (1)	18 (1)	2 (1)
Wood	52 (4)	-	84 (3)	18 (-)	-	4 (-)	-	-	8 (-)	-
Coal and wood	342 (29)	2 (1)	654 (20)	102 (2)	1 (-)	11 (2)	2 (3)	3 (-)	4 (-)	-
Other mixed fuels	105 (9)	-	373 (12)	224 (4)	64 (12)	40 (5)	17 (26)	53 (10)	27 (2)	2 (1)
Other fuels and fuel unknown ...	5 (1)	-	22 (1)	30 (-)	1 (-)	7 (1)	-	2 (-)	13 (1)	2 (1)
	1 187	562	3 159	5 841	511	728	64	548	1 646	203

The figures in brackets are pencentages

TABLE 7

CONDITION OF FUEL IN USE AT TIME OF OCCURRENCE (ALL PREMISES)

Condition of fuel in use	Brigade										Total	Average per-centage
	B	A	I	E	D	F	H	G	J	C		
Very wet	26	15	85	55	10	12	3	13	20	1	240	2
Damp	244	79	497	534	40	62	5	64	93	21	1 639	11
Dry	997	488	2682	5 439	475	670	61	488	1 589	186	13 075	87
Unknown	7	1	16	37+	2	7	-	2	15+	1	88	-
	1 274	583	3 280	6 065	527	751	69	567	1 717	209	15 042	100

+ Including one fire in which the fuel was covered with an inflammable substance

TABLE 8

THE FUEL IN USE AT THE TIME OF OCCURRENCE IN RELATION TO THE FUEL GENERALLY USED (ALL PREMISES)

Brigade	Total number of fires in all premises (a)	Total number in which fuel generally used was the same as that in use at the time of the occurrence (b)	Proportion (b : a) %	Total number of chimney fires in which coal was generally used (d)	Total number of chimney fires in which coal was in general use and at the time of the occurrence (e)	Proportion (e : d) %
B	1 274	1 024	80.4	694	609	87.8
A	583	552	94.7	570	540	94.7
I	3 280	2 651	80.8	1 967	1 763	89.6
E	6 065	5 445	89.8	5 482	5 074	92.6
D	527	445	84.4	445	405	91.0
F	751	707	94.1	671	655	97.6
H	69	51	73.9	48	42	87.5
G	567	497	87.7	500	466	93.2
J	1 717	1 623	94.5	1 636	1 577	96.4
C	209	205	98.1	203	201	99.0
All Brigades	15 042	13 200	87.8	12 216	11 332	92.8

TABLE 10
MATERIAL USED IN THE CONSTRUCTION OF THE CHIMNEY INVOLVED (ALL PREMISES)

Material used in construction of chimney	Brigade									
	B	A	I	E	D	F	H	G	J	C
Brick	1 215 (95)	493 (85)	3 127 (95)	5 963 (98)	517 (98)	730 (97)	67 (97)	560 (99)	585 (34)	206 (99)
Cast iron	8	42 (7)	43	27	4	3	2	1	8	1
Asbestos cement	-	-	9	6	-	-	-	-	4	-
Concrete (precast)	23	1	11	23	-	4	-	-	8	-
Concrete (in situ)	6	1	13	8	2	8	-	-	4	-
Stone	1	22 (4)	1	-	-	-	-	-	994 (58)	1
Brick and cast iron	14	3	47	29	3	3	-	4	2	1
Brick and other material ...	5	21 (4)	9	-	1	1	-	1	81 (5)	-
Other material	2	-	10	5	-	1	-	1	23 (1)	-
Unknown	-	-	-	4	-	1	-	-	8	-
Total	1 274	583	3 280	6 065	527	751	69	567	1 717	209

The figures in brackets are percentages

TABLE 11

THE NUMBER OF FIRES OCCURRING IN CHIMNEYS RELATED TO TYPE OF OUTLET (ALL PREMISES)

Outlet	Brigade										Total
	A	B	I	E	D	F	G	H	J	C	
Pot	444	1 147	3 005	5 564	496	727	521	68	1 650	205	13 827
	(76)	(90)	(92)	(92)	(94)	(97)	(92)	(99)	(96)	(98)	(92)
Cowl	32	34	96	405	12	14	29	1	51	2	676
	(5)	(3)	(3)	(7)	(2)	(2)	(5)	(1)	(3)	(1)	(4)
Stack only	94	73	136	54	14	3	13	-	7	1	395
	(16)	(6)	(4)	(1)	(3)	(-)	(2)		(-)	(-)	(3)
Sleeve or liner	-	2	4	2	-	1	4	-	2	-	15
							(1)				
Other	4	4	10	5	-	2	-	-	3	1	29
	(1)	(-)	(-)	(-)		(-)			(-)		(-)
Unknown	9	14	29	35	5	4	-	-	4	-	100
	(2)	(1)	(1)	(1)	(1)	(1)			(-)		(1)
Total fires	583	1 274	3 280	6 065	527	751	567	69	1 717	209	15 042
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

TABLE 12

THE NUMBER OF FIRES OCCURRING IN CHIMNEYS IN WHICH THERE WAS COMBUSTIBLE MATERIAL (OTHER THAN SOOT), OR CONSTRUCTIONAL FAULTS (ALL PREMISES)

	Brigade										Total
	A	B	I	E	D	F	G	H	J	C	
Combustible material	5	7	20	31	-	3	1	-	14	2	83
	(1)	-	(1)						(1)	(1)	(1)
Constructional fault	13	11	34	135	3	19	16	7	28	7	293
	(2)	(1)	(2)	(2)	(1)	(1)	(3)	(10)	(2)	(3)	(2)
Total fires	583	1 274	3 280	6 065	527	751	567	69	1 717	209	15 042

The figures in brackets are percentages

TABLE 13

METHOD OF CLEANING CHIMNEY INVOLVED (ALL PREMISES)

Method of cleaning	Brigade										Total
	B	A	I	E	D	F	H	G	J	C	
Brush sweeping	999 (78)	495 (85)	2 491 (76)	4 943 (82)	356 (68)	657 (87)	63 (91)	485 (86)	1 626 (95)	185 (89)	12 300 (82)
Vacuum and brush	155 (12)	52 (9)	580 (18)	573 (9)	106 (20)	32 (4)	4 (6)	34 (6)	31 (2)	21 (10)	1 588 (11)
Vacuum without brush	16 (1)	15 (3)	48 (2)	155 (3)	30 (6)	18 (2)	1 (-)	7 (1)	14 (1)	2 (1)	306 (2)
Chemical	8 (1)	7 (1)	13 (-)	47 (1)	1 (-)	4 (1)	-	4 (1)	3 (-)	-	87 (1)
Miscellaneous methods and more than one of the above	3 (-)	2 (-)	24 (1)	42 (1)	-	1 (-)	-	6 (1)	1 (-)	-	79 (1)
Unknown methods	93 (7)	12 (2)	124 (4)	305 (5)	34 (6)	39 (5)	1 (-)	31 (6)	42 (2)	1 (1)	682 (4)
	1 274	583	3 280	6 065	527	751	69	567	1 717	209	15 042

The figures in brackets are percentages

TABLE 14

THE REPORTED CAUSE OF THE CHIMNEY FIRE (ALL PREMISES)

Brigade	Paper or similar material ignited by fire	Fire drawn by forced draught e.g. bellows, metal sheet etc.	Soot igniting	Other causes	Total
B	39 (3)	20 (1)	1 192 (94)	23 (2)	1 274 (100)
A	37 (6)	36 (6)	477 (82)	33 (6)	583 (100)
I	133 (4)	98 (3)	2 987 (91)	62 (2)	3 280 (100)
E	346 (6)	198 (3)	5 372 (89)	149 (2)	6 065 (100)
D	35 (7)	27 (5)	454 (86)	11 (2)	527 (100)
F	67 (9)	91 (12)	567 (75)	26 (4)	751 (100)
H	10 (14)	9 (13)	42 (61)	8 (12)	69 (100)
G	82 (14)	58 (10)	400 (71)	27 (5)	567 (100)
J	135 (8)	17 (1)	1 529 (89)	36 (2)	1 717 (100)
C	28 (13)	-	179 (86)	2 (1)	209 (100)
Total	912 (6)	554 (4)	13 199 (88)	377 (2)	15 042 (100)

The figures in brackets are percentages

TABLE 15

THE NUMBER OF FIRES WHICH SPREAD BEYOND THE CHIMNEY IN EACH BRIGADE (ALL PREMISES)

	Brigade										Total
	A	B	I	E	D	F	G	H	J	C	
Confined to chimney	575 (99)	1 254 (98)	3 246 (99)	5 985 (99)	522 (99)	744 (99)	565 (100)	69 (100)	1 666 (97)	206 (99)	14 832 (99)
Spread beyond chimney	8 (1)	20 (2)	34 (1)	80 (1)	5 (1)	7 (1)	2 (-)	-	51 (3)	3 (1)	210 (1)
Total fires	583 (100)	1 274 (100)	3 280 (100)	6 065 (100)	527 (100)	751 (100)	567 (100)	69 (100)	1 717 (100)	209 (100)	15 042 (100)

The figures in brackets are percentages

TABLE 16

MEAN TIME SINCE LAST CLEANING IN RELATION TO TYPE OF CHIMNEY CONSTRUCTION

Type of chimney construction		Brigade								Total all Brigades	Mean time adjusted differences in proportion between Brigades
		B	A	I	E	G	J	D	F		
Shelf where soot can lodge, easily cleaned	Number of chimney fires	567	198	1 469	2 607	190	660	237	188	6 116	
	Average interval	5.5	5.6	5.8	7.1	7.7	4.0	6.0	3.8	6.1	6.1
Shelf where soot can lodge, not easily cleaned	Number of chimney fires	116	89	392	669	153	309	54	48	1 830	
	Average interval	5.6	4.5	6.0	7.0	7.7	4.2	5.8	5.4	6.1	6.1
Bend or constriction easily cleaned	Number of chimney fires	119	45	299	498	60	274	27	228	1 550	
	Average interval	5.6	5.1	5.9	8.3	8.3	3.8	6.5	4.1	6.1	6.6
Bend or constriction not easily cleaned	Number of chimney fires	76	68	195	417	32	92	42	111	1 033	
	Average interval	4.2	5.7	5.6	6.8	7.4	3.4	5.1	3.8	5.6	6.1
Both bend or constriction and shelf	Number of chimney fires	43	32	147	269	17	23	11	25	567	
	Average interval	5.9	4.8	5.7	7.6	8.5	3.5	4.5	3.0	6.4	6.1
Neither bend, constriction nor shelf	Number of chimney fires	119	100	366	669	63	166	68	67	1 618	
	Average interval	6.0	5.5	5.6	7.6	8.9	3.9	6.7	4.1	6.4	6.3
Unknown	Number of chimney fires	4	-	18	9	1	3	-	-	35	
	Average interval	6.5	-	...	6.7	4.0	5.0	-	-	...	...
Total - known time since last cleaning	Number of chimney fires	1 044	532	2 886	5 138	516	1 527	439	667	12 749	
	Average interval	5.5	5.3	5.9	7.3	7.9	4.0	6.0	4.0	6.2	6.2
Standard deviation of individual observation (months)		3.3	3.3	3.4	4.3	5.3	2.4	3.8	2.6		

TABLE 17

MEAN TIME SINCE THE CHIMNEY WAS LAST CLEANED ACCORDING TO THE TYPE OF HEATING APPLIANCE

Brigade		Heating appliance									Standard deviation
		Open fire normal stool or hearth type	Open fire with back boiler	Open fire continuous burning type	Other open fires	Openable stoves	Combination stoves heating and cooking	Other appliances	Type of appliance not stated	Total	
E	Mean time (months)	7.37	6.31	6.44	6.31	8.52	8.33	9.08	4.33	7.29	5.19
	Number of fires	3 562	215	573	221	206	345	13	3	5 138	
I	Mean time (months)	5.77	5.00	5.72	5.39	7.39	6.42	5.23	-	5.79	4.13
	Number of fires	1 485	277	423	300	161	230	10	-	2 886	
J	Mean time (months)	4.00	3.99	3.57	4.10	4.17	3.48	9.33	-	3.97	2.59
	Number of fires	732	504	47	118	58	65	3	-	1 527	
B	Mean time (months)	5.65	5.66	5.19	4.79	5.60	5.87	7.86	-	5.52	3.91
	Number of fires	538	82	146	130	53	82	13	-	1 044	
	Total number	6 317	1 078	1 189	769	478	722	39	3	10 595	
	Mean time (months)	6.46	4.84	5.92	5.36	7.29	7.01	7.83	4.33	6.23	
	Mean time adjusted for differences in proportions between Brigades	6.28	5.55	5.71	5.59	7.30	6.87	...	...		

TABLE 18

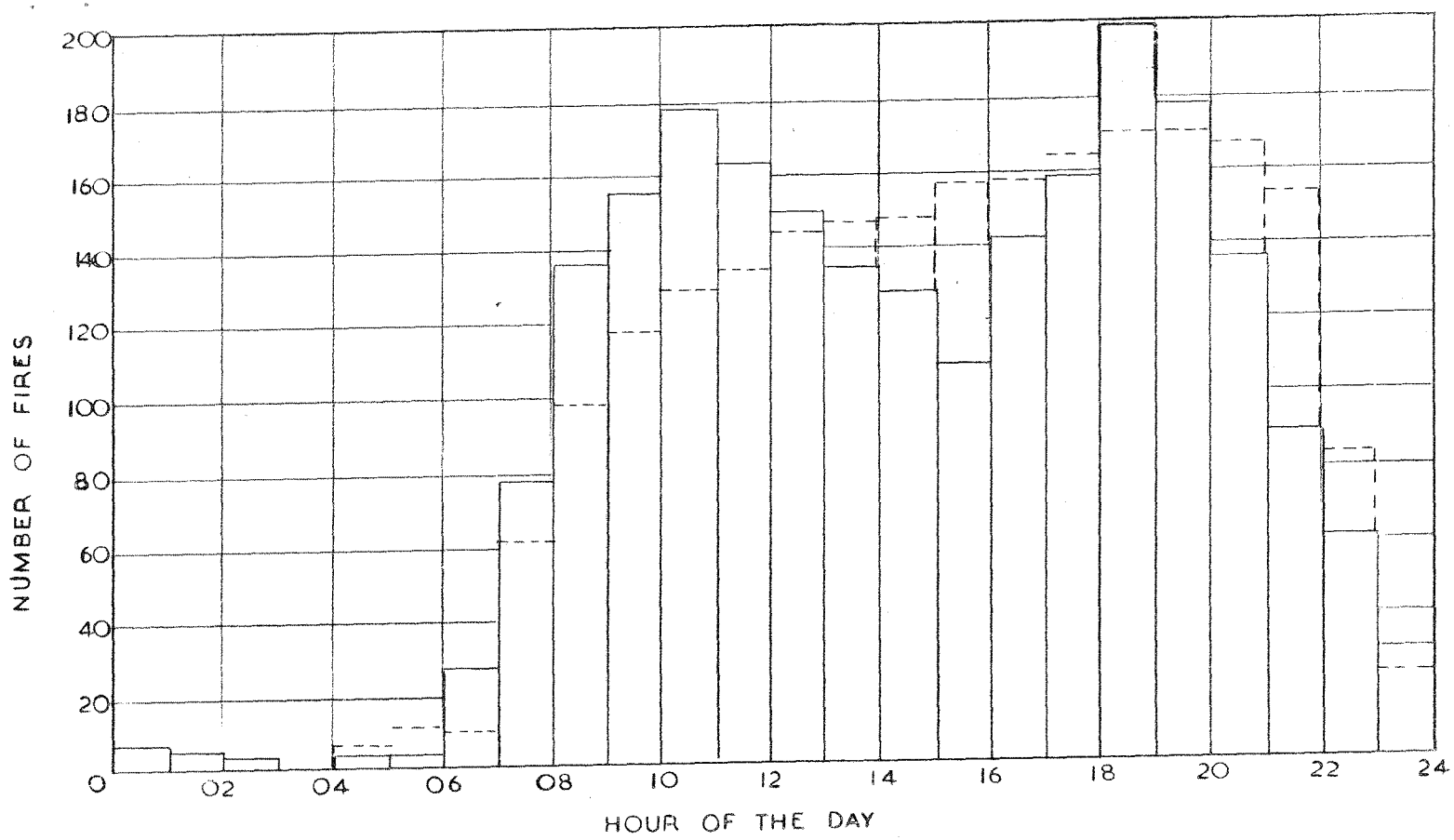
MEAN DEPTH OF THROAT OF CHIMNEY IN WHICH THE FIRE OCCURRED ACCORDING TO THE TYPE OF HEATING APPLIANCE (DOMESTIC PREMISES)

Brigade		Heating appliance									Standard deviation
		Open fire normal stool or hearth type	Open fire with back boiler	Open fire continuous burning type	Other open fires	Openable stoves	Combination stoves heating and cooking	Other appliances	Type of appliance not stated	Total	
E	Mean depth of throat (ins)	9.81	9.12	9.60	8.98	10.58	10.45	13.60	10.00	9.78	3.69
	Number of fires	3 358	189	547	181	100	249	5	4	4 633	
I	Mean depth of throat (ins)	8.69	7.93	8.20	7.81	8.92	9.56	5.75	9.00	8.48	2.93
	Number of fires	1 224	248	367	248	53	132	4	1	2 277	
J	Mean depth of throat (ins)	9.24	8.03	9.63	8.22	9.26	7.08	-	-	8.68	3.42
	Number of fires	544	363	43	85	23	50	-	-	1 108	
B	Mean depth of throat (ins)	8.92	7.97	8.28	7.70	10.52	11.15	14.00	-	8.75	3.97
	Number of fires	457	66	126	117	25	39	4	-	834	
	Total number	5 583	866	1 083	631	201	470	13	5	8 852	
	Mean depth of throat (ins)	9.44	8.23	8.97	8.18	9.98	9.90	11.31	9.8	9.21	
	Mean depth of throat (ins) adjusted for Brigade differences	9.39	8.57	9.12	8.46	9.98	9.86	...	...		

TABLE 19

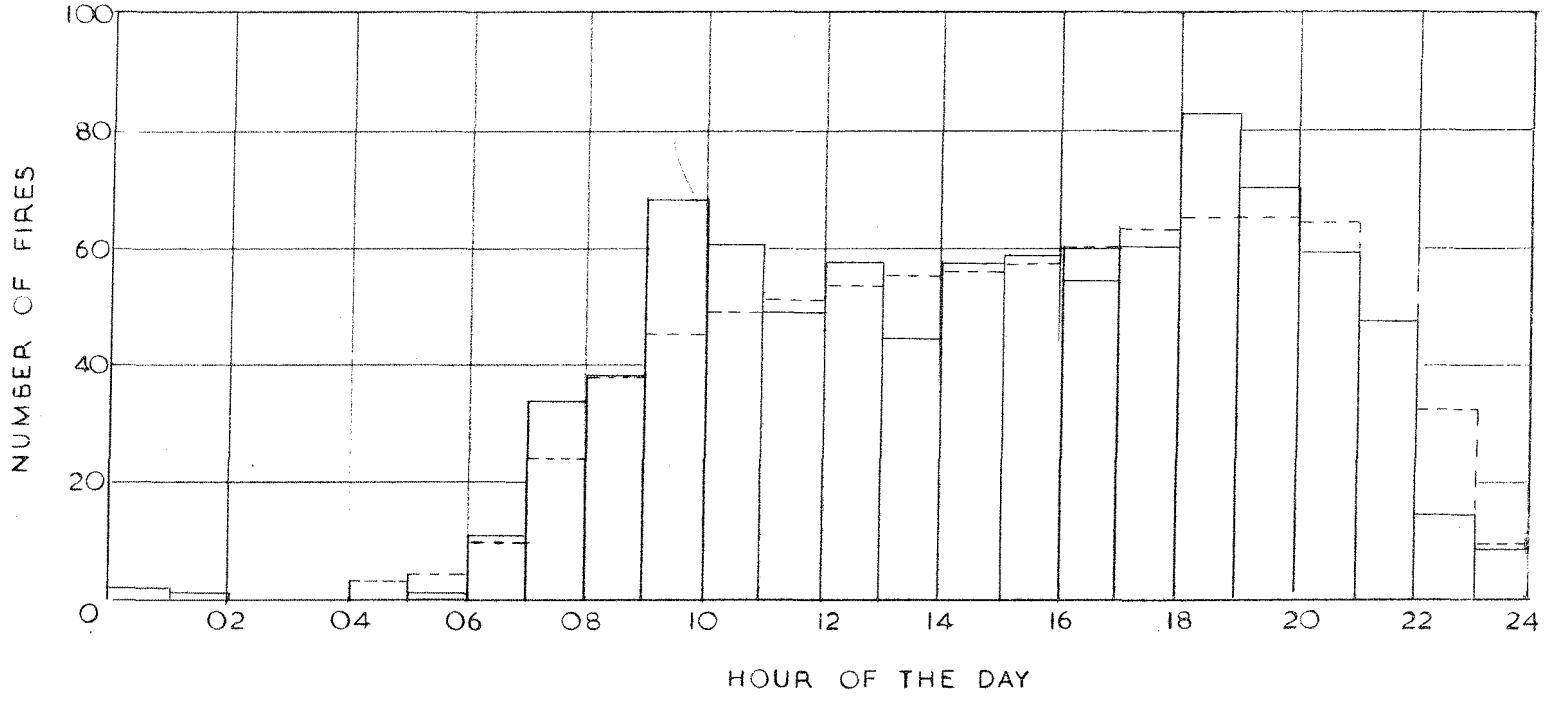
MEAN HEIGHT OF CHIMNEYS INVOLVED IN FIRES

Brigade		Private houses	Private flats built as flats	Private flats converted	Other premises	All premises
E	Mean height of chimney (ft)	34.8	43.7	38.0	50.3	38.8
	Number of fires	2 163	1 596	1 809	198	5 766
I	Mean height of chimney (ft)	31.5	31.8	34.5	28.4	31.8
	Number of fires	2 710	143	112	114	3 079
J	Mean height of chimney (ft)	33.8	43.2	50.0	55.4	42.6
	Number of fires	233	1 331	32	68	1 664
B	Mean height of chimney (ft)	30.3	33.3	36.7	36.4	31.0
	Number of fires	1 083	61	30	86	1 260



--- Expected number of fires per hour on basis of common rate in each hour in relation to number of fireplaces in use

FIG. 1. THE NUMBER OF CHIMNEY FIRES PER HOUR OF THE DAY ATTENDED BY BRIGADE I IN DOMESTIC PREMISES NOVEMBER 1954 — MARCH 1955



– – – – Expected number of fires per hour on basis of common rate in each hour in relation to number of fireplaces in use

FIG. 2. THE NUMBER OF CHIMNEY FIRES PER HOUR OF THE DAY ATTENDED BY BRIGADE B IN DOMESTIC PREMISES NOVEMBER 1954 — MARCH 1955

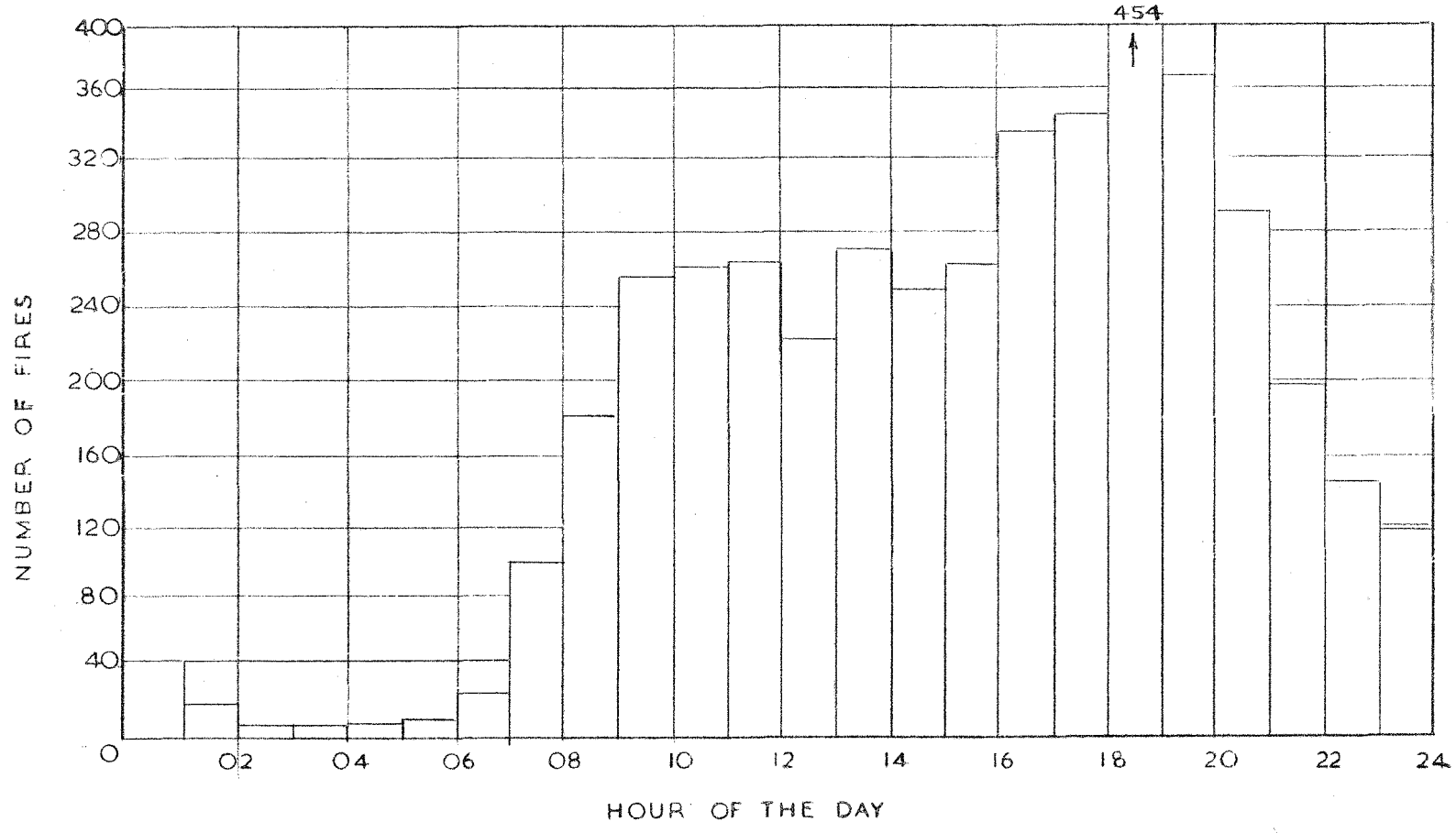


FIG. 3. THE NUMBER OF CHIMNEY FIRES PER HOUR OF THE DAY ATTENDED BY BRIGADE E IN DOMESTIC PREMISES NOVEMBER 1954 — MARCH 1955

F.R.265. 1/2409

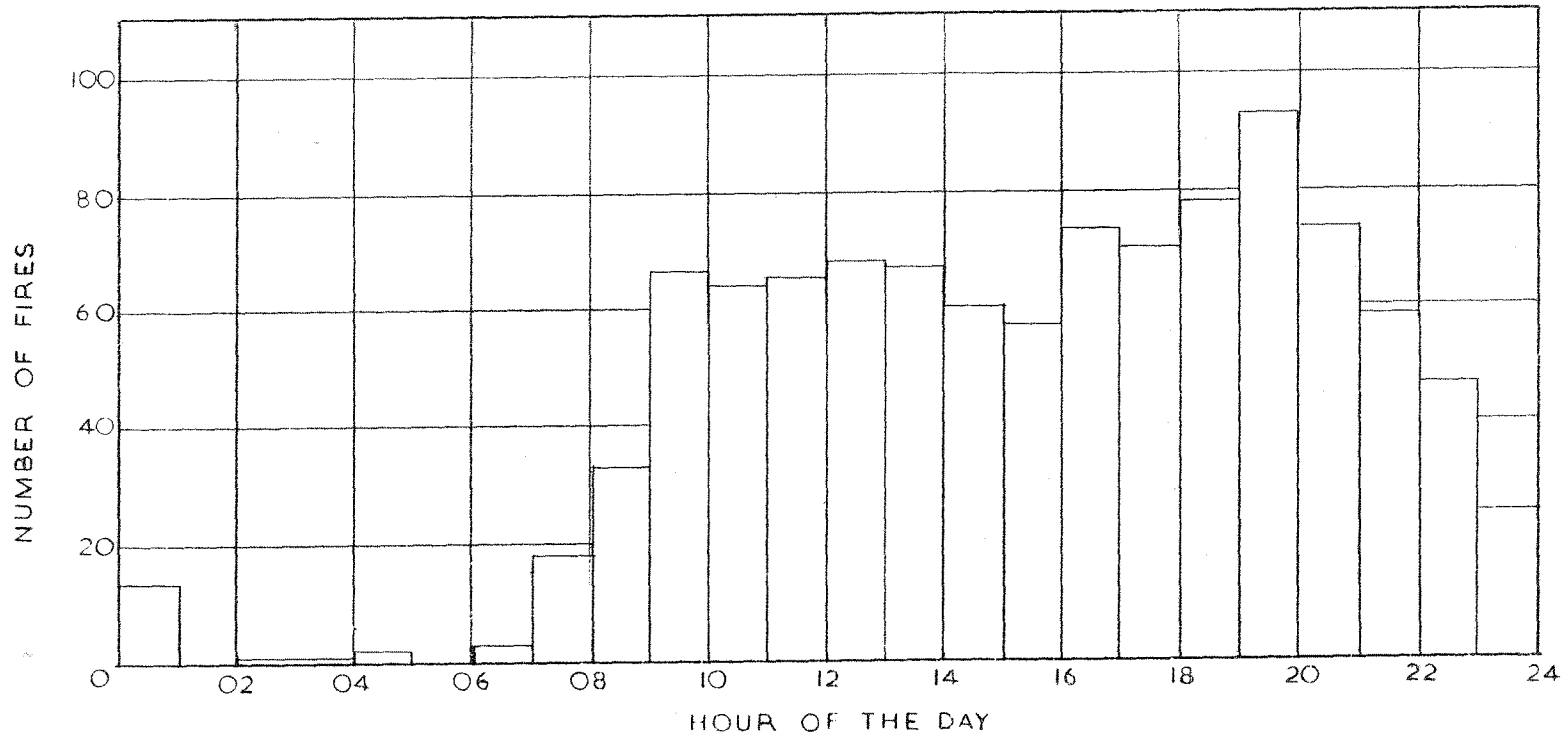


FIG. 4 THE NUMBER OF CHIMNEY FIRES PER HOUR OF THE DAY ATTENDED BY BRIGADE J IN DOMESTIC PREMISES NOVEMBER 1954 — MARCH 1955

F.R.265 1/2410

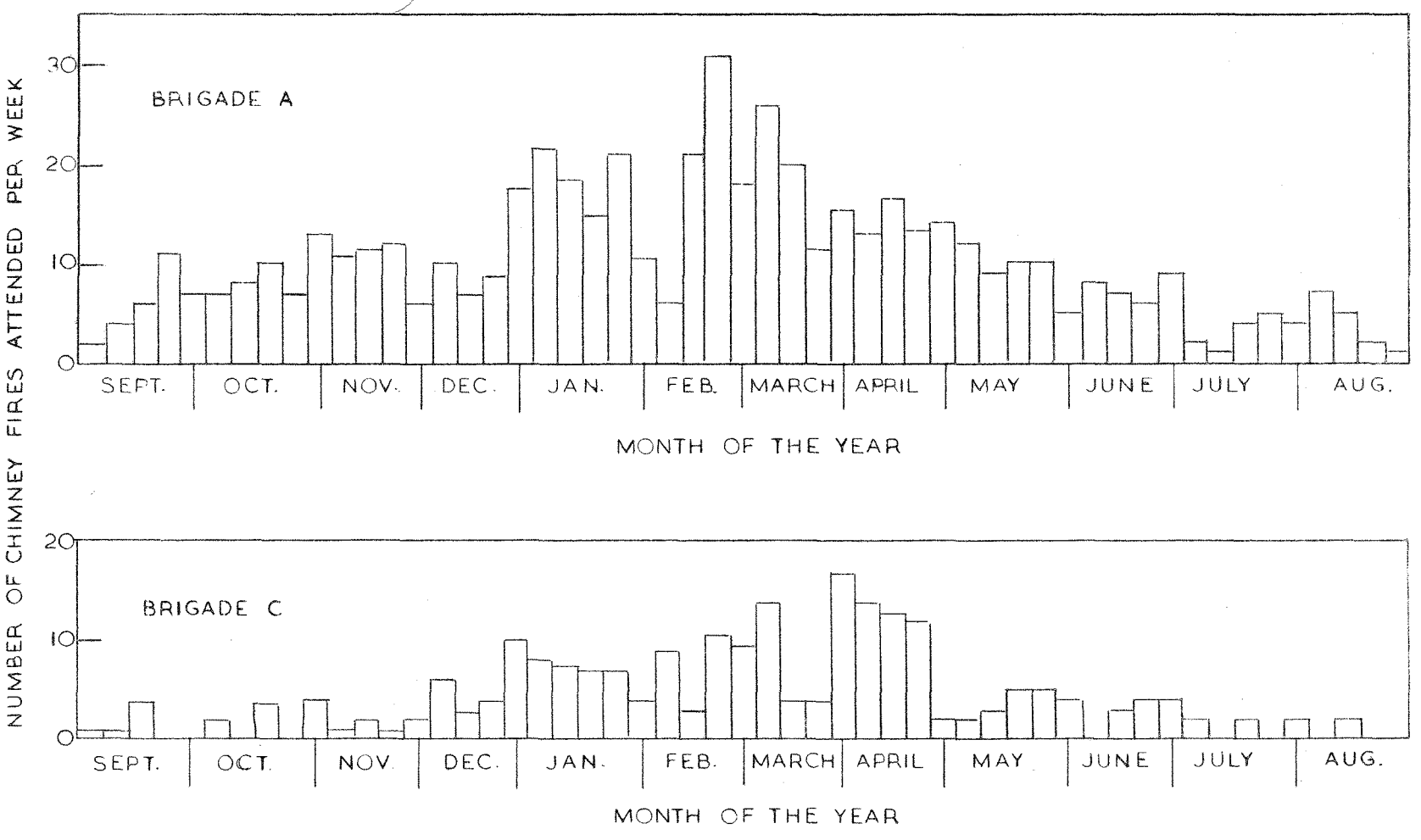
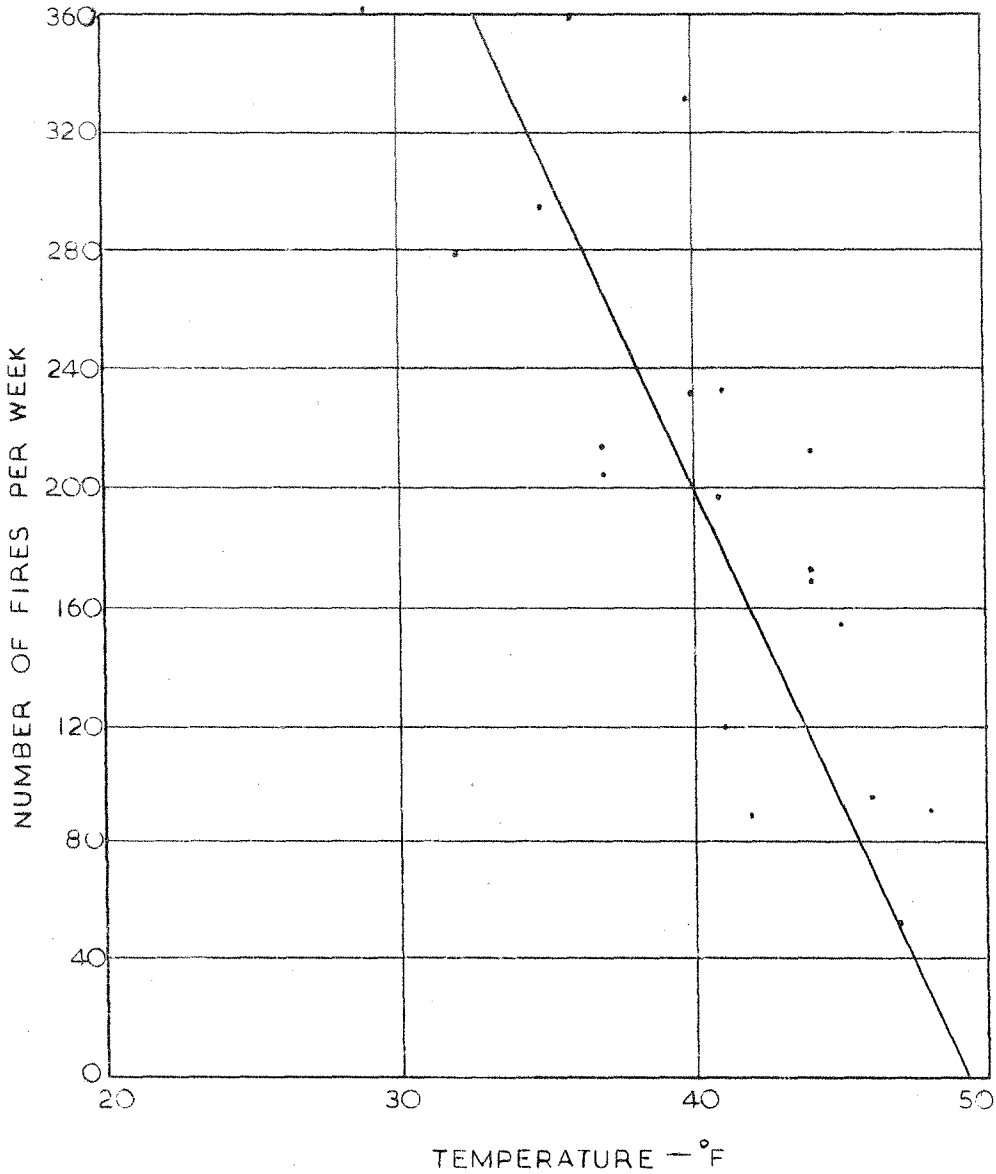
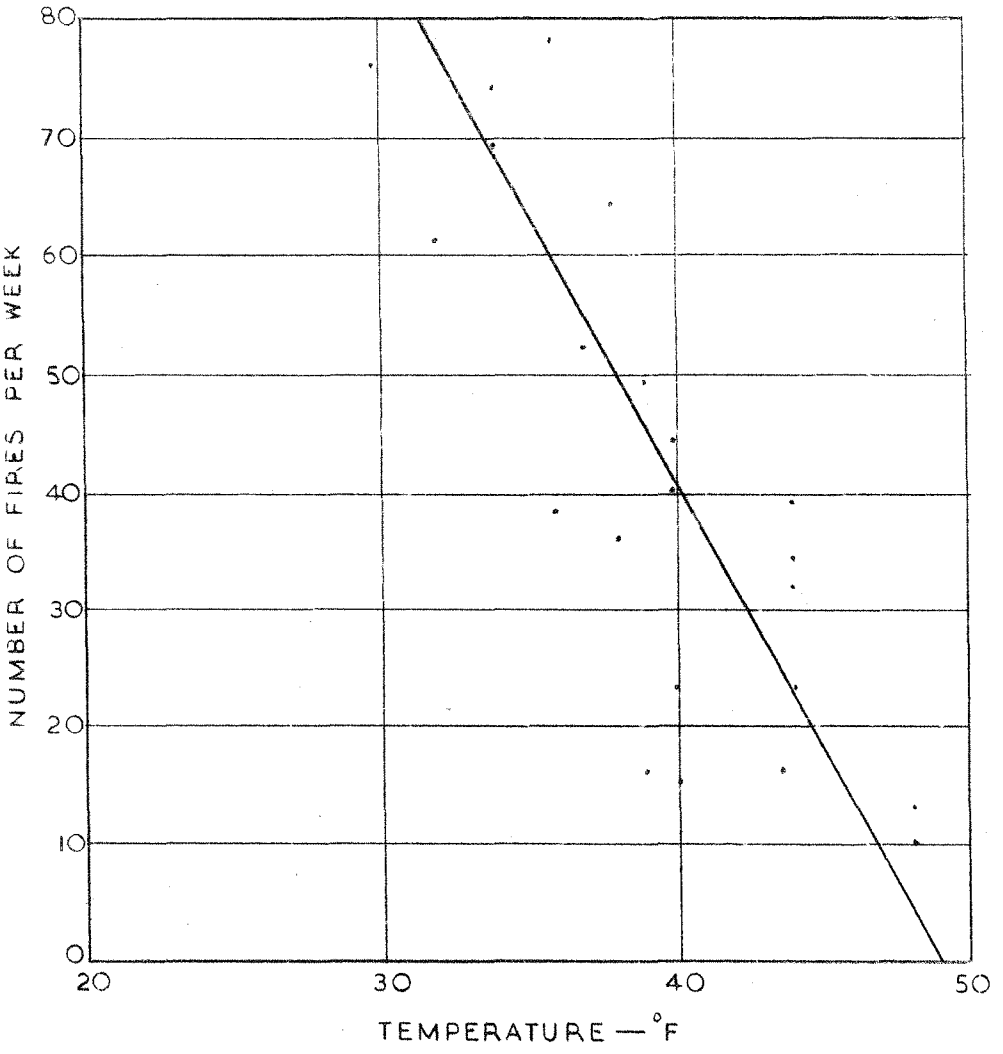


FIG. 8. THE NUMBER OF CHIMNEY FIRES ATTENDED PER WEEK BY BRIGADES A & C IN DOMESTIC PREMISES SEPTEMBER 1954 AUGUST 195[illegible]



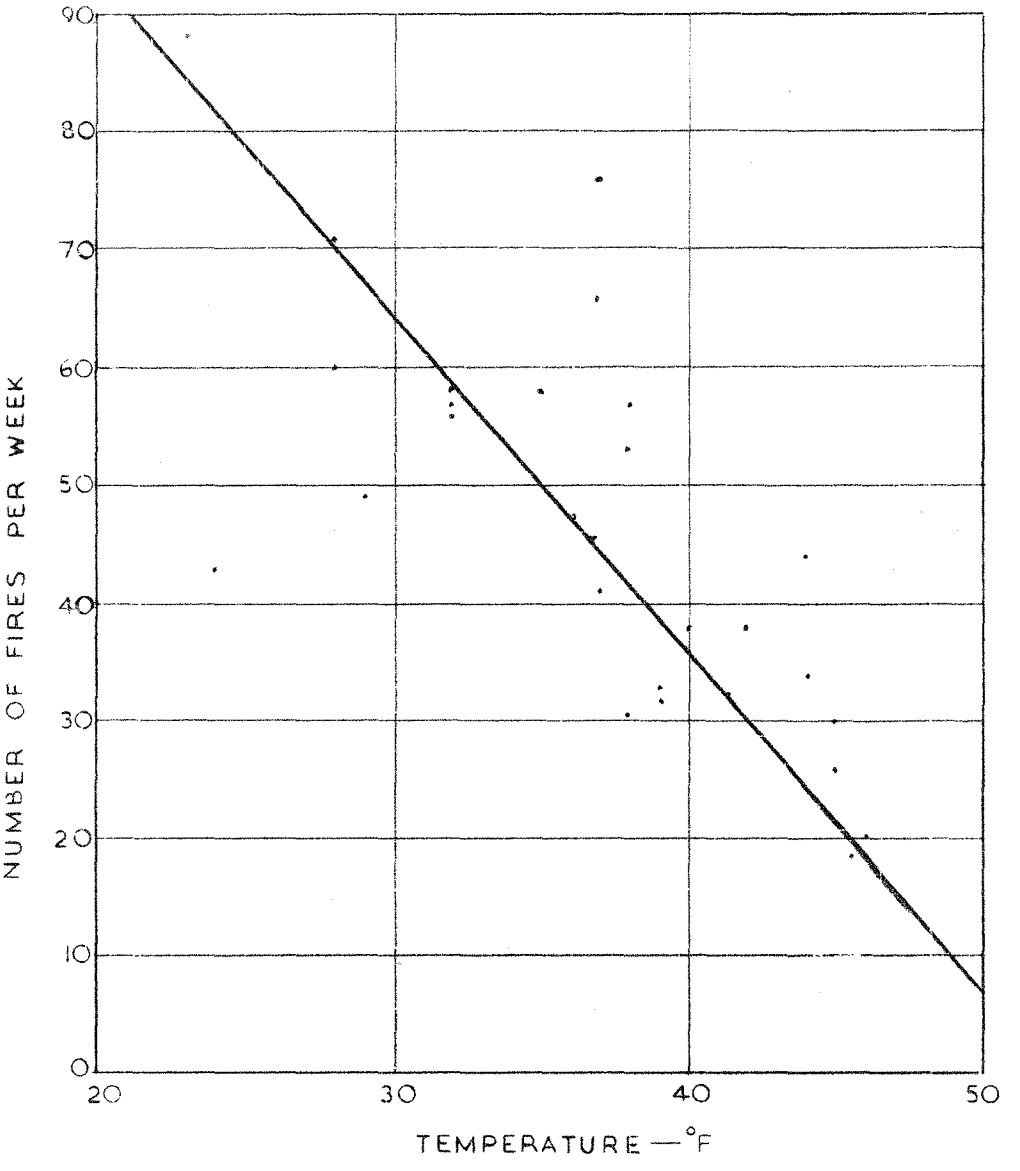
For each degree fall in external temperature the average number of chimney fires per week increases by 22·0

FIG. 9. THE VARIATION IN THE NUMBERS OF CHIMNEY FIRES WITH EXTERNAL TEMPERATURE IN DWELLINGS 31st OCTOBER 1954 — 2nd APRIL 1955 BRIGADE E



For each degree fall in external temperature the average number of chimney fires per week increases by 4·5

FIG. 10. THE VARIATION IN THE NUMBERS OF CHIMNEY FIRES PER WEEK WITH EXTERNAL TEMPERATURE IN DWELLINGS 31st OCTOBER 1954 — 2nd APRIL 1956. BRIGADE B.



For each degree fall in external temperature the average number of chimney fires per week increases by 2·8

FIG. 11. THE VARIATION IN THE NUMBERS OF CHIMNEY FIRES PER WEEK WITH EXTERNAL TEMPERATURE IN DWELLINGS 31st OCTOBER 1954 — 2nd APRIL 1955. BRIGADE J

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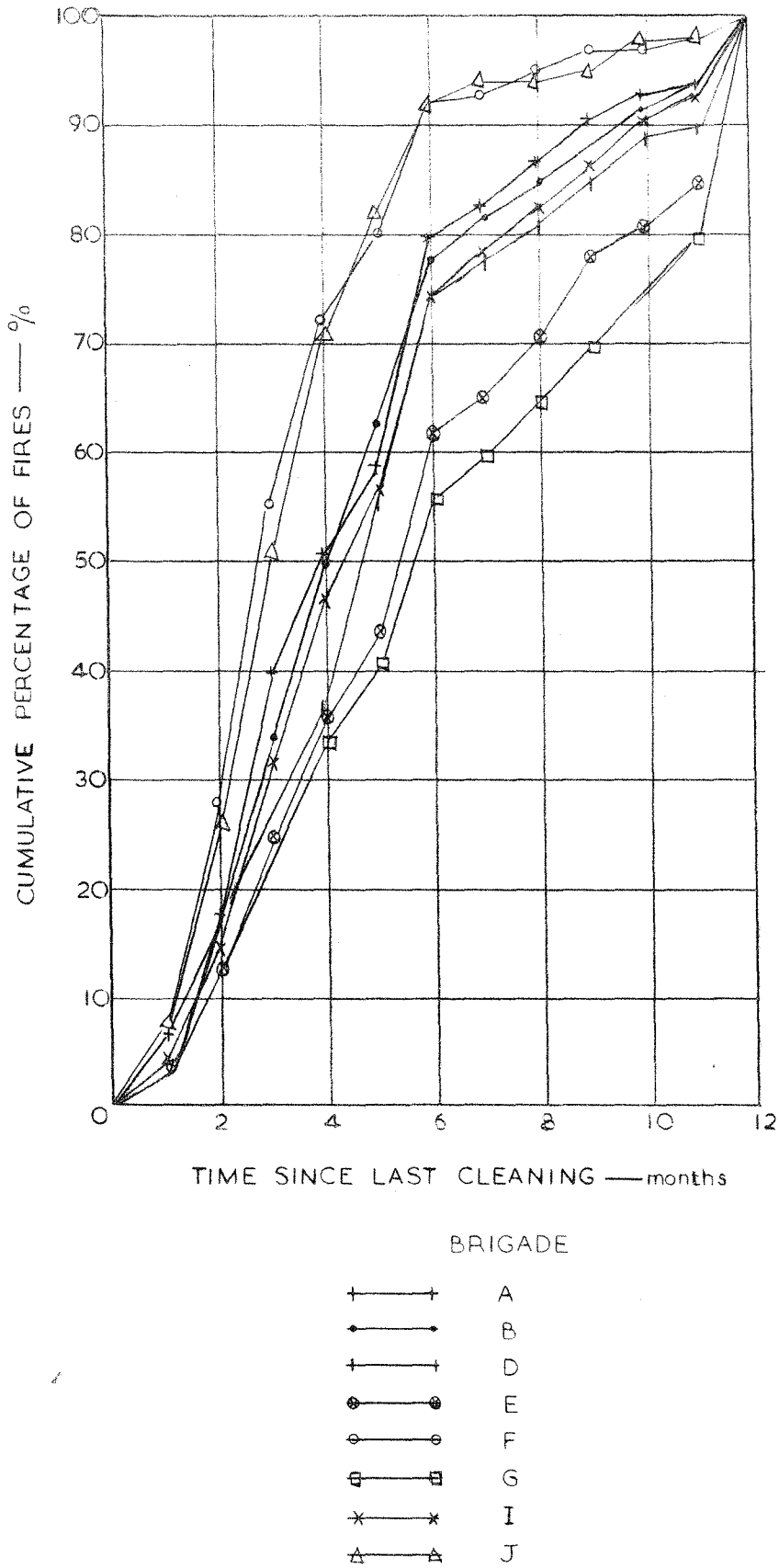

FIG. 12. CHIMNEY FIRES ATTENDED BY CERTAIN BRIGADES SEPTEMBER 1954—AUGUST 1955

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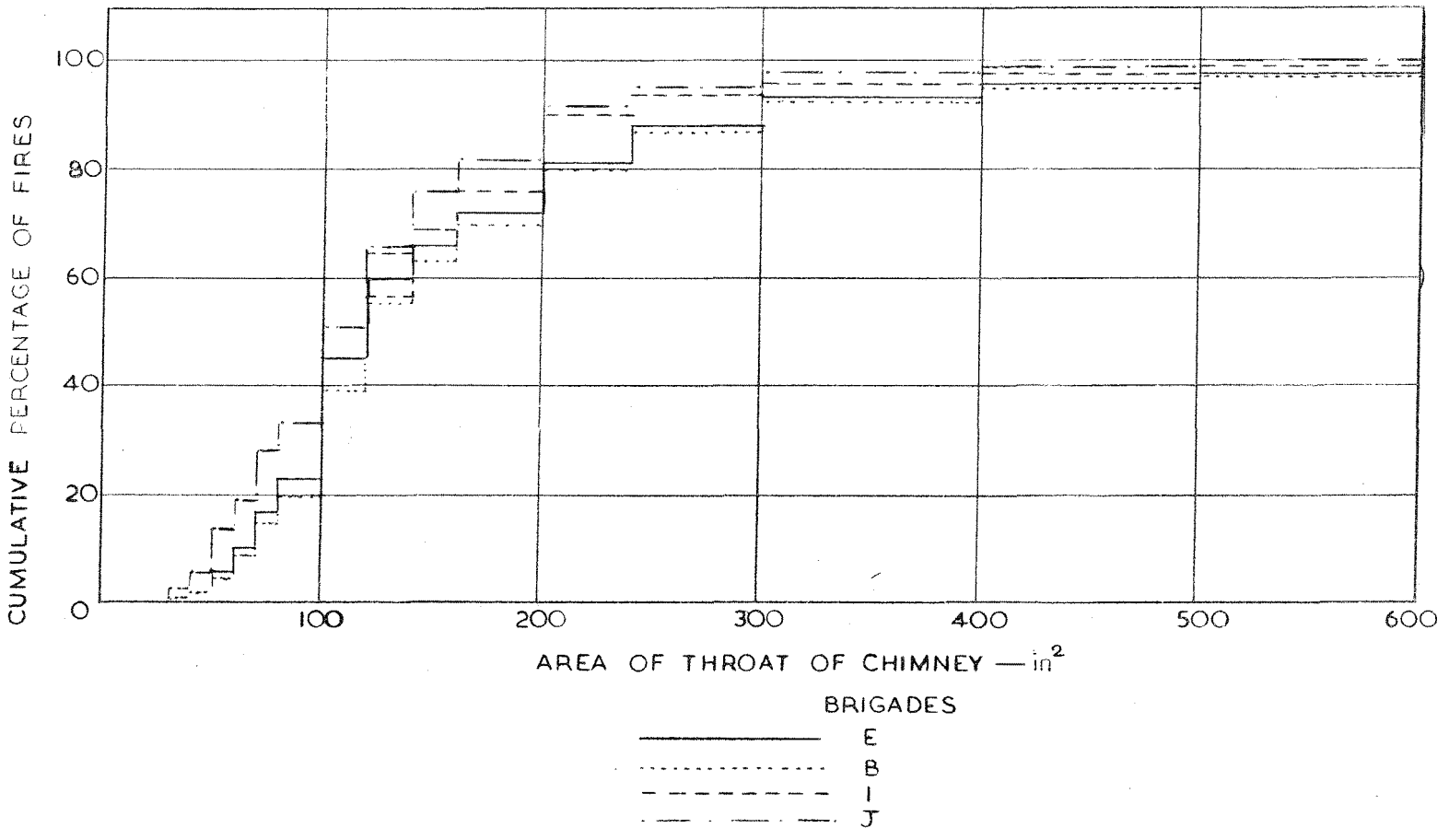

FIG 13 CHIMNEY FIRES ATTENDED BY CERTAIN BRIGADES SEPTEMBER 1954 — AUGUST 1955

THE AREA OF THE THROAT OF THE CHIMNEY IN WHICH THE FIRE OCCURRED

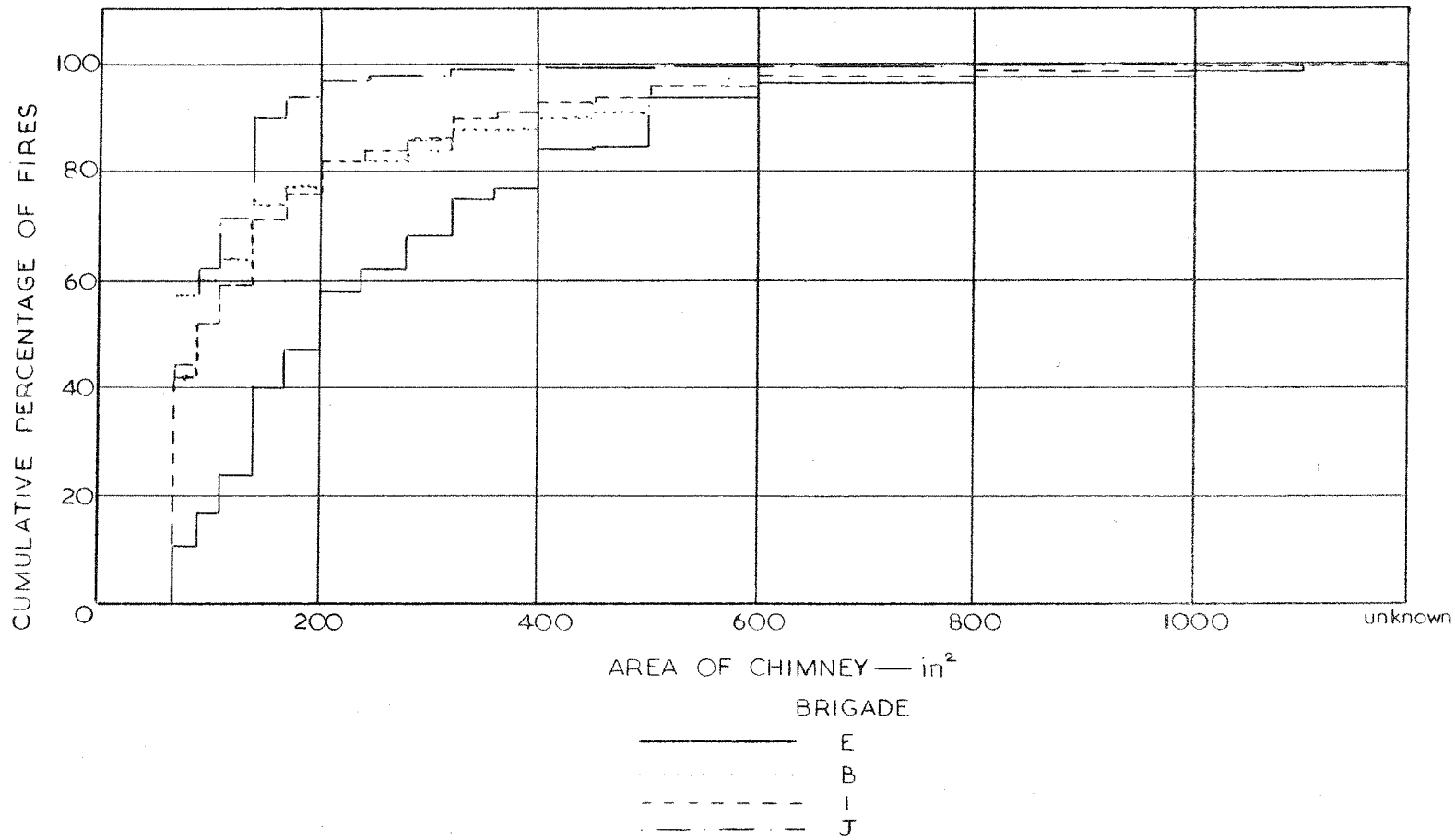

FIG. 14. CHIMNEY FIRES ATTENDED BY CERTAIN BRIGADES
SEPTEMBER 1954 — AUGUST 1955
THE AREA OF THE CHIMNEY IN WHICH THE FIRE OCCURRED

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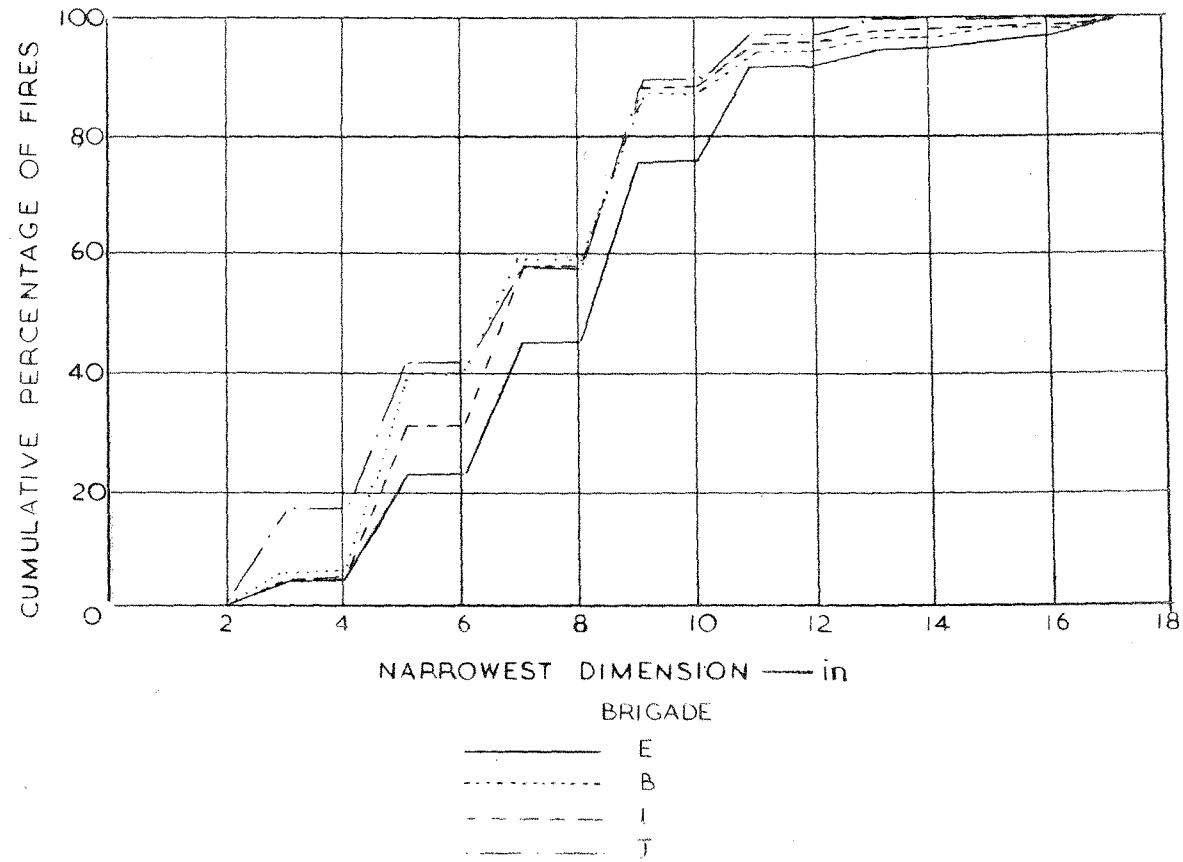

FIG 15 CHIMNEY FIRES ATTENDED BY CERTAIN BRIGADES
SEPTEMBER 1954 — AUGUST 1955
THE NARROWEST DIMENSION OF THE CHIMNEY INVOLVED

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