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EXPLOSION RISKS IN DOMESTIC BACK BOILERS

by

S. E. CHANDLER

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Fire Research Station.
Boreham Wood.
Herts.
('phone ELStree 1341)

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Summary

The severe winter of 1962-63 produced an alarming rise in frequency of incidents involving back boiler explosions. It was estimated that there were 115 incidents compared with an estimated 44 in the previous winter.

An analysis was made of 123 incident reports among those received in 1961, 1962 and 1963. In 94 of these the damage was confined to the room and boiler installation. In 83 incidents explosion damage was more serious than fire damage. A total of 82 casualties occured in 45 of the incidents. There were 3 fatalities in January 1963.

The times of day when incidents are most likely to happen are mid-morning and between 6 p.m. and 10 p.m. When temperatures fall below freezing point there is some evidence for a negative correlation between minimum temperature and number of incidents on a given date.

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Introduction

The severe winter of 1962-63 brought to notice the hazard from explosions in back-boiler installations and prompted an investigation into their cause and effect.

Fire incidents in which explosions occurred numbered between 400 and 500 for each of the years 1961 and 1962. Of these 78 in 1961 and 104 in 1962 involved solid fuel space heating apparatus, the explosions arising mainly from either back boilers or foreign bodies in the fuel.

In a normal winter the number of back-boiler explosions is comparatively small, but a severe cold spell, as in the winter of 1962-63, can lead to a rapid rise in the number of incidents, as may be seen in the comparison between the winter cold spells of 1961-62 and 1962-63 in Table 1

Table 1

Back-boiler explosions

Month	No. of incidents	
	Winter 1961-62	Winter 1962-63
December	36	28
January	8	83*
February	-	4*
Total	44	115

*All reports received. Other figures estimated from 1 in 2 samples.

For the study of causes, damage, etc. it has been assumed that any "between-year" variations are unimportant and all the incidents in the two winter periods 1961-62 and 1962-63 for which reports were readily available have been added together, giving a total of 123 incidents to be analysed. (This total comprises all reports received in January and February 1963 and those contained in 1 in 2 samples of reports for the other months).

Room of occurrence and extent of damage

Table 2

Room involved first in relation to extent of damage

Romm involved first	Confined to room and back boiler	Not confined to room and back boiler	Total
Living room, lounge	33	10	43
Kitchen, dining room	7	7	14
Front room (no further information given)	13	5	18
Back room (no further information given)	17	4	21
Other and unknown	24	3	27
Total	94	29	123

In the majority of incidents, as Table 2 shows, the damage was confined to the room and back-boiler. This table also suggests that incidents in kitchens may be more likely to spread than those in other rooms, but the numbers are too small for certainty. In three incidents damage extended to adjoining property.

In 83 of the incidents, about two-thirds, explosion damage was more severe than fire damage; about the same proportion as with town gas apparatus involved in explosions(1). In 31 incidents the subsequent fire caused more damage than the original explosion and in the remaining 9 incidents neither type of damage was predominant. These were small explosions in which the subsequent fire was extinguished before it would spread.

The severity of the explosion, which is indicated to some extent by the predominant type of damage, has some influence on the material ignited first, as can be seen from Table 3.

Table 3

Predominant damage in relation to material ignited first

Material ignited first	Predominant type of damage		Total
	Explosion	Fire or neither	
Carpet, floor covering	19	18	37
Furniture, furnishings	33	8	41
Other and unknown	31	14	45
Total	83	40	123

With a more severe explosion, it is to be expected that coal will be thrown further and will ignite materials further away from the grate. The table confirms this since explosion damage predominated in about 50% of the incidents in which carpets were ignited, whereas it predominated in about 85% of those in which furniture was ignited.

Casualties

Of the 123 incidents concerned in this survey, 45 resulted in casualties. It is known that there was at least one fatality during the winter of 1961-62, but it is not possible to provide an exact figure for the periods under review, since some of the data are from samples of reports. In January 1963, for which all reports were examined, there were three fatal casualties.

Compared with the total of domestic fatal accidents, this number of fatalities is extremely small. It is large, however, in relation to the number of incidents.

Table 4

Casualties in relation to predominant damage

Type of injury	Predominant type of damage		Total
	Explosion	Fire or neither	
Burns	34	6	40
Other injuries	40	2	42
Total	74	8	82
Incidents			
Involving casualties	39	6	45
Not involving casualties	44	34	78
Total	83	40	123

Table 4 shows that nearly 50% of incidents in which explosion damage was more serious than fire damage involved casualties; whereas when explosion damage was not predominant only about 15% of the incidents resulted in casualties. In other words the chance of injury is greater with the more violent explosions, as would be expected, but the table also shows that, even in these incidents the injuries are often burns. There were several multiple casualty incidents, the worst being an incident involving 8 casualties (2 fatal) and another involving 6 casualties (1 fatal).

Time of day, weather conditions

There seem to be two periods during the day in which incidents are most frequent. These are mid-morning and during the evening, from 6 p.m. - 10 p.m.

It is reasonable to assume that these periods occur at times when fires are producing maximum heat.

The number of incidents involving casualties follows the same pattern (see Fig.1). Both of the incidents involving fatalities occurred in the evening, when people are most likely to be sitting around a fire.

When the minimum temperature is below freezing point there is some evidence of a negative correlation between it and the number of incidents on a given day; this is particularly noticeable in the records for January 1963 shown in Fig.2 although the numbers involved are too small to establish a quantitative relationship. In this investigation the graphs of minimum temperatures[2] at London (Kingsway), Birmingham (Elmdon) and Manchester (Ringway) were shown to follow the same general trend and it was assumed that this trend was representative of the country as a whole. A probable explanation of the slight "time lag" apparent in Fig.2 is that it will take some time for temperatures indoors to drop sufficiently for the boiler system to freeze, and a certain amount of warmer weather will be necessary to de-freeze it and lessen the risk of an explosion.

Since most of the incidents occurred during sub-zero weather, although specific information is sometimes lacking from the reports, it is reasonable to assume that most of them resulted from freezing in some part of the installation. It is difficult to find out where in the system freezing occurs because a severe explosion tends to destroy the evidence; furthermore, there may be a time-lapse of several days between the incident and a thorough inspection of the installation.

Conclusion

An abnormally cold winter can lead to a sudden rise in the number of back boiler explosions. In about three-quarters of the incidents in the winters of 1961-62 and 1962-63 the damage was confined to the room of origin and the back boiler installation. About one-third of the incidents led to casualties, a much higher proportion than that in other fires attended by fire brigades[3]. Casualties are more likely to occur in incidents in which explosion damage predominates.

When temperatures fall below freezing point there seems to be a negative correlation between minimum temperature and number of incidents on a given date, there also appear to be distinct periods in the day when incidents are most prevalent.

Most incidents are the result of freezing in some part of the installation, but it is difficult to determine where this freezing occurs. Practical experimental work would seem necessary before any recommendations for remedial measures could be made.

References

(1) CHANDLER, S. E. Fire Incidents Involving Explosions. F.R. Note No.541.

(2) Meteorological Office.

(3) United Kingdom Fire Statistics 1962. Department of Scientific and Industrial Research. London, 1964. H.M. Stationery Office.

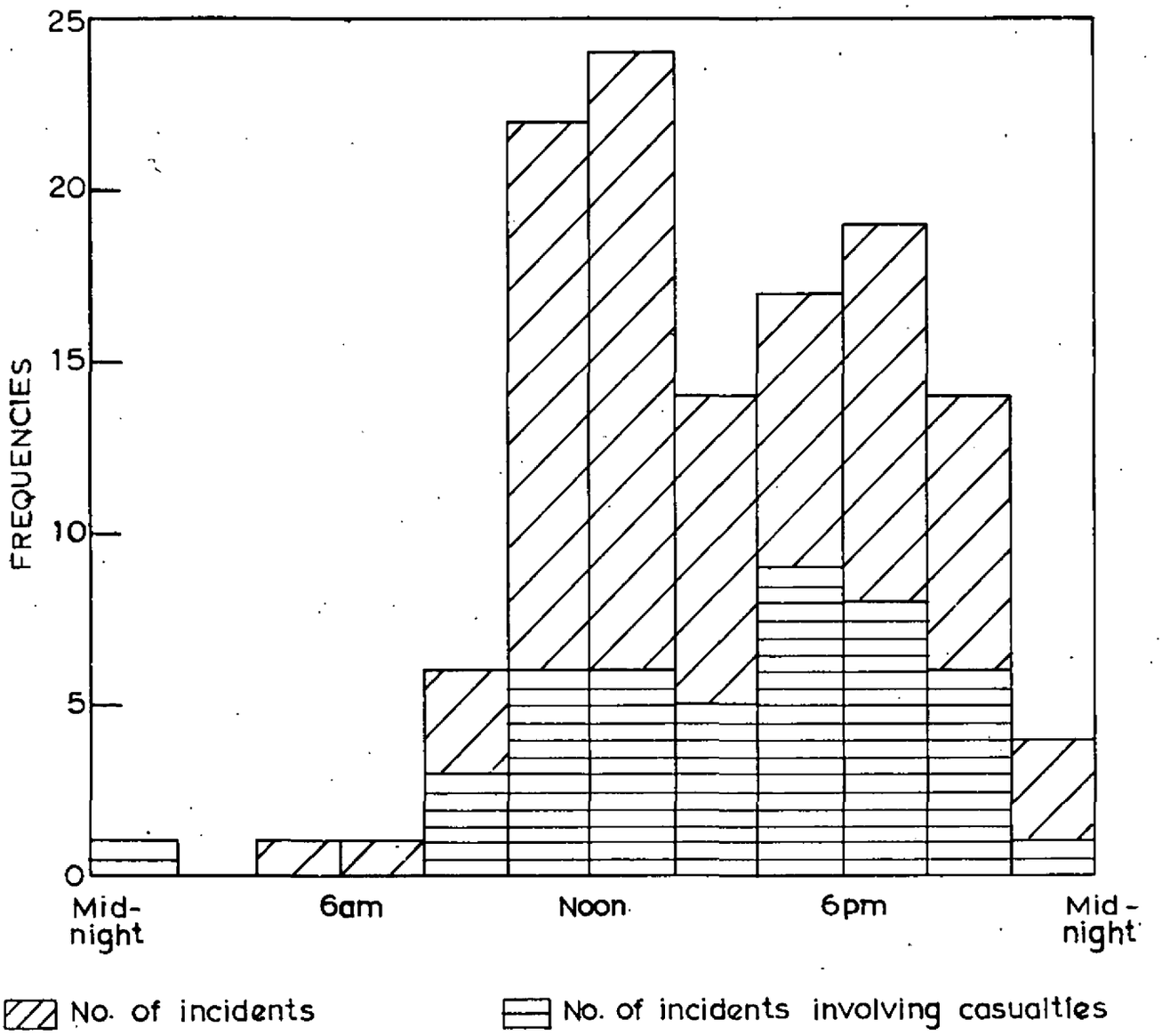

FIG.1A. INCIDENTS IN RELATION TO TIME OF DAY.

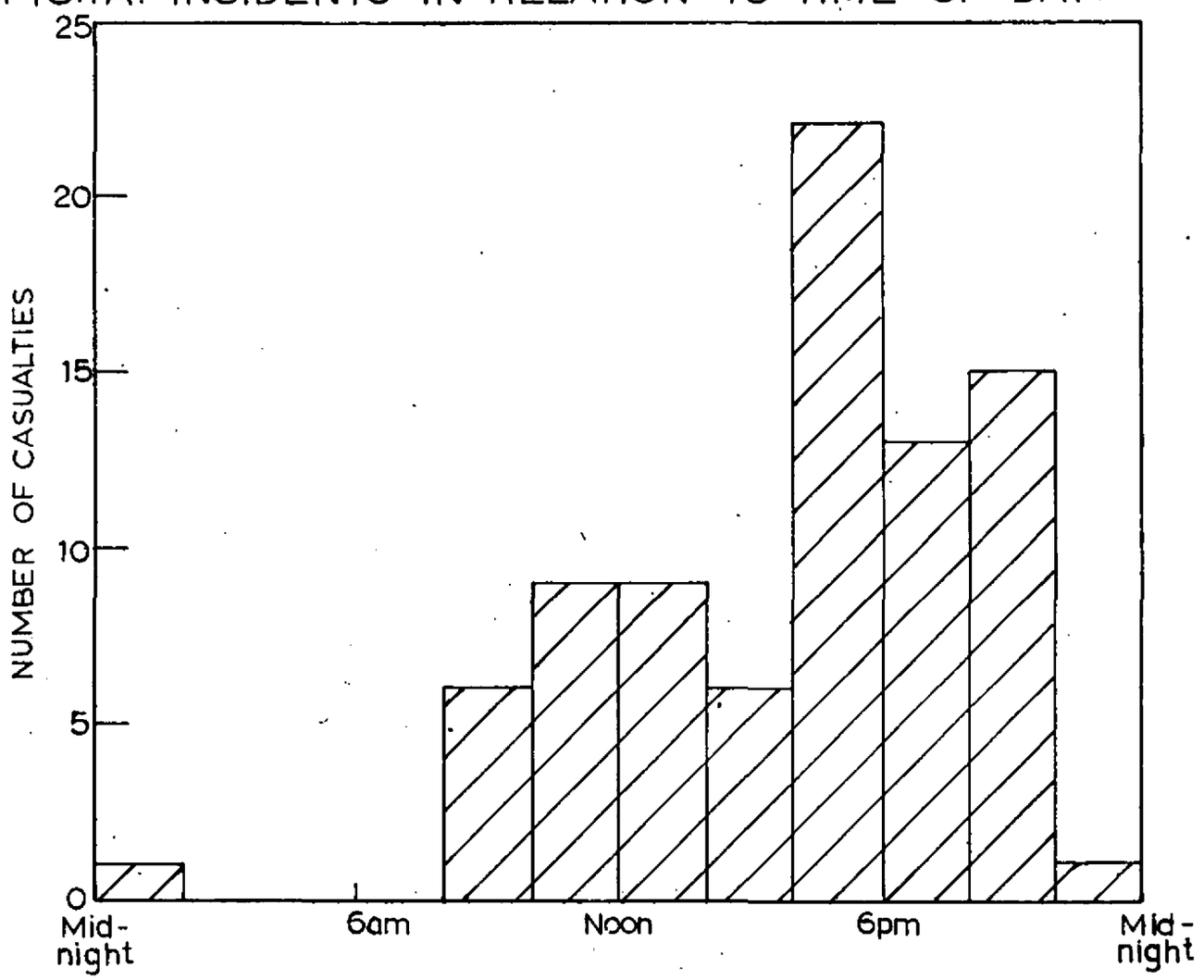

FIG.1B. CASUALTIES IN RELATION TO TIME OF DAY

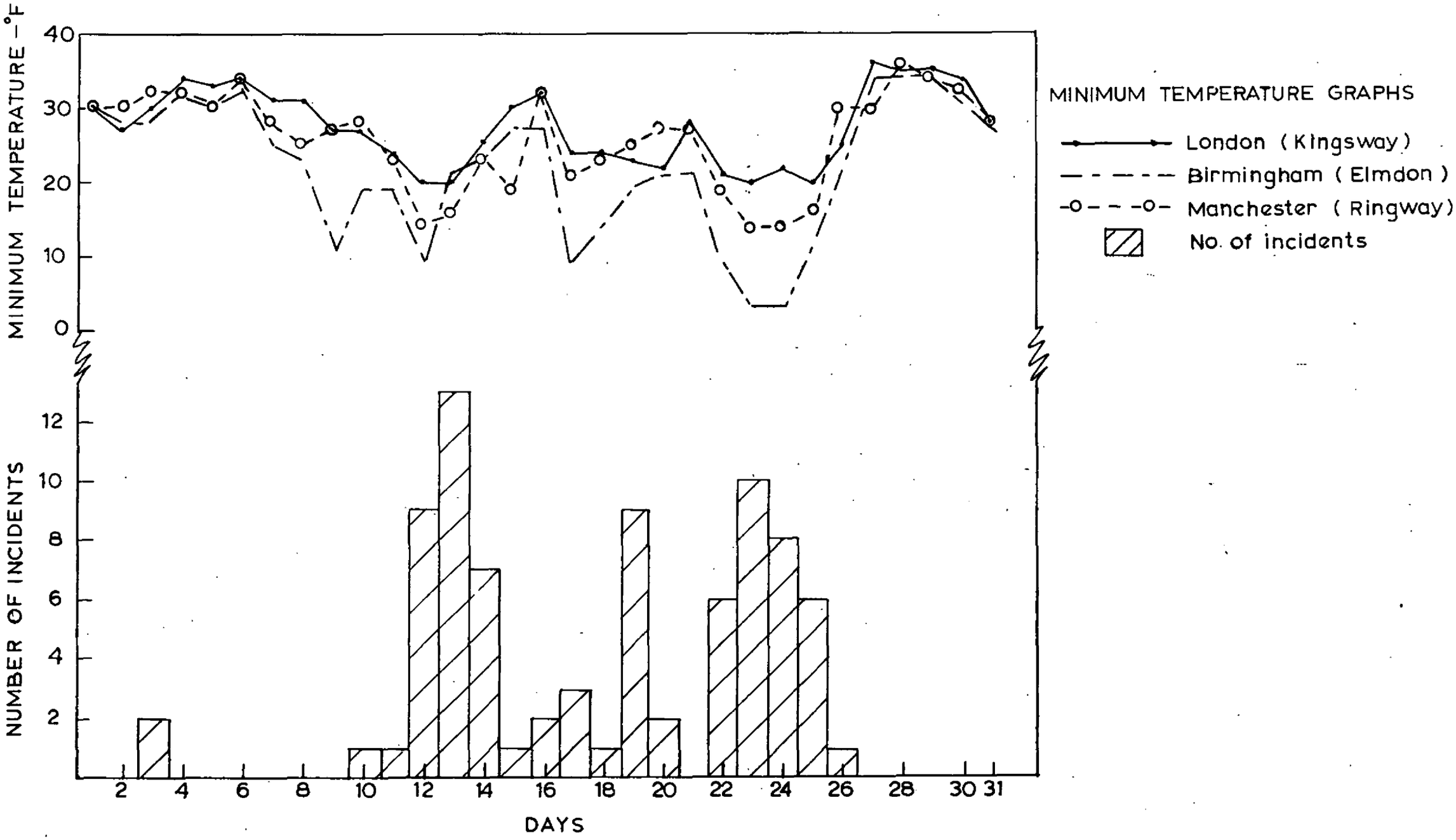

FIG.2. NUMBER OF INCIDENTS AND MINIMUM TEMPERATURE IN JANUARY 1963