THE BURNS' DAY STORM, 25 JANUARY 1990

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"Was five and twenty days begun,
'Twas then a blast o' Janwar Win'
Blew hansel in on Robin."

Robert (Robin) Burns
There was a lad

During daylight hours on 25 January 1990 an intense depression tracked across southern Scotland bringing severe gales and storm force winds to much of England and Wales, evoking memories of that notorious night of 15/16 October 1987 (hereafter referred to as the October Storm). Ironically the centre of the depression moved across Ayrshire, the home of the celebrated Scottish bard Rabbie Burns, on the anniversary of his birth, bringing heavy snow to parts of Scotland. However, it was the gales that brought the greatest attention and the strongest winds were to the south of the depression causing widespread damage over England and Wales. The human tragedy was greater than in the October Storm with the loss of 47 lives, largely because the strongest winds occurred during the day and over a wider area. However, the damage to trees was less severe, probably because of the lack of foliage on deciduous trees.

In this article a summary of the synoptic characteristics of this 'Burns' Day Storm' will be given and some comparisons drawn with the October Storm in 1987 (see special issue of *Weather,* March 1988). A short review of the available statistics on extreme wind will be presented along with a summary of the weather forecasts issued some days in advance of the event.

GENERAL SYNOPTIC DEVELOPMENT

The depression began life on 23 January as a rather ill-defined and complex shallow area of low pressure, off the eastern seaboard of North America. By 0000 GMT on the 24th, a portion of the depression, lying under a powerful jet stream (180 kn), started to develop as it was engaged by a short-wave upper trough moving east from the USA (see Fig. 1(a)). Often this type of system deepens as two baroclinic zones (regions of horizontal thermal contrast) merge and evidence of this can be seen in this case (Fig. 1(b)) with the separate zones identified by cloud bands A and B.

By midday on the 24th the central pressure of the low had fallen to 992 mbar (Fig. 2(a)) and the afternoon satellite picture (Fig. 2(b)) indicated several features typical of a depression set to deepen explosively.

Between the two main cloud areas (labelled A and B) a cloud-free or dry wedge formed, labelled C. The northern cloud (A) has become broad, and its poleward edge has developed marked anticyclonic curvature; this cloud feature is often referred to as a 'baroclinic leaf' (Weldon 1979). The centre of the depression is marked by the X.

This cloud signature comprising A and B and the dry wedge is a good example of the 'cloud head' (Monk and Bader 1988; Bottger *et al.* 1975). The first appearance of a cloud head is a reliable precursor of an explosively deepening cyclone, accompanied by the onset of storm force 10 (or greater) winds within 24 hours. Deep cold air, characterised by extensive cumuliform cloud, undercut the poleward edge of the northern cloud area (A), indicative of the strong horizontal and thermal contrast.

It should also be noted that the associated upper trough at 500 mbar (Fig. 3) showed characteristics typical of rapid cyclogenesis (see Young 1989). The trough was a rather flat, slightly confluent and fast-moving feature (near 45° west) emphasised by the powerful flow around its base and on its eastern flank. The associated vorticity pattern was characterised by marked descent to the rear of this trough and substantial ascent ahead of it; these are features identified in the October Storm by Morris (1988). Also the low was embedded in a

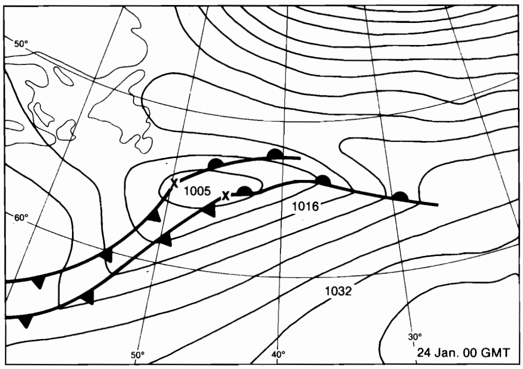

Fig. 1(a) Surface analysis (mbar) for 0000 GMT on 24 January 1990

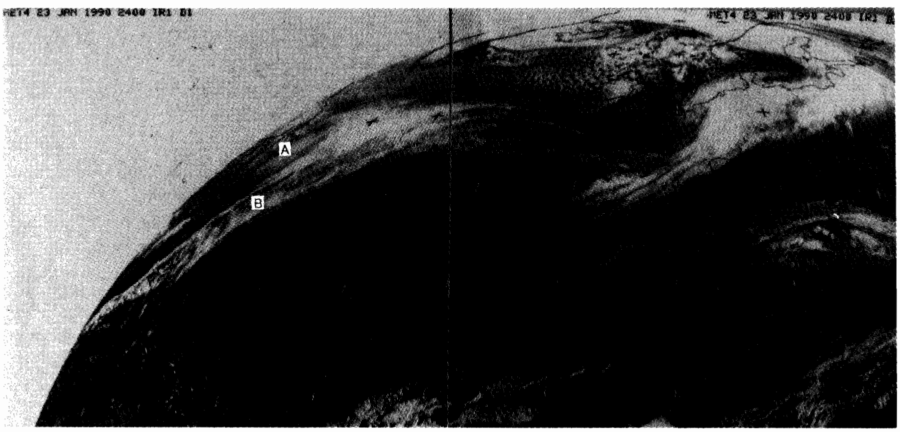

Fig. 1(b) METEOSAT infra-red image for 0000 GMT on 24 January 1990

strong (now merged) baroclinic zone and these conditions resulted in the low moving at around 50 kn and deepening rapidly as it hurtled towards the United Kingdom.

As the low approached Ireland during the early hours of the 25th the most rapid phase of cyclogenesis was taking place with the centre down to 968 mbar (Fig. 4(a)) and a classic hook shape of an occluded depression to the upper cloud on the satellite picture (Fig. 4(b)). Despite distortion of the thermal pattern the low continued to move rapidly eastwards as a good flow was maintained around the base of the associated upper trough. The storm centre tracked across Northern Ireland on the morning of the 25th (with falls of pressure of the order 16 mbar in 3 hours) and by midday was centred over Ayrshire with a central pressure of 952 mbar (see Fig. 5 and Cover).

The marked confluent nature of the upper trough caused pressure to rise rapidly behind the low (rises of 20.2 mbar in 3 hours at Valentia by late morning, similar to those measured in October 1987) with associated marked increase of the surface pressure gradient on its western and southern flank. The lowest central pressure of 949 mbar was estimated at around 1600 GMT, to the east of Edinburgh as the low continued its rapid movement towards Denmark.

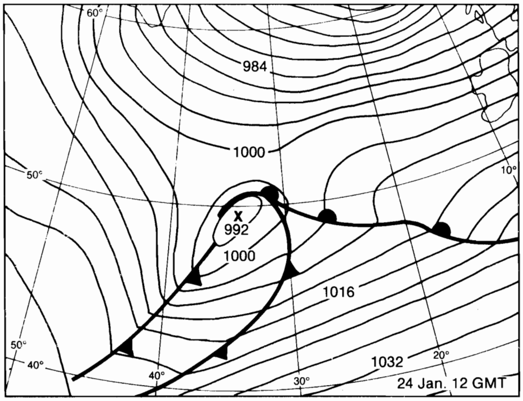

Fig. 2(a)   Surface analysis (mbar) for 1200 GMT on 24 January 1990

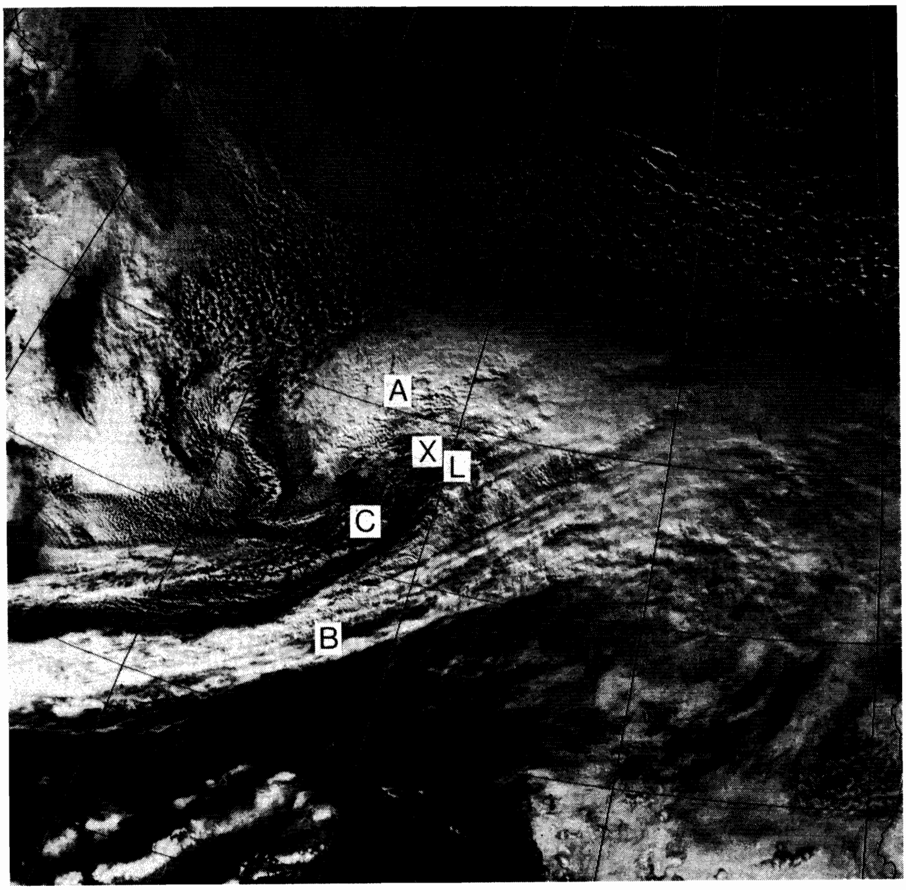

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Fig. 2(b)   NOAA-11 visible image for 1518 GMT on 24 January 1990

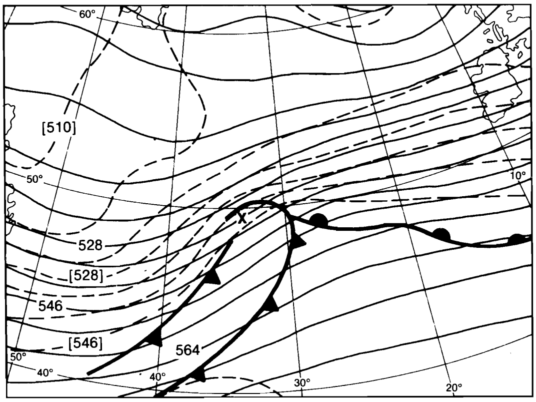

Fig. 3 500 mbar (solid lines) and total (1000–500 mbar) thickness (dashed lines) analysis for 1200 GMT on 24 January 1990. Units are decametres.

DETAILS ON WIND STRENGTH

The strongest winds flowed around the western and southern flank of the low with mean speeds around 40 to 50 kn over a large part of central southern England and Wales. Indeed in the most exposed locations of the south coast and of west Wales mean speeds reached 60 to 65 kn in the late morning and afternoon. However, it was the powerful gusts that were the most notable and arguably most damaging feature. Examination of the maximum wind speeds, see Figs. 6 and 7, shows that the strength of the gusts on this occasion was comparable with that of the October Storm. The highest gust was 93 kn at Aberporth and there were several gusts to 90 kn over a wide area of southern England. The area affected by the strongest winds covered much of England and Wales compared with only central southern and south-eastern England in the October Storm. Coastal sites in the south of England and west of Wales experienced the most extreme winds but the zone of maximum winds in the north of England was due to the high elevation of the recording sites. Analysis of the anemograph traces shows a two-wind maximum at many stations. The first was associated with powerful south-westerly winds on and just behind the cold front, with the secondary phase tied to the surge of pressure in the west-north-westerly flow to the rear of the 'backbent' occlusion/trough. It was during this secondary phase that the absolute maximum gust of 93 kn was recorded at Aberporth at both 1400 and 1500 GMT, with an associated mean speed of 65 kn. Winds experienced in this storm exceeded those recorded in the October Storm over parts of southern England and Wales, with records broken at Aberporth, Benson, Boscombe Down, Brawdy, Farnborough, London/Heathrow, Hurn, Larkhill, Plymouth, Stanstead Airport and St. Mawgan.

As in 1987 the rapid speed of movement of the system was an important addition to the surface wind. The surface wind is a function of the gradient wind (at about 1km), and in cases of cyclonic flow it is less than the geostrophic flow mainly due to curvature effects. In this case, because of the rapid movement of the system, the actual trajectory of the gradient flow was much flatter than the curvature implied from the contour pattern. Hence the observed winds were greater than those inferred from standard gradient calculations.

HOW WELL WAS THE STORM FORECAST?

The Meteorological Office gave excellent warning of the Burns' Day Storm. Fig. 8 shows the T+108 forecast from the Meteorological Office global model. Guidance from the European Centre for Medium-range Weather Forecasts also predicted marked cyclogenesis for the 25th but with the centre much deeper and further north. Forecasters

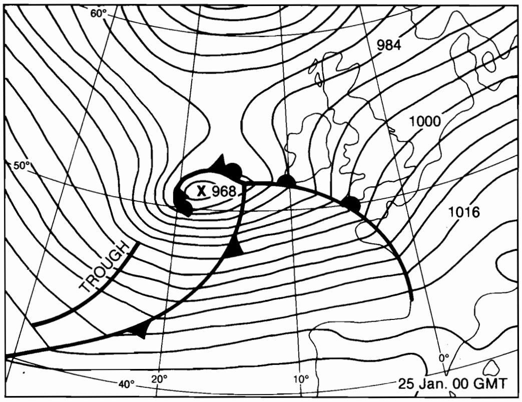

Fig. 4(a) Surface analysis (mbar) for 0000 GMT on 25 January 1990

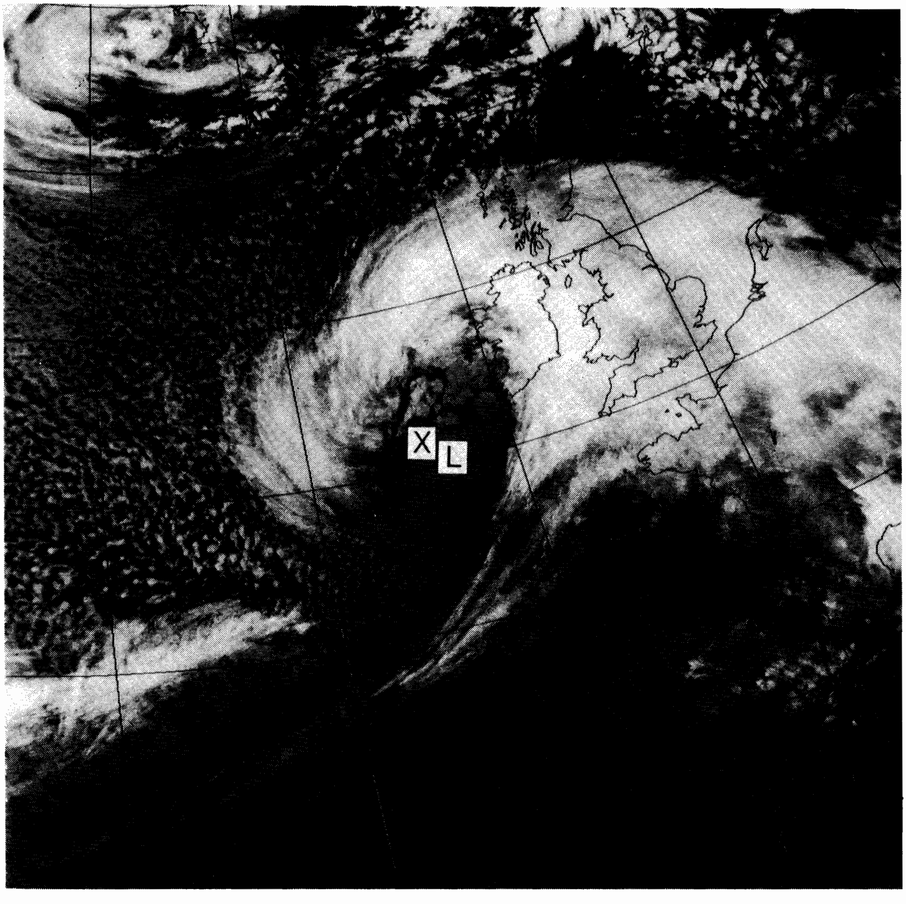

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Fig. 4(b) NOAA-11 infra-red image for 0329 GMT on 25 January 1990

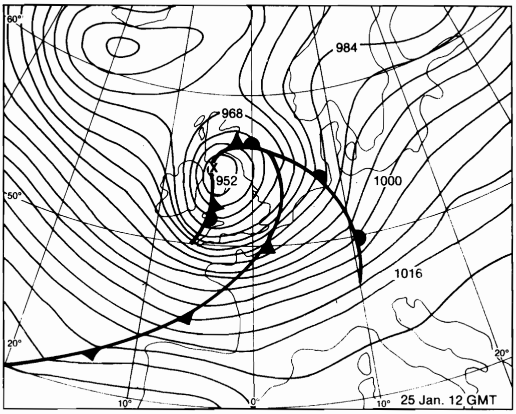

Fig. 5 Surface analysis (mbar) for 1200 GMT on 25 January 1990

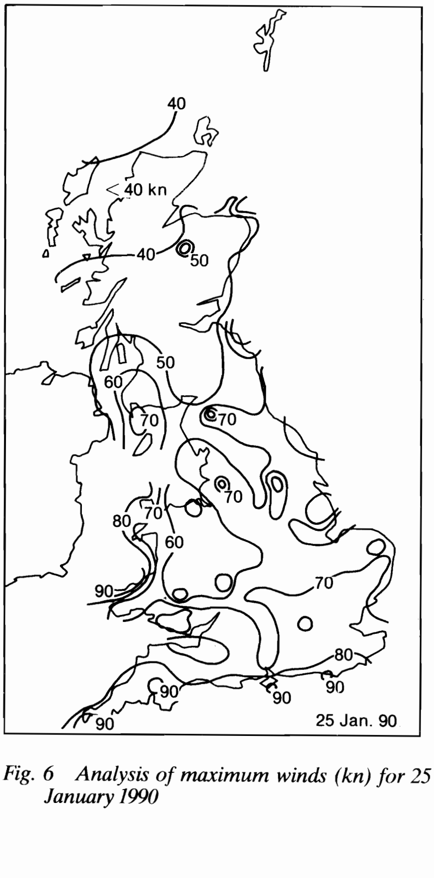

Fig. 6 Analysis of maximum winds (kn) for 25 January 1990

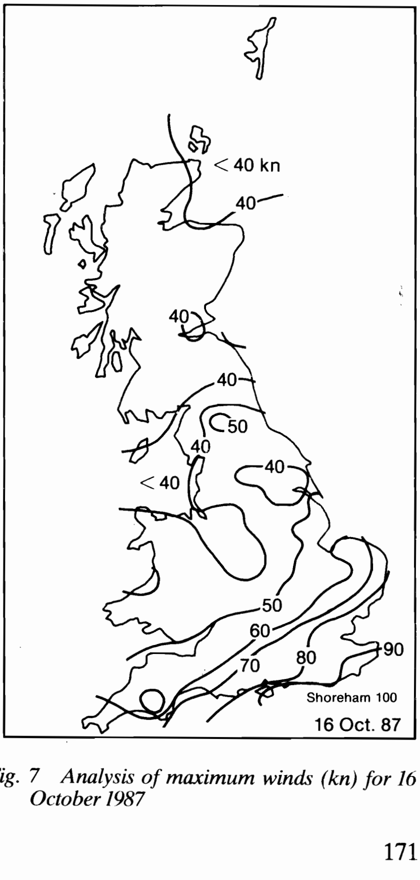

Fig. 7 Analysis of maximum winds (kn) for 16 October 1987

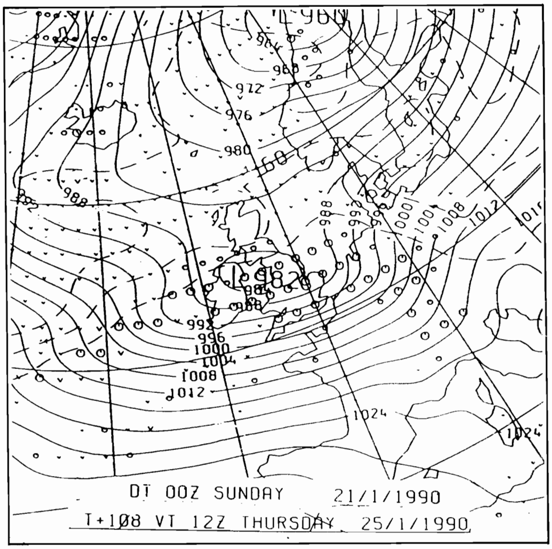

Fig. 8 T+108 forecast of mean-sea-level pressure (mbar) and precipitation from the Meteorological Office global model, data time 0000 GMT on 21 January 1990

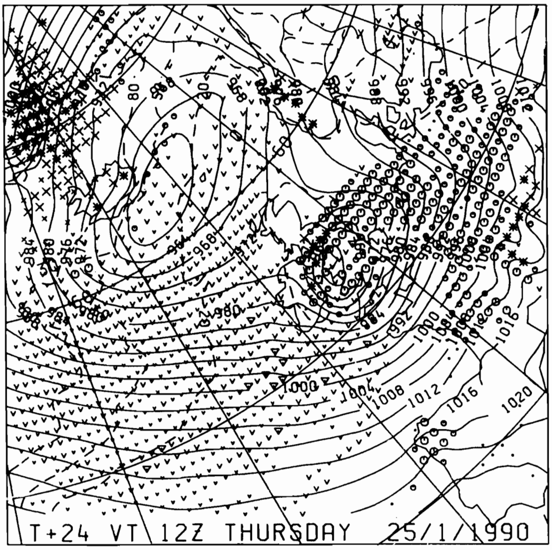

Fig. 9 T+24 forecast of mean-sea-level pressure (mbar) and precipitation from the Meteorological Office fine-mesh regional model, data time 1200 GMT on 25 January 1990

are expert at handling an ensemble of solutions from different forecast centres and on this occasion the signal for marked cyclogenesis was clear. Emphatic guidance of severe gales for the southern half of the United Kingdom was issued on the Sunday farming forecast on BBC1 TV, with uncertainties expressed about the track. As the event drew closer, more precise forecasts were issued on 24 January based on the 24-hour forecast from the fine-mesh regional model (see Fig. 9), which predicted mean surface winds of 50 kn. The Chief Forecaster, using this information and the prediction from the global model (run 1½ hours later) of a more northerly track, decided that a spell of very severe weather was imminent. It is not the place of this article to detail the plethora of warnings that were issued via the media and elsewhere, suffice to say that the event appeared to be extreme enough to warrant a Press release about the impending storm and the possibility of structural damage. Also a warning was signalled to the Ministry of Defence at 1830 GMT on Wednesday 24 January that military assistance to the civilian population might be required due to the severity of the winds.

CONCLUSIONS

The Burns' Day Storm of 25 Janury 1990 produced winds of a comparable magnitude to those of the October 1987 Storm, but over a much wider area. The storm exhibited similar characteristics to those of the 1987 storm and some other cases of rapid cyclogenesis, in that it was associated with a rapidly moving, slightly confluent upper trough and embedded in a zone of marked thermal contrast. Satellite pictures exhibited typical signatures of such deepening systems, in particular the baroclinic leaf shape and dry wedge. The rapid movement of the system and sudden surge of pressure behind the low (behind the confluent upper trough axis), were again important factors in the maximum wind speeds. Despite timely warnings from the Meteorological Office the casualty list was higher than in October 1987 because of the daytime arrival of the event (compared with night-time in October 1987) and the greater area affected.

ACKNOWLEDGEMENTS

The author would like to thank Dr Bob Riddaway, Martin Young and Alistair Woodroffe of the Meteorological Office for helpful comments on a rough draft of this paper.

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