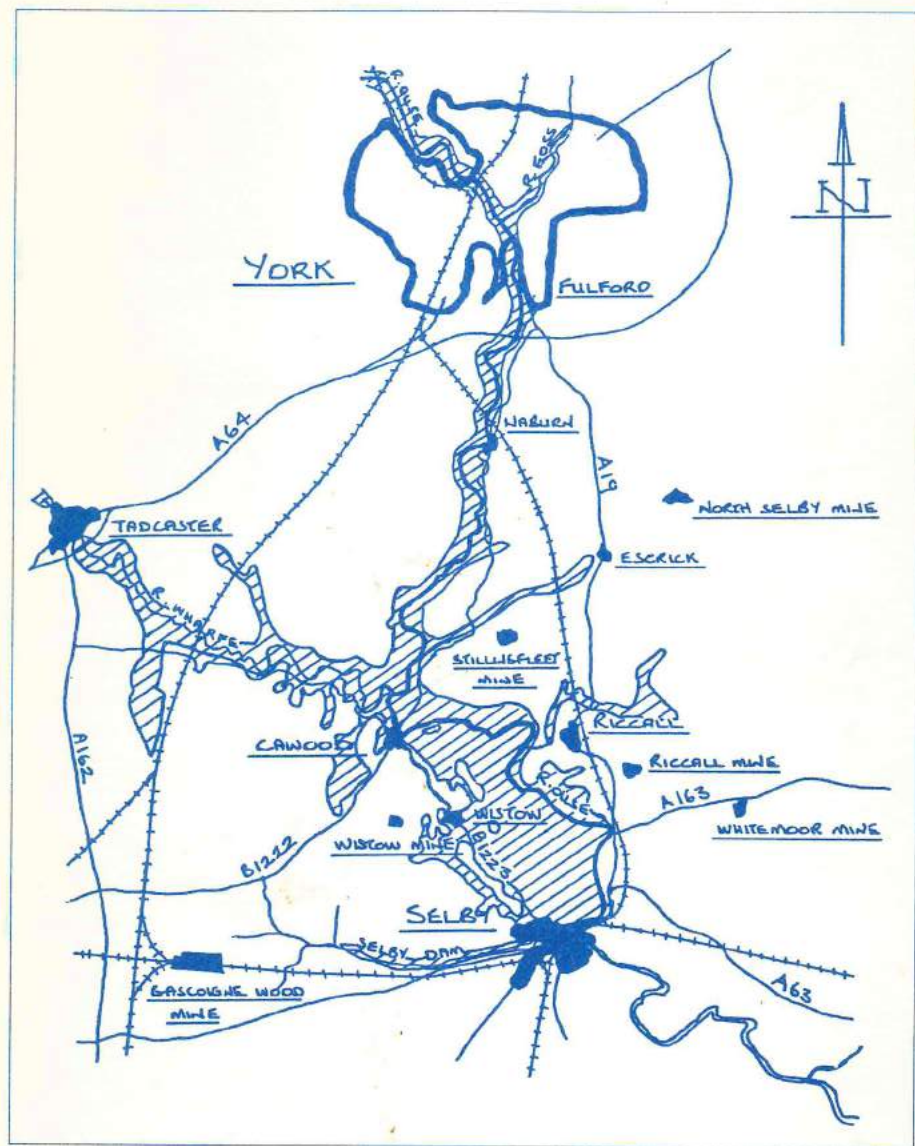


The JOURNAL of METEOROLOGY



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LE JOURNAL DE MÉTÉOROLOGIE

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Vol. 7, no. 66, February 1982

THE RECORD MINIMUM TEMPERATURES FOR ENGLAND BROKEN AGAIN

With surprising swiftness the English record minimum temperature, set as recently as 13 December 1981 at Shawbury, Shropshire, with -25°C , was broken on 10 January 1982 during a fresh surge of deep polar air. The new record is -26.1°C , and it occurred at Newport, Shropshire, at the Harper Adams Agricultural College. On the same morning the Scottish and all-British record of -27.2°C was equalled at Braemar which also held the previous record set 87 winters earlier. Several other stations had temperatures below -20°C on this and other days in the period 8 to 15 January, and many of the nation's weather observers reported measuring the lowest temperatures of their life-times.

Following Britain's cold weather of December which made December 1981 the coldest December since 1890 in most parts, there occurred a milder interlude at the end of the month which lasted into the first week of January. The thaw of December's lying snow, together with additional heavy rain, led to serious floods especially in northern England (see article by D. V. Randon). Cold air pushed south again across Scotland, and there were prolonged snowfalls in all districts especially in Wales, central and southern England on 7th to 9th. Low temperatures included -23°C at Braemar on 7th, and a near-record -26.8°C at Grantown-on-Spey (Highland) on the 8th. Then came the extremes on the morning of the 10th mentioned above, -26.1°C at Newport and -27.2°C at Braemar (the South Pole temperature was reported as -21°C that day); an article on the Braemar measurement follows next. Newport recorded -23.3°C on the 11th and nearby Shawbury -20°C . Gradually, as the quiet anticyclonic conditions shifted progressively southwards, the greatest extremes were reported from central and southern areas of the country. The 14th was perhaps the coldest, with for example, -20.8°C at Elmdon, -20.0°C Codford, -19.5°C Cosby (Leicester) and -17.6°C at Trowbridge. At a few stations the following night was colder, but before dawn a southerly wind was gaining strength and a thaw was imminent. The weather pattern changed completely, and the remainder of January was dominated by warm southerly winds with little frost and little precipitation.

In mid-January naturalists were reporting that as far south as the English Midlands stoats had been seen which were turning from their normal reddish-brown colour to white. This is common in Scotland, especially in the snow-covered hills, but rarely happens in England. The change takes place through a moult, and is triggered by severely cold weather.

BRITAIN'S RECORD LOW TEMPERATURE, -27.2 °C, EQUALLED AT BRAEMAR ON SUNDAY, 10 JANUARY 1982

87 years ago on 11 February 1895, when temperatures were read in whole degrees Fahrenheit, the temperature at Braemar in the eastern Central Highlands of Scotland fell to a historic -17°F , equivalent to -27.2°C on the Celsius scale. Ever since, this figure has been quoted as the lowest air temperature to have been measured in Britain in a Stevenson-type screen with orthodox exposure and thermometry. Now, that same temperature, -27.2°C , has been reached again, this time directly on a Celsius-calibrated thermometer, an event which reinforces Braemar's reputation as the coldest village in the country (its mean annual temperature is a chilly 6.5°C , 43.7°F). The story of the measurement of the latest record minimum temperature has been given to us by the observer Mr. Richard Graham, and it appears in the following pages. As readers will know, weather data from Braemar have been printed in this journal since our first issue in October 1975. The observer then was Mr. James C. Donaldson, and since January 1981 the observer has been Mr. Richard Graham, headmaster of Braemar School.

BRAEMAR VILLAGE

Braemar is situated in the upper reaches of the River Dee at an elevation of around 350-400 metres. Its population is about 350. The village is well sheltered in almost all directions by hills and mountains rising to 700 metres or more in the vicinity, and to 1000-1300 metres a few kilometres away. These mountains had the effect, in former centuries, of isolating Braemar from lower Deeside, and general attention only began to be drawn to the region with the eventual arrival of Queen Victoria and Prince Albert at Balmoral. Then in 1855 Prince Albert had a weather station established at the entrance to Braemar village, and it is remarkable to relate that the present station is in the same place as Prince Albert's so that the long weather records have a proper consistency in situation as well as in time.

The station was provided with a wooden louvered thermometer screen, and for 53 years Mr. Aitken, a bank manager, was official observer until he died in 1908. From then until 1980 the other observers were also bank managers, Mr. Donaldson being the last retiring in December 1980 after 23 years as climatological observer. Mr. Richard Graham took over in January 1981, with Mr. Donaldson then serving as deputy observer. A Stevenson screen was used from 1911 to 1981, when it was replaced by a new one. The old screen is still in use having been re-erected at Braemar School.

THE WEATHER IN OCTOBER-DECEMBER 1981

October began cold, and heavy overnight snow completely blocked the Braemar to Perth road at Devil's Elbow on the 2nd. On seven occasions in October there were fresh snowfalls on the surrounding hills, but no sharp frosts until the last half of November. Then came December which proved to be the coldest December at Braemar since 1895 and the coldest month since February 1963.

December's minimum was -18.0°C on the 17th, not as low as at several English stations, but on 12 occasions the temperature fell below -10°C . The highest temperature on the 16th was -11.2°C , and on Christmas Day between

0900 and 2400 the highest was -11.1°C . Snow fell on 20 days, but only on three days (13th, 14th and 30th) was it really significant. Snow lay on every day of the month except the 4th. The 14.5 hours of sunshine recorded by the sunshine recorder in December is incorrect because the globe refused to defrost on two days (in the middle of a period of four days where the temperature went below -15°C).

THE GREAT FROST OF 9-10 JANUARY 1982

The severe frost of December continued into January and reached a climax in the period from the 7th to 13th which had all nights below -16°C and five nights below -20°C . The mean temperature throughout those seven days and nights was -13.4°C .

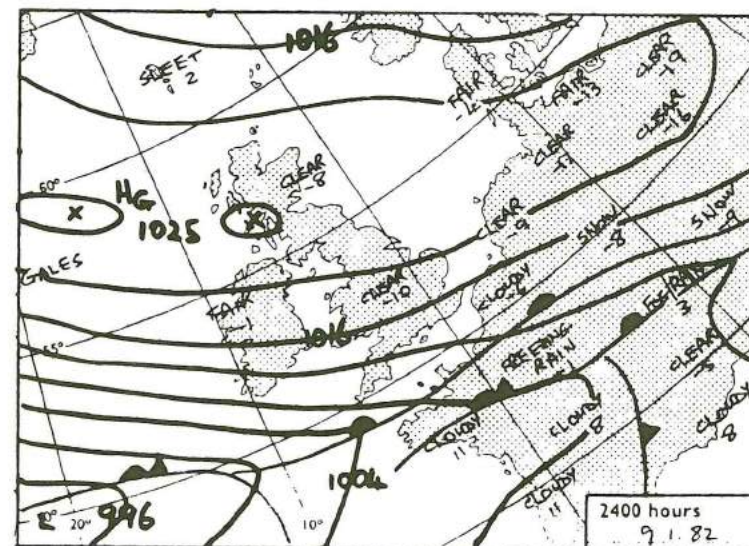


Fig.1 Weather map for midnight 9-10 January 1982. The deep polar air is stagnant over Scotland, and the temperature at Braemar is -24.7°C . About six hours later it reached -27.2°C , Britain's lowest air temperature this century. The map is reproduced, with permission from the London Weather Centre's *Daily Weather Summary*.

The evening of Saturday 9th January was clear and quiet, and Mr. Graham said it was easy to observe the lunar eclipse in the cloudless conditions. At 1800 hours, when the temperature was -20.2°C , it was obvious that another extremely cold night was forthcoming, so it was decided to take hourly readings. Mr. James Donaldson immediately agreed to assist Mr. Graham in this task, so that dual observations were made until 2300 hours when Mr. Donaldson retired to bed. Mr. Graham carried on alone until 0200 on the 10th when the thermometer stood at -25.6°C .

Getting up again at 0630, Mr. Graham hurried to the screen to find the minimum thermometer at -27.2°C , although the dry-bulb reading then stood at -26.9°C . Mr. Donaldson was aroused and the readings verified. The 'grass-minimum' thermometer was also read and found to be -28.2°C . The two observers walked up to the old Stevenson screen at the school where the

minimum thermometer was reading -27.5°C , after which the Meteorological Office in Glasgow was informed of the news.

The temperature readings that night were as follows:

1800	-20.2°C	-4.4°F
1900	-21.2°C	-6.2°F
2000	-22.5°C	-8.5°F
2100	-23.8°C	-10.8°F
2200	-24.1°C	-11.4°F
2300	-24.5°C	-12.1°F
2400	-24.7°C	-12.5°F
0100	-25.2°C	-13.4°F
0200	-25.6°C	-14.1°F
minimum	-27.2°C	-17.0°F
0700	-26.9°C	-16.4°F
0800	-26.4°C	-15.5°F
0900	-25.9°C	-14.6°F

Other local people reported lower temperatures from unprotected thermometers. For example, the thermometer kept by Grampian Regional Council Water Board at Braemar Sewage Works, where weather records have been kept for over 30 years, went off the scale at -29°C (-20°F).

Diesel fuel froze in all the buses and trucks, so that no heavy vehicles could enter or leave the village that day. Half the village was without water because of frozen supplies, and even central-heating oil and gas-oil froze. The fire-engine was put out of action, and one fire that day had to be extinguished with sand from buckets, the firemen attending on foot.

The severe frost continued all day, and by 1400 hours the day's maximum of -19.1°C was reached. This is possibly the lowest maximum temperature on record for Britain. Hourly observations continued all afternoon and evening because it was thought that new records might be established later. Unfortunately, thin high cloud was visible on the northern horizon by 1500, and it was slowly creeping south. At 2000 hours the temperature was down to -25.9°C but wispy cirrus clouds were covering the sky. Although -26.3°C was reached soon afterwards, the temperature then rose quite quickly, and at 2300 hourly observations ended.

1300	-19.5°C	-3.1°F
1400	-19.1°C	-2.4°F
1500	-20.5°C	-4.9°F
1600	-21.8°C	-7.2°F
1700	-22.2°C	-8.0°F
1800	-23.6°C	-10.5°F
1900	-25.0°C	-13.0°F
2000	-25.9°C	-14.6°F
minimum	-26.3°C	-15.3°F
2100	-24.8°C	-12.6°F
2200	-23.4°C	-10.1°F
2300	-22.9°C	-9.2°F

Within the next three days the worst of the great freeze had passed, but frost

continued until the 17th which was the last of 44 consecutive days with frost. Burst pipes appeared as the thaw began, and ice on the Clunie and the Dee began breaking up. One ice-flow sank a fishing boat in Aberdeen harbour, almost blocking the harbour entrance. Mr. Graham was without a water supply for 10 days, and the local minister for even longer. Snow continued to lie until the 29th, the 56th successive day with snow cover. This was also the warmest day of the month with a maximum temperature of 9.9°C .

ACKNOWLEDGMENT

We are most grateful to Mr. Richard Graham for supplying us with the Braemar weather information used in this article and for allowing us to reproduce as much of it as we wished. We also appreciate the regular supply of monthly weather data from this historic weather station.

(Reminder. Some data on long frosts at Braemar were provided by Mr. James C. Donaldson some years ago in a Letter to the Editor – *J. Meteorology*, Volume 1, no. 3, pp.103-104, December 1975.).

BRITAIN'S EXTREME TEMPERATURES IN DECEMBER 1981 AND JANUARY 1982

By A. H. PERRY

Department of Geography, University College, Swansea.

The severe cold spells of both December 1981 and January 1982 will long be remembered in Britain for the extremely low minimum temperatures that were recorded. These were especially remarkable because (1) they occurred in two discrete cold spells, separated by a distinct mild spell over almost all the country at the turn of the year, and (2) during the first cold spell the lowest temperature occurred on 12-13 December which is unusually early for extreme cold.

Previously, the lowest temperatures on record in the United Kingdom have occurred during protracted severe winters. These have included -27.2°C at Braemar on 11 February 1895, -24.6°C at Carnwath on 13 January 1979, and -23.3°C at Rhayader on 21 January 1940. During the current winter the lowest minimum temperatures have been:

December 1981. -23°C Shawbury (Salop) on 12th; -25°C Shawbury (Salop) on 13th; -21°C near Cheltenham (Glos) on 13th.

January 1982. -27.2°C at Braemar on 10th; -26.1°C at Newport (Salop) on 10th; -26.8°C at Grantown-on-Spey on 8th; -25°C at Jedburgh on 8th.

The Braemar figure on 10 January 1982 equals the lowest temperature yet recorded under orthodox conditions anywhere in the United Kingdom. Also, new low records were set for England on 12 December 1981 and again on 10 January 1982 with the Shropshire readings. Hopkins and Whyte (1975) have suggested that nowhere in England and Wales is the 50-year return period extreme minimum less than about -18°C , which puts into perspective the degree of extreme cold recorded this winter. In fact, on 12-13 December temperatures

below -10°C were widespread over almost all the Midlands, southern and eastern England, with -15 to -18°C at a number of stations.

Lyall (1973) in a study of very low temperatures has noted that the necessary synoptic conditions include a freshly-fallen snow cover, and a stagnation situation usually with a light easterly drift. These conditions occurred again this winter. On 12 December 1981 a weak anticyclone, moving from Ireland across central England provided intense radiation, while the spell of mid-January 1982 occurred following the heavy blizzards in Wales and parts of England in a slack easterly stream.

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LYALL, I. T. (1973): Low temperatures in southern Britain. *Weather*, 28, 134.140.

(N.B. The *Western Mail* (Thomson House, Cardiff, S. Glamorgan) has produced a 48-page supplement on the Welsh blizzards, price 25 pence plus postage, printed end-January.).

LIVERPOOL'S COLDEST DAY, 12 DECEMBER 1981

Here on Merseyside we have had the coldest December since 1890 and also the lowest December temperatures since records in the area began 115 years ago. The 12th was an exceptional day, the severity of the cold probably unequalled for a west-coast location.

Snow set in on the night of the 8th, and the maximum on the 9th was 3°C . More snow fell on the 10th which had a maximum of -0.6°C , as did also the 11th. On the 12th I awoke to fog and a temperature of -14°C , the night having been quiet with clear skies. The fog was not dense and cleared by 1100 to expose a hazy sun; even so, at Sefton Park (Liverpool) the noon reading was a mere -10°C . The maximum for the day, -7.0°C , was reached at 1330, after which the temperature fell quickly to -11°C at 1600 and -13.3°C at 2230 before the arrival of frontal cloud heralding the next day's blizzard. At Liverpool airport (Speke) the maximum on the 12th was -8.3°C . For Bidston the previous December *minimum* was -8.3°C !

In the local parks many shrubs have been killed, some of which had survived over 60 winters previously. Among those killed, and hitherto considered hardy in the Liverpool area, were *Senecio Greyii* (*Laxifolius*), *Escallonia*, and *Hebe*. All leaves were killed on *Privet* (*Ligustrum*), and leaves were 'burned' on *Bay*. Also, the total snowfall of 25 cm by the 14th (the most I have ever seen in December) smashed down many shrubs including *Conifer* and *Yucca*. *Cordylina Australis* had reached seven metres in height in sheltered places, and, although some suffered in the 1978-1979 winter, all have been killed to ground level now.

The previous lowest maximum I had recorded was -3.9°C in January 1963. The degree of daytime cold is beyond anything of which I had considered this area capable. And now January 1982 seems set to carry on where December 1981 eased.

Gateacre, Liverpool

KEITH G. LEDSON

DECEMBER 1981 AT BURTON-ON-TRENT

By D. J. STANIER

A rather undramatic but significant change took place in our weather during the night of 7th/8th December 1981. After a week of what may be considered 'normal' December weather, a depression passing to the north of this area in an easterly direction brought in a very cold northerly airflow in its wake. This marked the beginning of what eventually developed into a twenty-two day cold spell, which also included some unusual extremes.

TEMPERATURE

The highest maximum temperature during the cold spell was 4.0°C , recorded on the 14th. Only the 29th with 2.6°C joined the 14th with a maximum exceeding 2.0°C . There were eight freezing days, the coldest of which was the 17th with a maximum temperature of -5.3°C ; this followed -4.0°C , the maximum on the 16th. The lowest maximum of -5.3°C was the lowest observed since the exceptionally cold day on 3rd January 1979 (-11.5°C), and the number of freezing days was the greatest since 1963.

Minimum temperatures included a new station record, -17.0°C recorded on the night of 12th/13th (beating the -16.2°C of January 1979). This joins the lowest recorded temperature for this area during the last one hundred years. Four other nights had minima of between -10.0 and -12.0°C , and four other nights were without air frost (the highest minimum in the screen being 1.0°C). Frost was moderate to severe on all other nights during the cold spell. Ground frost was recorded every night except for 28th/29th.

Mean temperatures for the twenty-two day period were as follows:-

Mean maximum:	0.2°C	Difference from average (8-29 Dec 1970-80)	-7.6 degrees
Mean minimum:	-5.2°C	Difference from average (8-29 Dec 1970-80)	-9.1 degrees
Overall mean:	-2.5°C	Difference from average (8-29 Dec 1970-80)	-8.2 degrees

RAINFALL/SNOWFALL

The twenty-two day spell had 59.8 mm of rain* (or snow equivalent) on fourteen days (including four traces). The greatest 24-hour fall was 15.3 mm on the 13th.

The greatest level depth of snow was 20 cm on the 14th (with drifts of between 40 and 60 cm). This was the greatest accumulation at Stretton since 7 February 1969, although the drifting experienced here in February 1979 was more substantial than December 1981. A 100% snow cover was maintained from the 11th to the 28th, in spite of several periods of thawing. The cover was reduced to 80% on the 29th.

There were six individual snowfalls which gave accumulations. Three of these gave 5 cm or more.

* The total measured was 59.8 mm, but snow which fell on the 11th must have blown across the rain gauge as nothing was in the bottle at 0800 on the 12th. At least 2 cm of snow accumulated on the ground which should have been attributed to the 11th.

GENERAL OBSERVATIONS

9 December 1981: The first observation of snow this winter (showers only).

- 10 December 1981: The first freezing day since January 1980, and the first one in December since 1978.
- 12 December 1981: Temperatures: Noon -4.2°C ; Maximum -2.7°C shortly after Noon; 1600 hrs -7.0°C ; 1800 hrs -9.5°C . Some ice was in evidence near the banks of the Hilton Brook, Egginton, Derbyshire and the Alder Brook, Rolleston near Burton-on-Trent.
- 13 December 1981: Diurnal range of 18.5 degrees. Ice was observed on the quieter waters of the River Dove at Monk's Bridge, Clay Mills (near Stretton), the first sighting of ice on the river since 1963.
- 16 December 1981: Freezing fog persisted for most of the day, an ice-cystal precipitation was noted in and around brewery locations in Burton-on-Trent.
- 17 December 1981: Temperatures: 1730 hrs -10.0°C ; 1900 hrs -11.0°C ; Further fall was arrested, giving an overnight minimum of -11.8°C for the 17th/18th. Coldest December day on the Stretton record (since 1970) and the coldest day since January 1979.
- 19 December 1981: Approximately 50% ice cover on the Alder Brook, Rolleston, near Burton-on-Trent, while there was 95% on the Hilton Brook, Egginton, Derbyshire. The River Dove showed some ice along parts of the banks. In the quiet waters around Monk's Bridge, Clay Mills, there was considerable ice cover.
- 23 December 1981: The seventh freezing day of the month, beating the number recorded in January 1979. December 1981 was therefore behind only January 1963 in this respect.
- 24 December 1981: Still 8 cm lying snow after continual freeze/thaw conditions. The bottom 3 cm or so had turned to ice by this time.
- 25 December 1981: The first White Christmas at Stretton since 1968, and the first one with 100% snow cover in my memory (going back to 1955).
- 26 December 1981: Heavy rime frost.
- 28 December 1981: A miserable day: fog, rain and sleet, and very dull.
- 29 December 1981: If anything, rather worse than the 28th. Snow cover now reduced to about 80%. The night of 28th/29th was the first to be frost-free since the 3rd/4th.
- 30 December 1981: Temperatures reached 7.4°C , the highest since the 4th. The thaw and rainfall caused severe flooding locally.

CONCLUSIONS

Temperature records for the Burton-on-Trent area are scant, but information for Nottingham (some 40 kilometres to the north-east) would suggest that Decembers of the severity experienced in 1981 are rare. The extreme minimum of -17.0°C at Stretton would compare favourably with values of -15°C and

-21°C recorded at Nottingham in December 1879 and 1878 respectively. The overall mean temperature for the month was -0.5°C , making it the coldest month at Stretton since January 1979 (-0.9°C), but, comparing this with information available for Central England, December 1981 surpasses all cold Decembers this century. In the latter half of the nineteenth century, there were three particularly cold Decembers (1874, 1878 and 1890). The mean temperature for December 1981 compares favourably with Central England means in each of those years.

The year ended with extremes of a different nature: severe flooding. Melting snow, combined with a good deal of rain (30.8 mm at Stretton between 27th and 30th) led to heavy flooding in the catchments of the Rivers Dove and Trent. The village brook in Rolleston (three km from my station) flooded severely on the 30th, and the village was also badly affected by run-off. Several lanes in Stretton also suffered heavy run-off flooding. By the 31st, the River Dove at Clay Mills (two km from Stretton) had produced the largest flood since February 1977. The River Trent was still rising at 1600 hrs on the 31st, reaching a peak at approximately midnight 31st December/1st January, at which time the road between Repton and Willington was closed to traffic, as floodwater went around the end of the bridge across the river. This flood was more substantial than that experienced in February 1977, and may therefore have been the largest Trent flood since 1960.

FLOODS IN THE YORK AND SELBY AREA, JANUARY 1982

By D. V. RANDON

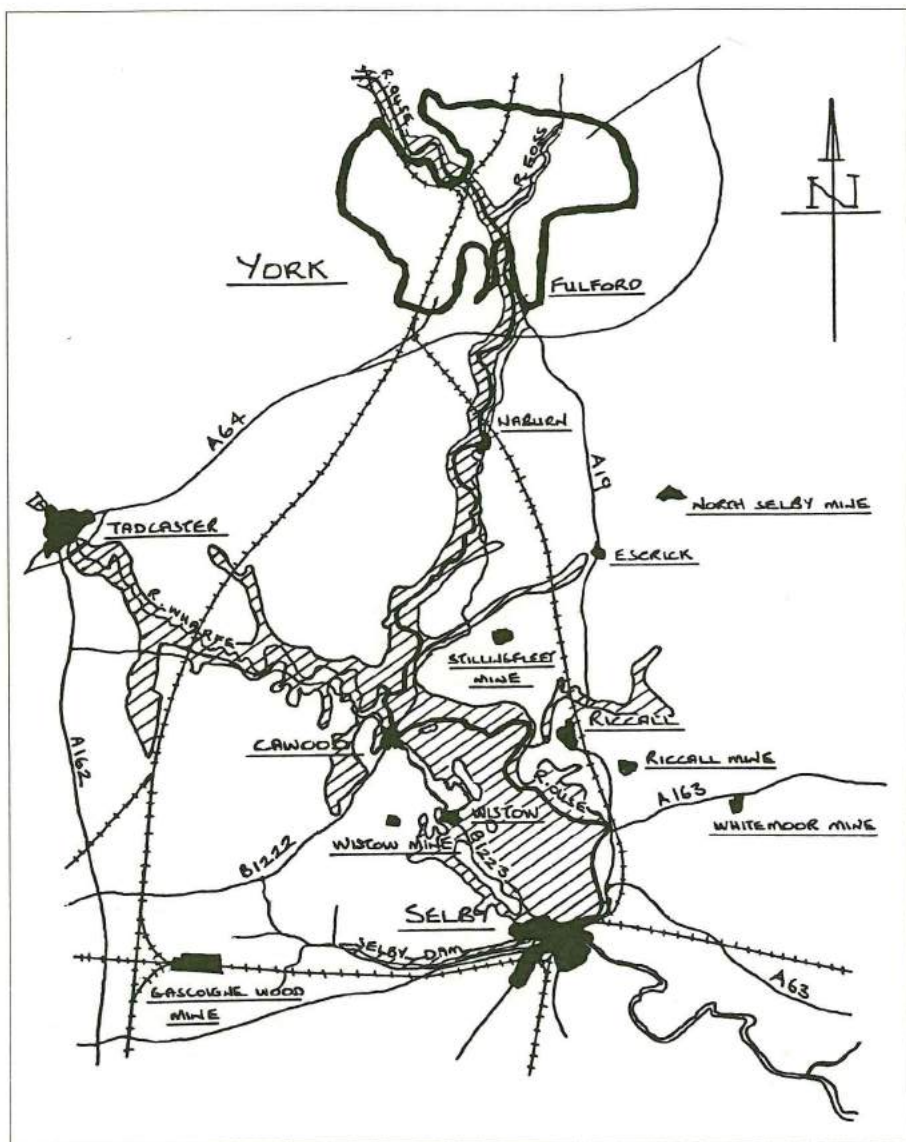
Manor Garth, Riccall, Yorkshire.

For the second time in three years, serious flooding affected the City of York, the market town of Selby and several villages including Cawood, which was last affected as recently as March 1981.

There was little doubt about the effect that the very rapid thaw of early January would have on the level of the River Ouse. Snow had accumulated in the Yorkshire Dales throughout most of December and had thawed only very slightly after Christmas. The tropical maritime air which pushed quickly across the country during the 2nd and 3rd brought a dramatic increase in temperature and also produced heavy orographic rainfall. Severe frosts had frozen the ground and therefore the combined rainfall run-off and meltwater rushed down the Dales into the Vale of York.

The first serious flooding affected York on 4th January 1982. Monitoring of the tributary rivers, which were affecting towns such as Boroughbridge, by the Yorkshire Water Authority, indicated that the level at York could reach at least 4.88 metres above normal. In the event, the level continued to increase during 5th January 1982 to a maximum of 5.05 metres above normal, which was 0.23 metres above the 1978-1979 peak level when 600 houses were flooded. In spite of the higher level, fewer houses were flooded because of flood-protection measures carried out during the last three years.

However, attention was by now focused on Cawood and Selby. The additional hazard downstream of York is that the river is tidal and the outward flow of the



Map showing flooding in the York and Selby area during early January 1982.

Ouse is effectively restricted during each tide. Extensive protection works had been in progress at Cawood during the last year, but were a long way from completion. There was no way that the river could be prevented from entering the village and affecting up to 100 houses. In addition, the river found a weak spot in a bend on the south side of the village which allowed water to flow into the area south-east of Cawood and towards Selby. The river over-topped its banks

extensively between Cawood and Selby but not in Selby town although there was a full emergency procedure organised in case this should happen or the banks were breached. The north-western part of the town was badly affected by the water over-topping upstream and flowing through the small breach at Cawood. Hundreds of acres of farmland were turned into huge lakes on both sides of the river between Cawood and Selby which effectively isolated several farms.

By 7th January 1982 very cold weather had returned and dramatically reduced the river flow from the Dales. The river fell quickly at York and after two high tides also fell at Cawood and Selby. By now, a thick crust of ice had formed in flooded streets and houses and the relief services which included the Army had a difficult task of pumping water back into the river and then removing hundreds of tonnes of ice. At the time of writing (21 January) with another thaw just established, this work is only just nearing completion at Selby.

Severe disruption was caused to the area with parts of York City Centre almost isolated for three days and many major and minor roads impassable. Commercial life in York including the New Year sales were very disrupted. In Selby, although the main routes were not affected, a large factory was flooded as well as many houses. The new coal mines of the Selby Coalfield were not threatened. One important difference between the floods of December/January 1978-1979 and 1982 was that some villages on the main tributary streams in the Vale of York were not affected this time. The main reason was that local rainfall was not heavy and the dykes and streams did not back up to the extent that they did three years ago.

A GIANT RAINGAUGE

The photograph shows a huge rainfall recorder and raingauge at Sainte Marie du Mont, near Tournet (altitude (1200 metres) in the French Alps. In the winter the snowdepth often exceeds one metre. The editor's son, Lionel Meaden, was 12 years old when the photograph was taken three years ago.

Photographs from readers of their weather stations will be welcome for a new series.



THE SEVERE STORM IN DENMARK ON 24 NOVEMBER 1981

By EBBE SKJØDT
Faergrevej 74, 3600-Frederikssund, Denmark.

November 1981 will be remembered in Denmark for three big storms. The first happened on the 2nd with a wind-gust at my station of 26.0 metres/second (51

knots) from the west. The second occurred on the 21st with a gust to 24.0 m/sec from the west, and finally there was the big one on the 24th with gusts reaching from the west 28.5 m/sec (56 knots).

My station is situated inland, near an inlet from the sea, and is open from the west and north. The storm of 24 November 1981 was probably one of the severest

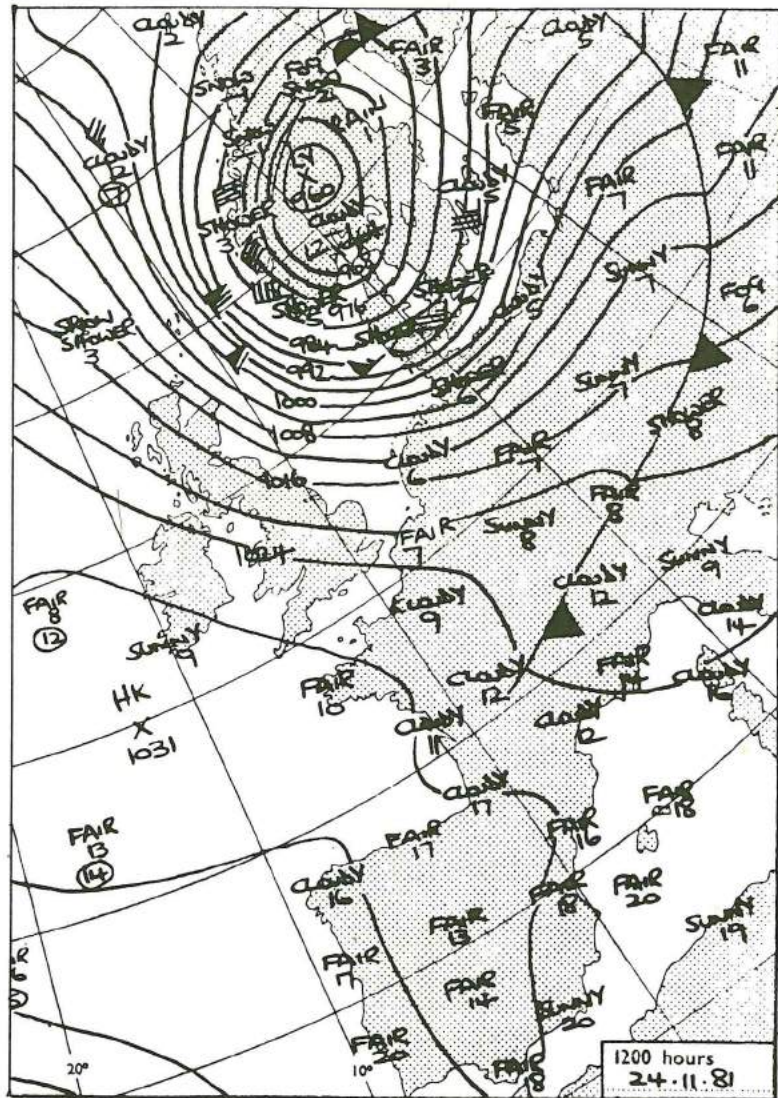


Fig.1 Weather map for noon, 24 November 1981, showing the deep depression over southern Scandinavia. The cold front lying across Central Europe is the one which 24 hours earlier gave rise to more than 70 tornadoes in England and Wales. The map is reproduced, with permission, from the London Weather Centre's *Daily Weather Summary*.

this century, among the others being the 'Christmas storm' of 1902 and the 'October storm' of 1967. The latest storm was caused by a deep depression which moved eastward over south Norway and central Sweden. The pressure dropped to near 960 mb at the lowest point. Because of several days of gales and storms before, the water-level was much higher than normal. On the morning of the 24th, the water-levels at the dikes on the west coast of southern Jutland reached a dangerous level. People in the threatened areas were evacuated, and units from the army helped to strengthen the dikes. At noon the water-level reached 5.1 metres above mean sea-level at Ribe, the highest ever known. The dikes broke in several places, and 80 per cent of the island Mandø was flooded by the sea. Fortunately, the storm caused no more than one death, probably because the storm had been well forecasted by the Meteorological Office.

The storm was extreme in length. At my station the wind-speed exceeded 24.5 m/sec for more than 17 hours with occasional gusts to 28.5 m/sec (Beaufort force 11). In October 1967 the wind with Beaufort force 10 only lasted three hours. There was considerable damage as well in the latest storm. At my station my anemometer mast bent 45 degrees, and a big branch from a tree was torn off. In Denmark the storm was worst on the west coast of Jutland and in the Baltic Sea, where windspeeds of 35 m/sec with gusts to 45 m/sec were measured. The worst damage was to flooded areas on the west coast and to areas flooded by the water rising abnormally in the inner-waters. The forests were also extensively damaged. In Gribskov in North Zealand timber for 12 years was blown down. It is likely to take 50 years for all the forests to recover from this disaster, the total overall cost amounting perhaps to 700 million Danish crowns. Insurance companies estimate the damage to property, buildings, etc. as 500 million crowns; this is the highest amount for any storm. Also in many places the electricity supply was cut off, and because of the danger people in several districts were warned not to leave their homes.

Following this great storm, a big discussion and argument commenced. Who is to pay for the flood-water damage caused by the sea, because the insurance companies will not? It came very close to being a truly national disaster; the fact that it did not was only because of the newly-constructed advanced dikes. Nevertheless, the dikes will have to be very carefully repaired again before the next storm comes.

MYSTERY SPIRALS IN A HAMPSHIRE CORNFIELD

By G. T. MEADEN

Tornado and Storm Research Organisation, Trowbridge.

On 19 August 1981 three nearly-circular flattened areas were discovered in a cornfield in Hampshire a few kilometres east of Winchester. The photographs shown in Figures 1 and 2 were taken by Mr. Steve Broome of Eastleigh on and soon after 20 August. The exact location was within the base of the 'punch-bowl' shaped hill at Cheesefoot Head (SU 530281), a part of Matterley Farm owned by Lt.-Commander Henry Bruce. Another photograph taken from the hill was published in the *Hampshire Chronicle* of 28 August 1981, and reports also appeared

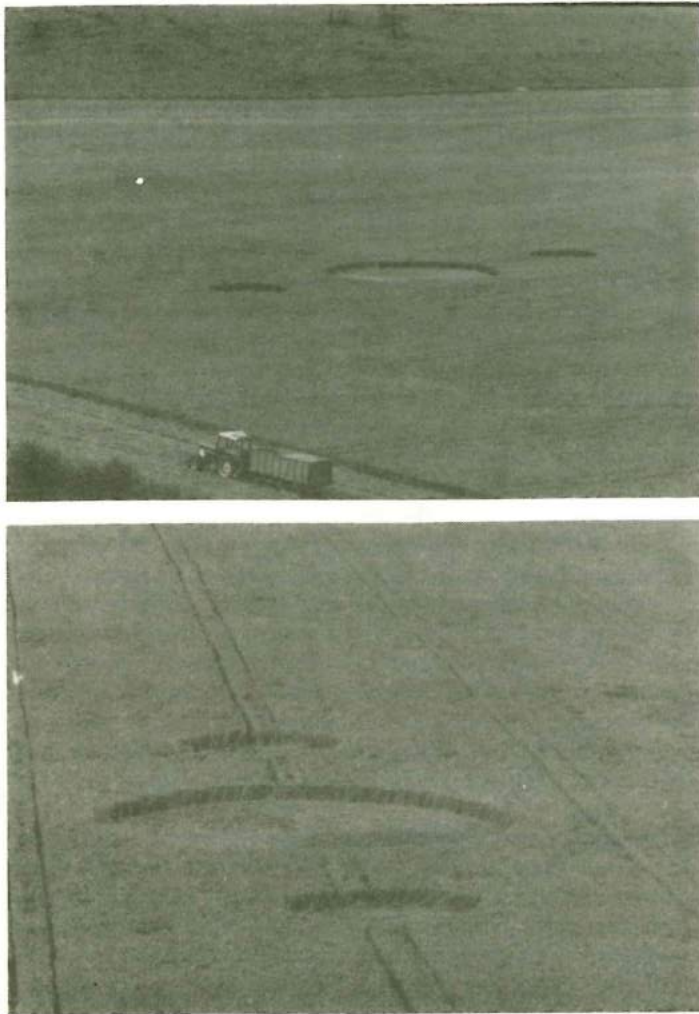


Fig.1 General views of the punch-bowl area showing the three spiral areas (photographs by Steve Broome).

in the *Southern Evening Echo* on 26 and 28 August from which we learn that 'similar circles appeared on his 1200-acre farm last year'.

The most distant of the three nearly-circular areas is the one shown in close-up. Three measurements of its diameter gave 25 feet, 25 feet 4 inches, and 26 feet 3 inches – a mean of 25 feet 6 inches or 7.8 metres. The clockwise spiral flattening of the corn is clearly apparent. Three measurements of number 2 gave 61 feet 8 inches, 61 feet 9 inches, and 62 feet – a mean of 61 feet 10 inches, or 18.8 metres. The third measured 26 feet, 26 feet, and 26 feet 6 inches – mean 26 feet 2 inches, or 8.0 metres (measurements by Steve Broome). The circles was slightly eccentric,

with, for example, an extreme radius ratio of 12 to 14 in the case of the third one. Their alignment was approximately north-west to south-east, the distance from the edge of the third circle to the boundary fence at the bottom of the 'punch bowl' being about 180 feet or about 55 metres.



Fig.2 Close-up of the furthest spiral.

As with the Westbury 'circles' investigated in August 1980 and reported in detail in *Probe*, volume 1, numbers 2 and 3 and in *J. Meteorology*, volume 6, no. 57, pages 76-80, the circles are all clockwise spirals radiating from a centre with a sharp cut-off occurring at each perimeter. For these and other reasons discussed in the present paper, it is again suggested that an unseen whirlwind was the agent. Certainly, helicopters could never damage the cereal crops in this way with their blasting downdraught. Weather conditions in August 1981 were frequently favourable for whirlwind development, and it is pertinent to remark that (quoting the *Southern Evening Echo*) 'villagers living near to the remote farm are of the general belief that the circles were caused by a whirlwind.' In what follows we attempt to explain both the Westbury 1980 and the Winchester 1981 phenomena, and to contribute to the little-understood theory of whirlwinds.

In whirlwinds the air spirals inwards and upwards with a wind-field much as represented in Figure 3 on page 79 of *J. Meteorology* (preceding volume). The wind-flow may be either clockwise or anticlockwise. Whirlwinds are often born as fair-weather thermals (columns of rising warm air) which have, for some reason, acquired a rotational movement. One common means by which this is done in a temperate country like Britain has its origins in the large-scale motion across the countryside of an invading air-mass which is sweeping before it a pre-existing air mass (e.g. a sea-breeze front, gust-front, or other micro-front or meso-front). At the frontal boundary the wind-shear (velocity variation with height) can start to twist any thermal which the advancing front reaches, and if certain other factors are also right a whirlwind is successfully born. If the air was quiet instead (which it is not

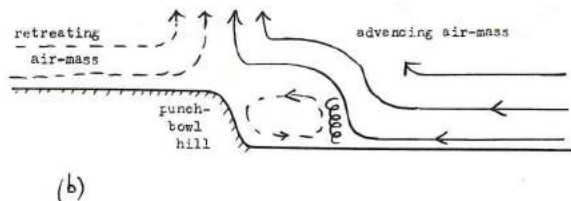
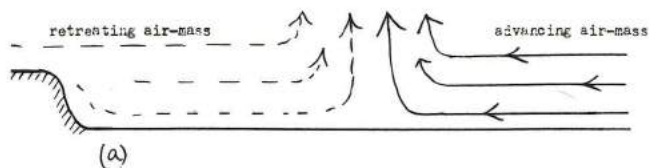


Fig.3 When an air-mass is being displaced by another one, whirlwinds sometimes form in the zone of discontinuity between the two air-masses. When this happens (upper figure), the whirlwinds are carried along by the advancing air-mass. It is here suggested that whirlwinds might be stationary when formed in front of a punch-bowl or concave hillside (lower figure), as discussed in the text. The concavity of the hill is not indicated in the figure.

under these conditions), the rotating thermal or whirlwind might remain dynamically stationary; otherwise, it would normally be carried along by the moving airstream (Figure 3a).

In both the Winchester and the Westbury events it does appear that the whirlwinds thus formed remained stationary during their brief life-times. The probable reason for this is of the greatest interest, as it is likely to be due to the extraordinary similarity between the geographical sites in the two cases. This is the feature that the two whirlwind sites were beneath and quite close to steep grass-covered chalk hillsides having a kind of punch-bowl or concave shape to them. The implied mechanism is that the air-mass which is being forced to retreat by the advancing air-mass is made to 'back up' against the concave hill-side so that the advancing frontal zone is temporarily brought to a halt in that region (Figure 3b). Any whirlwinds which happen to develop at this time appear to remain stationary with respect to their point of origin. It is noteworthy that the damage patterns seen in the photographs of Figure 1 appear to lie in the 'focal region' of the punch-bowl concavity. Possibly, moreover, after the life and death of the first whirlwind, the frontal boundary twice advanced some 25 metres before halting and permitting the thermal to re-establish itself as a new whirlwind. We infer that the three damage patterns lay close to one another, not because of chance coincidence, but because of the special position of their site relative to the adjacent hill.

Finally, we should mention the more obvious alternative explanation, that whirlwinds can appear below and close to hills, escarpments and cliffs by virtue of some kind of eddy-like effect causing a pre-existing thermal to rotate. In most such cases, the newly-born whirlwind will become a travelling one, as many country

observers will have seen; but it is possible that if the topography is right, with a suitably-shaped concavity in the hillside and a critical wind direction and strength, a stationary whirlwind might arise. We certainly urge all weather observers, when they are out in the country, to be prepared to look for evidence of such phenomena.

Acknowledgment: We wish to record our thanks to Mr. Ian Mrzyglod of Ashton, Bristol, for drawing our attention to these reports and for sending us the photographs. He has also published a report in *Probe*.

TEMPERATURES IN CENTRAL ENGLAND AND THE NETHERLANDS 1735-1981: Part 3, March

By DONALD J. HATCH
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Abstract: The series of mean temperatures for Central England and De Bilt are compared over the period 1735-1981 in separate monthly articles of which this is the third. Period and moving averages are analysed, and the predictive value of individual months for subsequent months is assessed by examining the data arranged by temperature quintile. An introduction and references were given in the first article of the series.

Over the period 1735-1980 the mean temperature in March was 5.3 °C in Central England (CE) and 4.5° at De Bilt (DB). The difference is only half as great

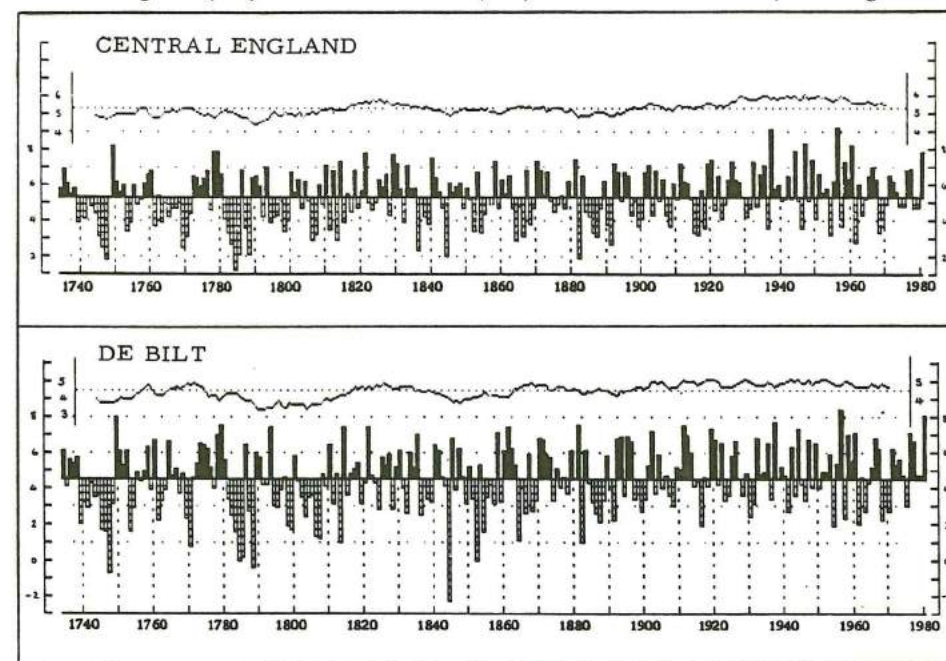


Fig.1. Mean temperatures in Central England and De Bilt, Netherlands 1735-1981.

as in February, and reflects the faster spring warming in continental Europe than in Central England. The variations around the mean are, as in January and February, greater at De Bilt than in Central England, with six occasions in the Netherlands of a monthly mean close to or below 0°. The absence of very cold Marches since 1900 is noteworthy.

Fig. 1 illustrates the run of monthly mean temperatures for CE and DB for the period 1735-1981, and the trend of the 20-year moving average (centred). Both are related to the means over the complete period.

Table 1 gives the means over consecutive periods of 30 years and indicates the extreme months for both CE and DB.

Table 1: Mean temperatures in Central England and at De Bilt, Netherlands.

	Central England	De Bilt	CE-DB
1741-1770	4.8	4.0	0.8
1771-1800	4.9	4.0	0.9
1801-1830	5.5	4.3	1.2
1831-1860	5.2	4.1	1.1
1861-1890	5.1	4.6	0.5
1891-1920	5.3	4.8	0.5
1921-1950	5.9	4.9	1.0
1951-1980	5.6	4.8	0.8
1735-1980	5.3	4.5	0.8
Coldest	1.2 1785	-2.3 1845	
Mildest	9.2 1957	8.4 1957	

For both CE and DB the 246 individual months 1735-1980 were allocated to quintiles, indicating their degree of relative mildness (Q5) or coldness (Q1). For example, quintile 5 Marches in CE are those with a temperature at least 1.4 degrees above the mean, i.e. 6.7 or more. The limits for the quintiles are given in Table 2.

Table 2: Quintile limits of mean temperature in Central England and De Bilt.

Quintile	Central England	De Bilt
1 Very cold	3.9 or below	2.9 or below
2 Cold	4.0 to 4.9	3.0 to 4.0
3 Average	5.0 to 5.8	4.1 to 5.0
4 Mild	5.9 to 6.6	5.1 to 6.1
5 Very mild	6.7 or above	6.2 or above

Division of the 246 months into quintiles makes possible the examination of the degree of predictive value for months following Marches in given quintiles. If, for example, there is no predictive value at all, the Marches of each quintile would be followed by Aprils randomly distributed over all the quintiles, i.e. a very cold March (Q1) would be as likely to be followed by a very mild April (Q5) as by a very cold April (Q1).

Fig. 2 illustrates for both CE and DB, for each March quintile, the distribution by quintile of all the Aprils, Mays and Junes following. For example, the 49 Aprils which followed Q1 (very cold) Marches in CE were distributed as follows: Q1 16 (33%), Q2 9 (18%), Q3 8 (16%), Q4 5 (10%), and Q5 11 (22%). The shading in the figure illustrates the percentages ranked into 5 groups.

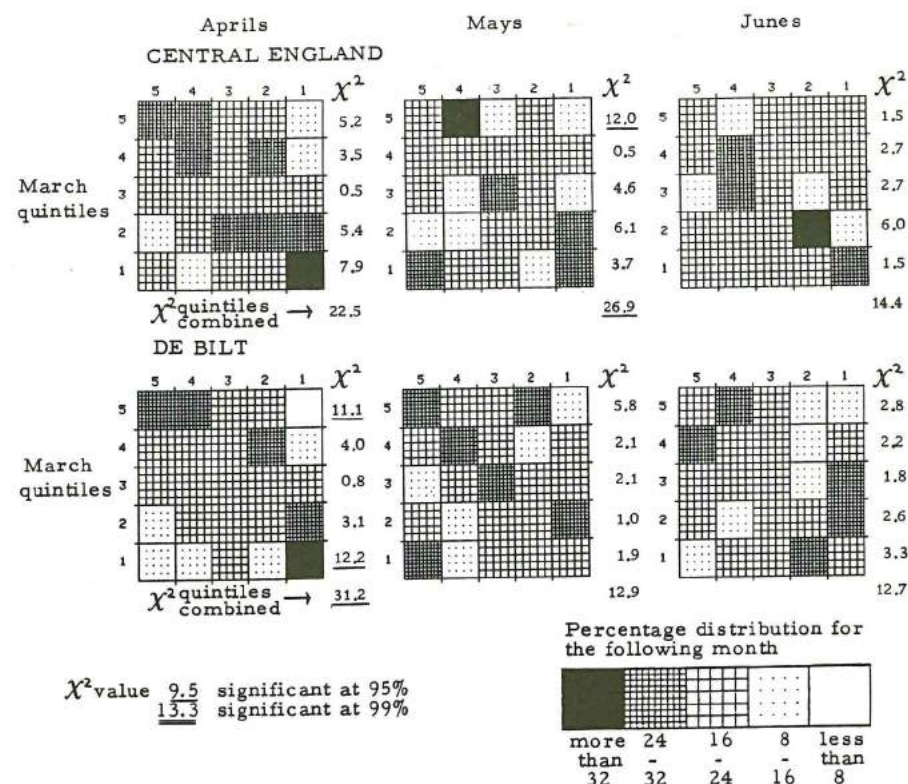


Fig. 2. Distribution by quintiles of the months following Marches of a given quintile.

The chi-square test is used to establish whether such a distribution differs significantly from the 20% which would be expected by chance. When the chi-square value exceeds 9.4, the distribution of the following months is significantly different from random at the 95% level of confidence: if chi-square exceeds 13.2 the level of confidence rises to 99%. Even when the chi-square values for the individual quintiles are not significant, it may be that the overall value for the complete distribution of all the following months may be significant; the limits for the chi-square values are then 26.3 and 32.0 at the 95 and 99% levels of confidence respectively.

Persistence of cold, or mild, Marches into the subsequent Aprils is apparent, but to a considerably lesser extent than was the case for February persistence into March. Only at De Bilt are the results significant at the 5% level. For Central England there seems to be a significant correlation between extreme Marches and the Mays following, with 59% of the Mays following very mild Marches being warm or very warm. The degree of correlation between March temperature and that of the June following is, however, negligible.

The compilations and graphs in this series of articles have been prepared using the HP 85 Personal Computer.

THE WEATHER AT DANGAR ISLAND, NEW SOUTH WALES, AUSTRALIA: Part 2

By ALAN TURNER

This is the second of a series of three articles about the weather and climate of Dangar Island on the eastern coast of Australia, 40 km north of Sydney. In part 1 (*J. Meteorology*, vol. 6, pp. 318-320), an introduction was followed by a summary of the weather for the winter of 1981 (June to August). The present article concerns the spring weather, September to November 1981, and the third article will treat the summer weather, December 1981 to February 1982. Together, these articles will give readers an impression of what the weather is like in the subtropical rain climate where I live.

INTRODUCTION

The weather of Spring 1981 (September to November) could perhaps best be described as 'not average'. Until October 10th it was almost rainless (only 4 mm) and persistently warm and sunny, after which it was exactly the opposite, being persistently cool and extremely wet (almost 500 mm). The resulting transformation in the landscape was almost incredible, from parched and arid to subtropical lushness.

September. After a cold, wintry end to August (maximum on August 31st only 11 °C), the weather quite suddenly warmed up under the influence of an intense anticyclone moving slowly east across New South Wales. This is illustrated by the maxima for 5th-9th which were 17, 21, 25, 27 and 31 °C. Thereafter a succession of highs moved slowly across, punctuated by cooler southerlies; as one high moved out into the Tasman Sea, the next moved in. A weak upper trough gave the only dull day on 19th, whereas on 26th-27th an intense low moved north-eastwards from the usual more southerly track into the southern Tasman Sea, giving a wild day on 27th with gusts to force 11. As the month ended, it became very warm as an anticyclone became established over the region.

October. The month began under the same regime as September with highs moving slowly across, except that their centres were often to the east or north-east giving very warm N.W. winds. Our hottest day of the Spring occurred on 2nd with 33 °C and the following night had an amazing minimum of 24.4, four degrees higher than the previous warmest October night minimum and warmer than any minimum recorded apart from a couple in January and February (records only go back to August 1973 though). Thereafter, there was a week of almost unbroken sunshine and the usual warning after the southerly change on 3rd, culminating on 9th with a 32° maximum.

On 10th a fundamental change set in which was to last till the end of November. A persistent trough developed and extended S.S.E. from Queensland into N.S.W. and this was an almost unbroken feature of the daily surface pressure maps after that date. The track of the highs was now altered to south-east from the Bight down across, or even south of Tasmania. At first there were only moderate amounts of rain but an upper-air disturbance moved slowly across on 17th-19th and we got a real drenching with 163 mm in the three days. On 18th we also had

our second coldest October day with a maximum of 14 °C. Towards the end of the month there was a brief settled interlude when a more 'aggressive' high managed to get through to just off the coast and we had 30° on 28th, but the rain had started again before the month's end.

November. An upper air low gave us another instalment of heavy rain to start the month: 94 mm on 1st and 2nd, with both days sunless. Thereafter there were lighter falls but usually at least some on most days. It also became very cool as the trough over eastern Australia extended right out into the ocean to link up with a deep and almost stationary low to the N.W. of New Zealand. There were a few sunny interludes, however, when highs managed to extend their influence briefly in our direction – notably on 10th-11th and 17th-18th. On the morning of the 17th we had our lowest November minimum of 9.7 °C, the only one with less than 10°. Despite a cloudless day and very intense unbroken sunshine, the temperature could only reach 19 °C that day, while the next night was almost as cold. There was some heavy rain with thundery showers on 21st-22nd with a very unstable S.E. airflow, giving us nearly 70 mm on the two days and again on 25th with 20 mm. Finally, it became drier in the last few days as the persistent trough showed signs of breaking down but it still remained cool, although the night minimum had been rising with 19 °C on 29th.

The table below presents a summary of the Spring weather (averages are over 9 years 1973-1981 inclusive).

	DAILY MAXIMUM			DAILY MINIMUM			RAIN mm	SUN hours
	High	Mean	Diff.	Low	Mean	Diff.		
SEPT.	31	23.1	+1.9	7	11.8	0.0	4	251
OCT.	33	23.4	+0.4	10	14.7	+0.8	239	206
NOV.	29	22.8	-2.2	10	15.3	-0.7	238	184

CONCLUSION

The table illustrates the complete turnaround in the weather between the first and second half of Spring. September was the second warmest and the driest of the 9-year period. October was the wettest, but otherwise near average as the warm dry start counterbalanced the cool wet second half. November was bad in every respect, being the wettest, dullest and coolest of the record, as well as having the lowest extreme maximum and minimum temperatures.

FALL OF A COFFEE-CONTAMINATED ICE LUMP AT ANERLEY, LONDON

By E. W. CREW

26 St. David's Drive, Broxbourne, Hertfordshire.

A lump of ice about 0.71 kg in weight crashed through the roof of the house of Philip and Kay Wells, 21 Stembridge Road, Anerley, London SE20, at 1980 BST on 23 June 1981 and another piece, about 0.05 kg in weight, broke off and landed

in their garden. The ice was slightly discoloured by a brown substance with the smell and taste of coffee. An investigation by the Civil Aviation Authority identified an overflying aircraft at the time (Rome to Heathrow), in which there had been a fault in the gallery waste disposal system. The airline concerned has paid compensation for the damage to the house, so there is no doubt that the ice was produced by liquid ejected from an aircraft. The ice was not analysed chemically as Mr. Webb was told by the Public Analyst that it would cost £100 and the ice almost certainly consisted of 99% water. Mr Wells stated (private correspondence, 6 September 1981) that the ice appeared to him to be layered, but his wife described it as globular and gnarled, rather than layered. He also stated that the sky was dull and overcast at the time and none of his family heard the plane.

Several aspects of this incident are likely to be of interest to meteorologists. A report about it in a national newspaper¹ quoted a CAA spokesman explaining that "passenger aircraft have an atomiser which reduces waste liquids in the galley to a fine mist. This is let out into the atmosphere and there are no restrictions on where this is done as it just virtually disappears into the air. In certain weather conditions it is possible for this fine mist to form into ice on the way down." This statement implies a process in which a moving column of drops of water freeze and the ice particles at the head of the column are slowed by air resistance, causing the following particles to impact together into a solid lump. This is similar to the process I suggested had occurred when an ice lump fell some minutes after a single violent stroke of lightning², except that I thought it more likely that the freezing and impacting of ice formed by the water trapped in the filamentary lightning channel would have taken place on the ascending, rather than the descending, part of the trajectory. I therefore wrote to the CAA to ask if they could provide scientific evidence or details of calculations supporting this statement. They did not comment on my query about the views attributed to their spokesman, but stated (private letter dated 9 November 1981): "The ice involved was formed from galley water which is normally ejected from the aircraft through heated nozzles. However it would seem that, on this occasion, the heater failed which under certain circumstances can lead to a build-up of ice around the nozzle. As the size of the build-up increases, so does the drag force actions upon it and this will eventually pull the ice away from the aircraft."

This explanation seems more likely than the published statement, otherwise there would presumably be far more frequent instances of the fall of ice due to liquid mist ejected from aircraft. It also indicates the advisability of automatically sealing liquid exits from aircraft unless the heater system or an alternative disposal system is in operation. No comments were made by the airline involved in reply to my enquiries about the nature of the fault.

The meteorological process for the formation of a large lump of cloud-water ice, described in my paper², is not, in my view, made more unlikely by the findings of this Anerley incident.

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1. *The Sunday Express*, 19 July 1981, p.15 (report by Brendon Mulholland).
2. CREW, E.W. (1981): Fall of a large ice lump after a violent stroke of lightning. *J. Meteorology*, U.K. 6. 43-44.

TORNADO AT MARLBOROUGH, WILTSHIRE, ON 26 AUGUST 1853

The account that follows was found by Mr. Christopher Chatfield, of Marden, Kent, in *The Times (London)* dated Thursday, 1 September 1853. The tornado is of historic interest because it passed through the grounds of Marlborough College narrowly missing the 'domestic apartments' although damaging the well-built chapel.

About half past 5 o'clock on Friday morning, our town and neighbourhood were visited by a most terrific and destructive hurricane, or whirlwind, preceded and accompanied by violent rains, and leaving ruinous desolation in its wake. The storm, which blew S. by W., lasted about five minutes only. The destruction commenced at Oare, a village a few miles distant. The mail-cart was passing at the time, and the driver had a narrow escape, the trees falling on every side, indeed, to use his own words, "all at once the oaks and elms flew in all directions like bits of stick." At Cranham-farm, the residence of Mr. Hillier, two large trees near the house and many others on the farm were prostrated; a large barn was completely turned over and smashed to atoms; and several trees in Mr. Maurice's meadow, adjoining the river, were completely uprooted. At the college the storm met the most resistance, and consequently did the most damage. Every one acquainted with this place well knows that old and favourite spot named the "Wilderness" hitherto containing an extensive rookery, but now rendered literally a wilderness. Indeed, between 20 and 30 noble trees have been torn from the resting-place of centuries; some snapped off like a sapling, others with full six feet of earth attached to them. Twenty-three rooks were found dead on the ground. Nearly 300 panes of glass were broken in the east window of the chapel; the lead on the roof was turned up, and, had it not been for the ornamental iron-work on the top, it is conjectured that the roof itself would have been carried off. A high wall facing the Bath Road, forming part of the fives-courts, is levelled with the ground, and the iron railings, with the solid masonry at the bottom, are entirely torn up, as though by some mighty giant hand. The roof of the covered playground is riddled, scarcely a tile remaining firm. Providentially the domestic apartments escaped without any injury. The damage done to the college alone is roughly estimated at from £200 to £300. In the extensive and picturesque meadow opposite, used as a playground, the scene defies description, the majestic elms lying prostrate in the wildest confusion, and the whole ground being strewn with leaves and branches. At the Bridewell the family of Mr. Alexander had an almost miraculous escape, the chimney falling through into a double-bedded room, where four children were sleeping. At St. Peter's Church, a portion of lead was taken off the roof, and laid in the churchyard. St. Peter's schools which are in course of erection, were disastrously visited; one of the cables, with the roof, is quite destroyed, and the other cable so much shaken as to require rebuilding. The house adjoining, occupied by Mr. Leader, was damaged so much as to require the immediate removal of the inmates. The fury of the storm appeared to confine itself principally to the lower part of the town. In the meadows at the top of Kingsbury-street, belonging to Mr. T. Merriman, which contained several magnificent elms, now

much torn, the scene is described by an eye-witness as "a raging storm of leaves and boughs." At the Union we are informed that, in addition to the other damage, about 100 panes of glass have been broken. A large tree was blown across the road, breaking down in its descent a portion of the Union wall. The violence of the storm appears to have extended not more than 400 yards in width, and it seems scarcely credible that such a tornado should have come and gone without the slightest casualty to life and limb.

TORRO THUNDERSTORM REPORT: July and August 1981

By KEITH O. MORTIMORE

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July was less thundery than normal with thunder somewhere in Great Britain and Eire on 15 days, compared with the normal of 21. But, although there was a deficiency of thunder days, some quite severe outbreaks occurred during the month. Many western and northern areas of Britain were completely thunder-free but in south-eastern counties four or five days were reported quite widely.

Thundery showers developed in parts of southern Scotland during the afternoon of 1st and in north-east Scotland around midnight, while on the following day there were thundery showers in Northern Ireland and on Merseyside. With a cold upper trough over the U.K. showers developed widely on 3rd and there were thunderstorms in many central and eastern areas of England in the afternoon. A house was damaged by lightning at Hagley, West Midlands. Around mid-afternoon on 5th there was an isolated report of thunder to the south of Glasgow. The 8th was sunny and very warm in central and eastern areas of Great Britain but conditions turned thundery later and after an afternoon storm on Humberside, further storms broke out in the south-east Midlands in the evening and moved north through the east Midlands to Yorkshire by the end of the evening. There was also an early evening storm at Jersey in the Channel Islands and by midnight further outbreaks moved north into southern coastal areas of England from Dorset to Sussex. On 9th scattered storms moving north from France joined forces with locally-developed outbreaks to affect many central-southern, central, and eastern areas of England. Severe storms were reported widely with intense rainfall and local flooding. Central London was particularly badly hit with 58 mm of rain and hail falling at the London Weather Centre in 50 minutes. Other heavy falls included 19 mm in 20 minutes at Chelmsford, 54 mm in one hour at Bury St. Edmunds and 80 mm in 70 minutes at Littleover in Derbyshire. At Yeovil in Somerset a 20-year-old Wren was killed by lightning and at Norwich a man was injured while picking strawberries. Among reports of lightning damage, houses were hit at Bath, Compton Dando, near Bristol, and various parts of the Derby area. Later in the day a cold front brought clearer, fresher conditions to all areas from the west. On 11th, as a cold front moved east across England, there was some heavy thundery rain in East Anglia and in Scotland a severe storm hit the Glasgow area in the evening. 40 mm fell at the Glasgow

Weather Centre in two-and-a-half hours, of which 18 mm fell in 15 minutes at one time. There was thunder at Galway in western Eire late on 15th.

Storms occurred more widely again on 16th, developing on a cold front as it crossed eastern and south-eastern areas of England. Heavy rain fell in places and a severe storm in the Southend area produced 1 cm diameter hailstones and reduced visibility to around 300 metres for a time. During a storm at Wadhurst, near Tunbridge Wells, 36 mm of rain fell in about 40 minutes. Showers developed over much of Great Britain on 17th and a few turned thundery in parts of southern Scotland, northern England, and locally in the east and south. Parts of Kent and Sussex had thundery showers again on afternoon of 18th. Following the passage of a cold front on 21st temperatures rose rapidly in south-east England in the afternoon. Showers developed locally and there were some thunderstorms over and to the east and south-east of London. Greenwich recorded 12 mm in 15 minutes and heavy rain also fell in other storms. Parts of East Anglia had thunderstorms during the early hours of 22nd while in the afternoon further storms broke out, mostly to the south-east of a line from Portland Bill to the Humber. A similar of England was again affected by thunderstorms and heavy rain during the afternoon of 23rd and a tornado caused some damage to Cove near Farnborough. During the afternoon of 24th scattered thundery outbreaks affected east Norfolk. A trough moving north from France spread widespread thunderstorms to south-west and central-southern England during the morning of 31st, and after a brief respite, further storms spread north to central-southern and south-eastern counties in the evening with heavy rain in places.

On the continent there was thunder in Belgium on 9th, 10th, 15th, 17th, 18th, 22nd, 23rd, 25th and 31st, just below the normal of 11 days. Denmark had thunder on 3rd, 6th, 12th and 16th, Netherlands on 9th-11th, 16th, 18th, 24th and 25th, Norway (Dønski) on 4th, 12th, 22nd and 24th, Sweden (Valla) on 12th, 25th, 26th and 28th, and in West Germany on 3rd, 10th, 11th, 13th, 16th, 17th and 22nd-25th.

August was much less thundery than July, thunder being recorded on only five days in Great Britain and Eire, 1st, 5th, 6th, 29th and 30th, compared with the normal of 19. There was no thunder in Scotland and only the occasional scattered storm in Ireland and western counties of England and Wales. Away from the west there were thunderstorms widely on one day and on two days in central and northern areas.

Some central-southern and south-eastern counties of England had thundery rain during the early hours of 1st but, although dying out by dawn, there were further outbreaks in the Isle of Wight for a while during the morning. On 5th, a very weak cold front moving slowly south-east across England and Wales, suddenly re-activated towards evening and showers and thunderstorms moved north-east across south-west England and the Midlands, and, later in the evening and early hours of 6th, across parts of Wales and northern England. Thunderstorms were heavy in places, particularly in the Manchester area where 96 mm fell at Ringway Airport in 11 hours of which 44 mm fell in one hour. Storms continued to affect a broad band of the country from Devon through south-east Wales and the Midlands to Lincolnshire early on 6th, and during the

day these were reinforced by further thunderstorms moving north-east across much of southern and eastern England. Severe storms were widespread, many with hail, and rainfall totals exceeded 25 mm over a wide area. During the midday and early afternoon storms in south-eastern counties it became as 'dark as night' and there was considerable, quite violent, lightning. Heavy rain and local thunderstorms continued in some central and eastern areas until late in the day and 24-hour rainfall totals to 2100 GMT included 113 mm at Ringway, 59 mm at Bingley, 60 mm at Worthing, and 59 mm at Gatwick. Lightning damage and flooding was reported in places. After a long, thunder-free spell there were scattered thunderstorms in north Wales during the evening of 29th and early hours of 30th, and the Merseyside area was affected for a while around, or soon after, dawn. Further scattered storms broke out over north Wales in the afternoon and there was also a storm at Galway in Eire.

On the continent there was thunder in Belgium on 1st, 2nd, 5th-7th and 20th, the normal being 12. Denmark reported storms on 16th and 22nd, Netherlands on 1st, 8th, 9th, 16th, 22nd and 23rd, Norway (Dønski) on 22nd, Sweden (Valla) on 8th and 26th, and West Germany on 1st-4th, 6th-9th, 16th, 22nd and 31st.

WORLD-WIDE WEATHER DISASTERS: November 1981

- 1-2: Cyclone from Arabian Sea hit west Indian coastal states of Saurashtra and Gujjarat, uprooting thousands of trees, hundreds of power and telephone poles demolished, many buildings unroofed and weaker structures demolished, several ships sunk off coast. Cyclone had wind speeds of 120 km/h, with heavy rains and high seas, 12 dead. *Lloyds List*.
- 1-3: Severe gales in many areas of Poland caused what official said was the worst damage in such a short period since World War II; in Warsaw 1,000 trees uprooted, 200 roofs on residential blocks in city destroyed or damaged, many windows and shopfronts also damaged, at least 2 dead. *L.L.*
- 5-6: Hurricane "Katrina" hit Cayman Islands and Cuba with high winds and heavy rains, in and around Santa Cruz del Sur area, Cuba, 3,000 people evacuated because of floods, some crops damaged, 2 dead in accidents related to storm in Cuba. *L.L.*
- 5 (reported): Floods in city of Jogjakarta, 420 km east of Jakarta, Indonesia, destroyed or damaged 500 homes, leaving 6,000 homeless, no casualties. *Birmingham Evening Mail*.
- 7: Floods, touched off by monsoon rains, swept through Lucena, 98 km south-east of Manila, Philippines, leaving 14 dead; houses and a pontoon bridge swept away. *International Herald Tribune*.
- 7 (reported): Drought has cut Argentina's wheat crop. *I.H.T.*
- 9: Heavy rains and snow in Greece and Yugoslavia, in Greece, temperatures fell to -7°C and in traffic accidents due to snow in Yugoslavia at least 27 died, including 8 when bus left snow covered road and fell down ravine at Pec, 20 others injured. *Daily Telegraph*.
- 9: Mv. *Emerald* sank in storm some 40 km north-east of Qatar Peninsula, Persian Gulf, leaving 9 dead. *L.L.*

- 10: Fierce storm along southern Crimean coast caused widespread damage to homes, factories and farms, a 5,000 tonne cargo ship thrown ashore at port of Eupatoria, no deaths. *L.L.*
- 12: Snow and rain over wide areas of Turkey. *L.L.*
- 12 (reported): Heavy snowfalls over past few days in Bulgaria, power cut off to 673 towns and villages, water cut to 320 settlements, at least one person died in snow-related accidents. *I.H.T.*
- 12 (reported): Severe storms and hail in Western Australia, millions of \$Aus-worth of damage to wheat crops, also losses to stock and farm buildings and machinery reported. *L.L.*
- 13 (reported): Severe drought in Morocco, described as most devastating on record, 50% of grain crop lost. *I.H.T.*
- 14: Fv. *Aldebaran* sank 64 km off La Coruna, Spain, in heavy seas, leaving five dead. *I.H.T.*
- 14-15: Windstorm hit California, Washington, Oregon, and Idaho, U.S.A.; considerable property damage in Oregon and western Washington, five dead in Oregon. *L.L.*
- 16 (reported): Heavy rains and floods in past week in Minas Gerais state, central Brazil, leaving 16 dead and 4,500 homeless. *L.L., I.H.T.*
- 18: M.fv. *Tornado* sank in gale and rough seas 10 km north of Pendeen, Cornwall, leaving 5 dead. *L.L.*
- 18: Heavy rains touched off widespread floods in North Wales, many roads blocked, no casualties. *B.E.M.*
- 19 (reported): Severe drought in Spain, described as worst this century, crop losses put at \$1 billion, many reservoirs down to record low levels, water shortages in many areas. *I.H.T.*
- 20: Tropical storm "Hazen" crossed Phillippines south of Manila and headed out over the South China Sea; two injured in Quezon Province; on Marindique island trees and power lines uprooted and 2,000 made homeless. *L.L.*
- 20: High winds, with gusts up to 130 km/h, hit Ulster, Scotland and northern England; two people seriously injured in Belfast when wall blew down, and in Greenock, near Glasgow, when a shipyard crane blew down, no casualties. *D.T.*
- 21: Mv. *Hammerholm* sank in North Sea off Danish/Norwegian coast in heavy weather, leaving five dead. *L.L.*
- 21: M.tank *Globe Asimi* grounded in gale force winds and heavy seas at Klaipeda, Baltic Sea coast of U.S.S.R., spilling thousands of tons of oil into sea, no casualties. *L.L.*
- 21: Blizzards swept across mid-west of U.S.A., leaving 15 dead, scores injured and millions of dollars-worth of damage, storm described as worst in mid-west for 41 years, storm piled up 350 mm of snow in areas; meanwhile, in Atlanta, Georgia, a tornado hit the international airport, damaging 24 planes and injuring five. *Sunday Express*.
- 23-24: Typhoon "Irma" hit five provinces on Luzon Island, Philippines, with winds up to 210 km/h, torrential rains, floods and a storm surge, winds blew down houses, power and communication lines and caused widespread crop damage, at least 408 dead, with thousands homeless. The storm wave hit towns of Benagaspasan and Garchitorena in Camarines Sur Province, 187 died in

storm wave. *L.L.*

23-25: Severe gales in North Sea and Northern Europe; details below.

North Sea. Two oil rigs broke free and drifted for several hours, non-essential crew air-lifted off, no casualties.

Great Britain. Winds gusted to 121 km/h at Wittering near Peterborough, widespread moderate damage throughout the country; over 70 known tornadoes, including ones at Hull, Holyhead (N. Wales), and Pelsall, West Midlands; no casualties on mainland, but three men swept off trawler, the *Clarkwood*, off Fair Isle, were drowned; all above on 23rd.

Denmark. Port area of Esbjerg flooded from 1000 to 1700 hrs. Nov. 24th, water level reached 4.90 metres above normal zero. Coastal areas of Jutland evacuated as high seas and tides smashed coastal dykes, power cut off over wide areas, one dead when f.v. *Sorstrand* sank off island of Sult, 1,200 people driven from homes in coastal areas.

Sweden. Widespread flooding in port of Gothenburg where water reached nearly one metre deep; also in port, sailor killed by wind-whipped marine cable; widespread power cuts when the Barseback nuclear reactor shut down after ventilators in the outside wall of a reactor were blown in. At least ten injured in storms which hit on 24th.

West Germany. Winds gusted to 110 km/h along Baltic and North Sea coasts, high tides flooded parts of Hamburg causing millions of £'s worth of damage in port area, floods up to 6 metres deep, storms and tides, which hit on 24th, described as worst since 1976.

East Germany. Severe storms closed ports along Baltic coast. *L.L., D.T.*

26: Storm in Atlantic around Bermuda, winds up to 160 km/h, the m. general-cargo container vessel *Elma Tres* *L.L.*

29: Mv. *Naros* ran into gale-force winds and heavy seas off Dutch coast, ship began to sink, one dead, five rescued. *L.L.*

29-1 Dec.: Heavy rains and floods in Izmir area of Turkey, power lines cut, roads closed and property extensively damaged; in a 24-hour period which ended sometime on 1 December, 74 kg per square metre of rainfall fell. *L.L.*

30: Coal-carrier *Shokai Maru* sank in rough seas 20 km north-east of Okushin Island, off Hokkaido, north Japan, leaving 9 dead and 6 missing. *L.L., B.E.M.*

WORLD-WIDE WEATHER DISASTERS: December 1981

1: Hundreds of villages isolated by snow in eastern Turkey, flash floods in Izmir and Istanbul. *International Herald Tribune.*

1: Mv. *Yusei Maru No.12*, sank in high winds and heavy seas 4 km north-west of Yomitan, Ryuky Islands; 1 dead. *Lloyds List.*

1: Fishing vessel and lifeboat sank in stormy seas outside Hirtshals port, Jutland, Denmark, leaving nine dead, six of them from lifeboat. *L.L.*

1-6: High winds and torrential rains in north-east Malaysia caused widespread floods which left 14 dead, 300 injured and 4,500 homeless, extensive damage to roads and railways. *L.L.*

1-6: Storms, floods and landslides in five southern provinces of Thailand, left at

least 55 dead. Crops and homes worth U.S.\$13 million were destroyed together with roads, bridges and railways. In Gulf of Thailand waves up to 10 metres high reported, some 24 trawlers sank, also a 2,000 tonne cargo vessel, at least 19 dead. *L.L.*

2: Mv. *Crystal Star* battered by heavy weather in lat 18°28N, long 125°10E, crew abandoned ship, one died. *L.L.*

2-14: Torrential rains and mudslides in Rio De Janeiro state, Brazil, worst hit cities being Petropolis and Teresopolis; two particular periods of heavy rain, one on 2nd/3rd left 46 dead, 23 injured and 1,250 homeless, and one on 12th/13th when 24 died in Petropolis, with 3,000 homeless; total dead over whole period is in excess of 80. *L.L.*

4: Heavy rains, floods in northern Sri Lanka left 7 dead, 22,000 homeless and 50% destruction of crops. *Daily Telegraph.*

6: Torrential rain fell on Moroccan coastal plains between Casablanca and Tangier, breaking one of worst droughts this century. *D.T.*

6: Landslide triggered by heavy rain left 17 dead, 25 missing in small village in Java, Indonesia. *Birmingham Evening Mail.*

6-7: Snowstorm in New England, U.S.A., 25 cm of snow fell in Boston, Massachusetts, up to 60 cm of snow in other areas, many traffic accidents, at least 8 indirect deaths in storm. *D.T., I.H.T.*

7: Refugee boat capsized in stormy seas in South China Sea near Tumpu 320 km north-east of Kuala Lumpur, Malaysia, leaving 19 dead. *D.T.*

8: Mudslide, touched off by 10 days of heavy rains, buried eight houses in village of Joho, East Java, Indonesia, leaving 22 dead, 19 missing. *D.T.*

8-31: Severe weather in many areas of United Kingdom, with snow, cold, gales and floods, main highlights described briefly below:

8th Heavy snowfall over many areas of country disrupted road, rail, air transportation, worst snow from north Midlands southwards.

11th More heavy snowfalls in many areas, severe frost in Scotland on evening of 10th/11th.

13th Mv. *Bonita* sank in storm in English Channel: 2 dead.

Fv. *Orlando* sank in rough seas in mouth of Newhaven harbour, Cornwall: 1 dead.

Gale-force winds, blizzards, tidal floods in southern areas of England as far north as Midlands, tidal floods in east Kent, Hampshire and Sussex coasts, severe coastal floods in Avon and Somerset, widespread power cuts and transport disrupted.

14th Floods, snow, sleet in many areas of nation.

15th Coaster *Grainville* sank in storm off S.E. Ireland, 3 dead.

18th Severe frost in many areas, with new snowfalls.

19th Fierce gale in Cornwall, Penlee lifeboat lost, along with coaster *Union Star*, 16 dead, snow in northern areas of England and into Scotland.

20th Gusts of wind blew down wall in Notting Hill, London, leaving nine-year-old girl dead and mother injured.

21st Snow again in many areas of country, especially in south-east.

26th Thaw started in some areas. Fog covered over 20 counties.

27th Heavy snow in many areas of country.

- 28th Thaw commenced, floods in Midlands.
 29th-31st Widespread floods along Avon, Severn and other rivers in Midlands, fog also in many areas. *Various*.
- 9: Violent snowstorms with winds reaching 150 km/h ripped down power lines and trees, tore off roofs and blocked roads in Switzerland. *I.H.T.*
- 9 (reported): Heavy snow in Chanthang area of Ladakh, east Kashmir, 25 missing. *D.T.*
- 10-12: Cyclone in Bay of Bengal hit Bangladesh and West Bengal, Orissa states in India, winds gusted to 145 km/h with high seas along coastal areas.
Bangladesh: Trees and power lines brought down, seven dead.
Orissa, West Bengal: 85 dead, waves up to 2.75 metres high hit coast, widespread damage. *L.L., D.T.*
- 11: Snowstorm in upstate New York, U.S.A., with up to 60 cm of snow, at least 3 indirect traffic deaths. *I.H.T.*
- 11: Mv. *Bratstvo* sank in storm off Tunisia, 9 dead. *L.L.*
- 12-18: Monsoon rains in Malaysia and Singapore, serious floods in Trengganu state and Johore state, hundreds homeless, roads cut, floods up to 2.2 metres deep in Johore. *L.L.*
- 12-31: Torrential rains and melting snow caused widespread floods in south-west and eastern France, 1 dead near Bourg-en-Bresse, Burgundy, on 24th in floods. Rivers Saone, Garonne and Seine in flood, thousands of hectares of farmland flooded, thousands of farm livestock drowned, roads closed by floods. *L.L., Sunday Telegraph.*
- 13: Blizzards in Eire, one death from exposure in Wicklow mountains, Co. Wicklow, and a farmer found dead near Dundalk, Co. Lough, when local floods subsided. *D.T.*
- 14 (reported): Forest fires in northern Corsica destroyed 3,000 hectares of forest, fires whipped along by winds of 130 km/h. *I.H.T.*
- 14: Violent tornado and hailstorm in area of Sarandi del Yi, Durazno department, central Uruguay, caused considerable damage, but no casualties. *L.L.*
- 14-16: Heavy snow and avalanches in western Swiss Alps, many valleys and villages cut off, avalanches on 16th left 2 dead, avalanche on same day derailed train near Zermatt, injuring several people. *D.T., I.H.T.*
- 14-16: Heavy rain and floods in western Turkey, floods stretched from Aegean Sea coast to the southern Antalya province on Mediterranean coast, highways cut and bridges washed away, at least 7 dead and 4 missing. Floods also in eastern Anatolia provinces, in Erzurum, east Turkey, gale force winds uprooted street kiosks, roof tiles and shop fixtures, injuring at least 30 people. *L.L.*
- 18: Heavy snowfall in Swiss Alps, cut off 20,000 people in resort of Vervier, Geneva airport closed. *D.T.*
- 20: Mv. *Sing Yong* sank in bad weather about 150 km east of Singapore, near island of Pengibu, 1 dead. *L.L.*
- 22: High tide, reaching height of 1.4 metres, swamped centre of Venice, Italy. *D.T.*
- 23: Thick fog and icy road surfaces caused many accidents on highways in north Italy, 5 dead; many hurt. *D.T.*

- 25-28: Flash floods in Jakarta, Indonesia, left 9 dead, 100,000 homeless and widespread damage, floods up to 2.44 metres deep. *D.T.*
- 26-27: Typhoon "Lee" hit central Philippines with winds up to 166 km/h and flash floods; at least 156 dead, 129 missing and 1,586 injured, crop, property damage put at \$24.7 million, some 500,000 homeless. *L.L.*
- 26-30: Torrential rains and 105 km/h winds hit Spain, large areas flooded, rain broke two-year drought, many power pylons brought down by winds or minor landslips, blocking out wide areas of central and southern Spain. *L.L.*
- 26-31: Torrential rains, floods in Portugal, rains broke two-year drought, road, rail and telephone communications cut. Flash floods at Arosa, north-east Portugal, left at least 15 dead, total deaths in country totalled 30, widespread damage, winds gusting to 100 km/h closed ports; on 29th floating crane capsized in River Tagus, Lisbon, leaving one dead, 3 missing. *D.T., L.L.*
- 28: Heavy rain touched off landslide which buried five houses in village in West Java, Indonesia, left 13 dead, another landslide near town of Boor, injured two. *D.T.*
- 29-29: Heavy snow in northern Italy, up to 100 mm in Milano and Torino, but in high Alpine regions up to 250 mm fell, traffic disrupted in area. *I.H.T.*
- 29: Landslide of mud and rocks hit small town of Yanacocha, 195 km north-east of Lima, Peru, leaving 10 dead, 60 injured. *I.H.T.*
- 29: Mv. *Marina di Equa* sank in storm off north-west Spain; 30 dead. *L.L.*
- 31: Floods, caused by thunderstorm, almost destroyed town of Barbacoas, south-west Colombia, leaving 14 dead, scores missing; mostly wooden houses either washed away or burnt down in fire set off by lightning. *L.L.*
- 31 (reported): River Arno running high through Firenze, Italy, some flooding in Tuscany area of Italy. *I.H.T.*

ALBERT J. THOMAS

WORLD WEATHER REVIEW: October 1981

United States. *Temperature:* cold except S. Florida (+2 deg.) and very marginally in S. Texas; -2 deg. widespread; -3 deg. locally from Wisconsin to New England. *Rainfall:* most states wet; over 300% in N. California; E. Nevada to N. Utah; C. Montana; N. Minnesota; C. Texas to E. Oklahoma. Under 50% in N.W. Montana; N. Oregon; S.E. California to S.W. Arizona; S.E. Colorado to S. Nebraska; most of Florida; coastal N. Carolina.

Canada and Arctic. *Temperature:* warm in most of Alaska and N.W. Territories; N. Quebec; Labrador; N. Greenland; +4 deg. on Melville Peninsula. Cold in S. Canada; S.W. Alaska; S. Greenland; Iceland; -3 deg. round Great Lakes; -4 deg. in Iceland. *Rainfall:* wet in most of Canada; S. Alaska; locally in N. Iceland; over 200% from N. British Columbia to Melville Peninsula; S. Saskatchewan; Newfoundland. Dry in W. Alaska; S. British Columbia; Ontario to W. Quebec; Greenland; Iceland; Ellesmere Island and nearby islands. Under 50% in S. Iceland and S.W. of Ellesmere Island.

South and Central America. *Temperature:* warm round Buenos Aires; Nicaragua to most of Mexico; West Indies; rather warm in much of N. Brazil and

W. Venezuela. Cold in Andes at least 15° - 40° S; S.E. Brazil; W. Colombia; N.W. Mexico; -2° deg. in C. Bolivia, locally in N. Mexico. Rather cold in lower Amazon Basin. *Rainfall*: wet on parts of E. coast of Argentina; Bolivia; much of Brazil; most of the Guianas; N. coastal Colombia; much of W. coastal Mexico; N. Mexico near S.W. Texas border; round Mexico City. Over 200% in S. and E. Bolivia; S.C. Brazil; coast of Guianas; the three areas of Mexico given above. Dry in most of Argentina; Uruguay; Paraguay; extremes S., E. and N.W. Brazil; Colombia; Venezuela; N.W., N.E. and most of S. Mexico. Under 25% in C. and extreme W. Argentina; extreme S. Brazil; much of Paraguay and Uruguay; the three areas of Mexico given above.

Europe. *Temperature*: mostly warm: $+5^{\circ}$ deg. W. of N. Urals; $+2^{\circ}$ deg. in C. and S. Spain; Sicily; N.W. Yugoslavia; S. and E. Greece; Bulgaria; E. Romania; locally in Austria and Hungary; most of European Russia. Cold in British Isles; Norway; S. Sweden; Denmark; W. Poland; Germany; Low Countries; N. France; Switzerland; N.W. Italy; -3° deg. in Eire; -2° deg. in Low Countries; U.K.; N. Germany; E. Switzerland; N.W. Italy. *Rainfall*: a decidedly wet month; over 200% in N. Finland; S.W. Norway; C. and N.E. Sweden; parts of Denmark; Estonia; parts of Ukraine; W. Romania; a very large area from W. Poland and W. Czechoslovakia through S. Germany and N. Switzerland to Netherlands and N. France; over 300% at several stations in S. Germany. Dry only in N. Norway; near Urals; southern regions (most of Iberia; S. France; S. Italy; Hungary; much of Yugoslavia; S. Greece; Bulgaria; S. Romania). Under 25% in S. Italy; S. and E. Spain. Provisional sunspot number 161.

Africa. *Temperature*: warm N. of 10° N; Ghana; W. coast of Cape Province; $+3^{\circ}$ deg. N. Mauritania; $+2^{\circ}$ deg. Niger to N. Chad. Cold elsewhere, especially in S.; -2° deg. in interior South Africa; Mozambique; Zimbabwe; Botswana; much of Namibia; -4° deg. locally in N.E. South Africa. *Rainfall*: wet only very locally N. of Equator; round L. Victoria; Mozambique; most of Cape Province; over 200% in coastal Mozambique; over 500% in interior W. Cape Province. Dry N. of Sahara; most of area Senegal to Nigeria; S. South Africa; S.W. Cape Province; under 50% widespread in all these areas.

U.S.S.R. *Temperature*: warm, except 70° - 130° E; $+5^{\circ}$ deg. W. of N. Urals; $+3^{\circ}$ deg. N. of Sea of Okhotska; -5° deg. in lower Yenisey Basin. *Rainfall*: wet generally; over 200% in Estonia; parts of Ukraine; W. of Irkutsk; W. coast of Sea of Okhotsk; Sakhalin. Dry from near L. Baikal W.N.W. to N. Urals then S. in broad band to Aral Sea, the E. to L. Balkhash and W. to Sea of Azov; also E. of Lena Basin. Under 25% in most of Kazakhstan.

Middle and Far East. *Temperature*: warm from Turkey to most of Saudi Arabia; Bangladesh; Burma; S.E. Asia; Borneo; few areas more than $+1^{\circ}$ deg. Cold round Persian Gulf through Afghanistan and Pakistan to virtually all China and Mongolia; interior W. India and round Patna; -2° deg. in most of China and Mongolia; -4° deg. in N.W. China and W. Mongolia. *Rainfall*: wet in N. Turkey; W. Mongolia; parts of W. and S.E. India; Laos; N. Vietnam; S.E. Philippines, S.E. and parts of N.E. China. Over 200% in Gujarat; much of S.E. and locally in N.E. China. Dry in S. Turkey; most of China, India and Pakistan; Bangladesh; Burma; N. and S.W. Philippines; E. Korea; probably most of Indonesia. Japan variable but mainly dry. Under 25% in very large areas of China and most of Bangladesh; rainless in N. India.

Australia. *Temperature*: warm in W. Australia and from L. Eyre to Sydney; cold elsewhere; -2° deg. locally. *Rainfall*: dry except 140° - 150° E and in N.E. W. Australia; under 50% widespread.

DECEMBER 1981 WEATHER SUMMARY

December was a very cold month in virtually all areas of the United Kingdom with mean temperatures between 2° and 6° C below normal. The three-week cold spell which began in most areas on 8th was the most severe experienced in December since 1878 and during its most severe stage minima of -23° and -25° C were recorded at Shawbury in Shropshire on 12th and 13th, the latter a new English record. Away from the south-western peninsula minima below -10° C were recorded somewhere in the U.K. on at least 15 nights and -15° to -20° C occurred on at least seven nights. Day maxima were also very low at times, particularly in freezing fog when on 12th the temperature reached only -12° C at Shawbury and -10.8° C at Trowbridge. The only mild weather during the month occurred early and late in the month when temperatures reached from 10° to 13° C in places, particularly in the south-west. Rainfall was mostly above normal in southern and eastern England, where more than twice the normal was recorded in southern parts of Devon and Dorset, and much below normal in west and south-west Scotland where a large area recorded less than 25 percent, and locally less than 15 percent. With pressure frequently low to the south-west and south of Britain there were several quite heavy falls of snow, particularly in central and southern areas, although rain fell at times near southern and western coasts. Away from the south-west the ground was continuously snow-covered for up to 23 days. The major snow event of the month occurred on 13th when blizzard conditions affected southern areas of Britain for a time before turning to rain in many places later in the day. In Scotland rain or snow fell most widely, if not heavily, on 3rd, 13th, 19th and 20th, while over much of England and Wales the 13th was generally the wettest day with rain or melted snow totals exceeding 20 mm quite widely and with more than 30 mm to 40 mm in places. Over the higher parts of the south-west 60 mm fell on the 19th and further quite heavy rain fell widely towards the end of the month. Sunshine totals were variable with western Scotland, northern England and the north-east Midlands having a sunny month while it was dull in eastern Scotland and near average elsewhere.

The first week of the month was generally on the mild side and it was particularly mild over Scotland on 2nd and 3rd with 15° C at Dyce early on 3rd. During these early days pressure was high to the south-west of Britain and mostly weak frontal systems moved south-east across the country from time to time. Late on 5th cold weather with snow reached the Northern Isles and, as a cold front moved erratically south, very cold northerly winds spread across Scotland and as far south as central England by the 7th with rain turning to snow in places by evening. As the last of a series of frontal waves crossed southern counties of England on 8th, rain turned to snow in many southern areas giving accumulations of up to 15 cm in places, especially in the Chilterns. Frost was widespread and locally persistent on 9th and there were further snow showers in parts of the west and north. Frost was severe and again persistent on 10th and there was a good deal

of freezing fog while later in the day as a depression moved east into the south-western approaches, rain reached the south-west, turning to snow well inland. This area of snow, with rain near coasts, affected many southern areas on 11th and 10 to 15 cm of snow fell over a wide area. Late in the day clearer conditions spread to most parts from the north, but with light winds the following night it was bitterly cold, minima early on 12th being widely below -10°C and below -15°C in places (-23°C at Shawbury). Where freezing fog lingered through the day maxima were in the range of -8 to -12°C , but even where the day was sunny temperatures failed to exceed -5 to -8°C in some central areas of England. The temperature fell rapidly after sunset and -16 to -20°C was reached in a number of places by midnight. At Shawbury it was -22°C at 1800 and -25°C at midnight. Early on 13th temperatures were still widely between -15 and -20°C over central areas of England but with winds slowly picking up and cloud thickening ahead of a deepening low to the south-west of Ireland, temperatures rose rapidly to near, or above, freezing within a very few hours and by noon blizzard conditions had spread to much of the south-west. Snow continued to spread east to much of central and southern Britain by the end of the day but southern counties became less cold in the evening with the snow turning to rain and with widespread flooding. With winds reaching storm-force in the south-west overnight, the Bristol Channel coasts of Somerset and Avon were badly affected by huge seas which breached the sea defences in places and inundated a large area of the Somerset levels.

The 14th was less cold in southern Britain, where it was showery with hail and local thunder, but colder weather returned to most places on 15th. The next few days were extremely cold with severe, and in places, persistent frost. Maxima in Scotland were below -10°C in places on both 16th and 17th, and at Abbotsinch the temperature rose to -10°C on 17th and -9°C on 18th. While much of the country was dry with some sunshine, low pressure to the south and south-west kept south-western counties mostly very cloudy for a time with occasional rain and with snow over the moors. Southerly winds freshened over the country on 19th and it became milder in western and southern areas with heavy rain in the west later, while on 20th, with winds reaching severe gale in places, some rain or snow spread to most parts. With low pressure becoming established to the south-west, cold weather and snow spread back from the east to many parts of Britain on 21st and up to 20 cm snow fell in the east and north. The following few days were rather on the cloudy side with a little snow in places, and a good deal of frost, severe at night, and with some freezing fog, while on 23rd, as a small but intense depression moved into northern France, there was some heavy rain or sleet in the extreme south-west. Christmas Day was sunny in many places and there was widespread freezing fog over much of eastern England, but later in the day southerly winds and a little rain reached the far west, and during the next two days milder conditions, preceded by strong winds and drifting snow, spread from the west to most areas. Rain in the south-west was heavy with some flooding. By the end of the month a series of fronts moving north-east and then north across Britain had spread milder weather and heavy rain to all areas, and with the rapid thawing of snow there was considerable flooding in vulnerable areas, particularly in the Severn Valley.

TEMPERATURE AND RAINFALL: DECEMBER 1981

	Mean				Grass					
	Max	Min	Max	Min	Min	Rain	%	Wettest	D	T
AUSTRIA: Innsbruck	2.2	-3.8	11.2(31)	-12.8(21)	-17.6(21)	72.5		12.0(14)	18	1
BELGIUM: Uccle	3.4	-1.5	9.6(31)	-8.4(17)		106.3	153	17.3(30)	21	0
„ Brugge	3.8	-0.9	10.2(1)	-8.6(13)		124.9	187	21.2(8)	22	0
„ Houwaart	2.8	-2.6	9.5(31)	-10.5(19)	-12.5(17)	115.4	156	16.5(8)	23	0
DENMARK: Fano	-0.1	-7.4	7.8(3)	-15.8(21)		47.9	66	6.6(10)	17	1
„ Frederikssund	-0.8	-5.8	7.9(3)	-17.0(17)	-22.8(17)	49.2	96	11.0(25)	14	0
FRANCE: Campist's	10.8	5.1	17.0(12)	-4.0(19)		193.0	171	24.0(14)	23	0
„ Montpellier	11.8	4.8	19.0(11)	-2.0(4)		103.0		22.0(13)	17	
„ Marseilles	10.5	4.7	16.0(11)	-3.0(4)		111.0		27.0(17)	21	
„ Nice	13.2	6.0	19.0(12)	2.0(5)		212.0		58.0(21)	14	
GERMANY: Berlin	-0.9	-4.8	6.5(4)	-11.6(16)	-15.3(16)	65.8	160	18.3(3)	21	0
„ Hamburg	-1.0	-6.3	7.8(4)	-17.4(21)	-21.3(20)	44.7	77	14.4(3)	20	0
„ Frankfurt	0.8	-2.8	9.7(31)	-10.2(17)	-14.4(20)	97.9	185	16.6(8)	26	1
„ Munchen	1.4	-5.7	9.7(8)	-16.1(17)	-21.6(27)	133.2	266	20.8(16)	25	0
„ Sonthofen	2.2	-5.0	8.7(8)	-16.1(20)	-24.1(20)	272.7		34.2(16)	25	5
GREECE: Korfu	15.2	9.0	19.0	2.0(28)		253.0		57.0(14)	20	
ITALY: Pian Rosa	-12.2	-17.0	-8.0(27)	-24.0(v)						
„ Passo Resia	-1.4	-7.6	6.0(4)	-15.0(v)						
„ M.Cimone	-4.0	-6.3	2.0(10)	-13.0(4)		102.6		22.2(29)		1
„ Casalecchio	6.8	1.9	12.0(v)	-1.0(v)		93.0	114	30.0(19)	12	1
MALLORCA: Palma	17.6	10.2	22.0(13)	0.0(26)		17.0		7.0(22)	9	
MALTA: Luqa	17.3	11.7	21.4(31)	6.3(1)	1.3(27)	75.3		28.8(4)	9	2
NETHERS: De Bilt	1.7	-3.4	9.1(3)	-12.3(18)	-15.4(16)	99.1	129	17.5(5)	20	2
„ Schettens	0.9	-4.6	8.2(2)	-18.8(16)	-20.0(16)	60.3	101	15.7(1)	21	2
„ Ten Post	0.0	-5.5	8.2(4)	-14.9(17)	-17.1(15)	64.1	86	8.7(1)	21	2
„ Monnick'dam	1.5	-2.5	9.2(3)	-9.6(17)		63.2		12.3(4)	22	2
NORWAY: Dønski	-5.8	-12.4	9.8(4)	-23.2(14)	-30.2(-)	43.9		9.2(18)		0
SPAIN: Sevilla	17.1	8.8	21.0(14)	0.0(7)						
„ Malaga	19.1	10.7	24.0(14)	4.0(20)		155.0		56.0(21)	12	
SWEDEN: Valla	-4.7	-10.1	6.0(3)	-20.8(15)	-25.5(14)	55.1		11.4(8)	22	0
SWITZER'D: Basel	4.2	-1.4	13.2(31)	-11.6(20)		154.8		24.4(18)	26	2
„ Geheve	5.1	0.7	12.2(16)	-8.9(20)		253.3	321	30.3(19)	25	2
EIRE: Straide	5.4	-0.2	12.0(3)	-9.0(18)		87.3	63	23.0(13)	20	0
NJIRE'D: Bessbrook	3.9	-0.8	10.6(3)	-10.6(12)		114.6	111	23.7(13)	17	0
SHE'T'D: Whalsay	3.5	0.6	10.3(3)	-4.6(13)	-8.2(19)	67.7	59	17.0(10)	22	0
„ Fair Isle	3.9	1.1	9.7(3)	-3.3(18)	-8.0(15)	76.9	79	9.3(31)	25	0
SCOT'D: Braemar	0.5	-7.2	10.5(2)	-18.0(17)		74.8		19.6(14)	15	0
„ Edinburgh	1.9	-2.9	10.5(3)	-12.3(17)	-18.0(17)	35.5		9.3(13)	13	0
WALES: Lampeter	4.3	-1.8	10.4(4)	-13.2(13)	-15.3(13)	184.9			18	0
„ Pembroke	6.5	1.3	11.2(4)	-4.5(12)	-8.4(12)	145.7	112	27.4(13)	22	0
„ Carmarthen	4.9	-1.0	11.1(3)	-10.2(12)	-14.5(12)	124.1	91	28.1(13)	20	1
„ Gower	5.8	0.7	11.1(4)	-5.0(19)	-9.3(19)	103.1	79	25.1(13)	16	1
ENGLAND:										
Penryn, Cornwall	8.6	3.4	12.0(4)	-3.6(19)		209.9		38.1(13)	26	2
Denbury, Devon	6.5	0.6	12.5(3)	-8.5(19)	-12.0(19)	226.5	165	33.4(13)	20	2
Gurney Slade, Somerset	3.1	-3.2	13.4(2)	-18.4(13)	-21.5(13)	159.3	142	27.5(30)	16	1
Yatton, Avon	5.2	-0.2	11.6(3)	-10.5(13)	-12.7(13)	115.1	124	18.3(7)	15	2
Corsham, Wilts	3.8	-2.2	10.6(3)	-16.2(13)	-21.5(13)	117.2	150	21.1(7)	17	1
Trowbridge, Wilts	4.2	-3.0	10.7(3)	-16.3(13)	-20.5(13)	111.3	157	18.5(7)	18	1
Codford, Wilts	4.6	-3.0	11.4(3)	-17.0(13)	-19.6(13)	143.5	159	26.1(13)	17	1
Reading, Berks	3.9	-2.3	9.7(3)	-13.4(13)	-16.1(13)	85.0	143	17.6(13)	14	0
Sandhurst, Berks	4.3	-2.2	10.0(1)	-14.4(13)	-15.5(13)	89.5	130	18.1(13)	18	0
Newport, Wight	6.0	0.2	10.4(4)	-6.2(19)	-9.2(19)	107.0	114	20.3(13)	19	0
Horsham, Sussex	4.3	-1.0	9.8(4)	-8.6(13)	-10.6(13)	86.7	113	23.3(13)	16	0
Brighton, Sussex	5.1	-0.3	10.0(4)	-5.6(19)	-6.5(19)	89.4		17.1(20)	22	0

	Mean		Max	Min	Grass		Rain	%	Wettest	D	T
	Max	Min			Min						
Hastings, <i>Sussex</i>	5.0	0.6	11.5(1)	-3.4(v)	-5.3(26)	71.6	90	26.7(11)	16	0	
East Malling, <i>Kent</i>	4.3	-0.9	10.0(4)	-11.5(13)	-15.5(13)	80.1	128	17.5(13)	19	0	
Gillingham, <i>Kent</i>	3.3	-0.3	9.4(3)	-7.8(26)		93.2	150	21.6(13)	19	0	
Epsom Downs, <i>Surrey</i>	3.3	-2.0	9.6(4)	-14.4(13)	-14.0(13)	95.8	115	24.3(13)	16	0	
Reigate, <i>Surrey</i>	1.2	-0.9	9.7(4)	-10.6(13)	-10.7(13)	91.4	137	18.8(13)	18	0	
Guildford, <i>Surrey</i>	3.7	-0.5	9.9(4)	-9.8(13)	-11.5(13)	99.2	142	19.1(13)	16	0	
Worplesdon, <i>Surrey</i>	4.3	-1.6	9.8(4)	-14.4(13)	-18.9(13)	70.9		17.9(13)			
Hayes, <i>London</i>	3.7	-1.7	9.6(30)	-12.4(13)	-13.6(13)	76.4	141	16.0(7)	17	0	
Sidcup, <i>London</i>	3.8	-1.0	9.7(30)	-9.5(13)	-13.0(13)	90.9	162	17.6(7)	16	0	
Hampstead, <i>London</i>	3.3	-1.5	9.2(30)	-8.4(13)	-16.5(13)					0	
Royston, <i>Herts</i>	2.6	-1.9	9.5(3)	-8.5(13)	-14.6(13)	56.9	107	11.2(13)	15	0	
Loughton, <i>Essex</i>	2.1	-2.5	8.7(30)	-15.5(13)	-18.9(13)	66.3	100	16.0(7)	14	0	
Leigh, <i>Essex</i>	3.2	-0.8	10.0(4)	-9.2(13)	-12.8(13)	80.2	161	14.9(7)	18	0	
Buxton, <i>Norfolk</i>	2.7	-2.3	9.2(3)	-12.4(13)	-16.0(13)	38.8	64	12.0(13)	14	0	
Pulham, <i>Norfolk</i>	3.0	-3.4	9.1(3)	-13.6(13)	-16.8(13)	64.1	121	15.9(13)	19	0	
Ely, <i>Cambs</i>	2.2	-3.7	10.0(3)	-13.3(13)	-13.3(13)	49.9	105	11.3(14)	16	0	
Luton, <i>Beds</i>	2.8	-2.4	9.0(3)	-16.0(13)	-23.6(13)	66.2	109	13.5(7)	15	0	
Oxford, <i>Oxon</i>	3.6	-2.2	10.3(3)	-16.1(13)	-20.1(13)	74.0	132	15.3(28)	18	0	
Buckingham, <i>Bucks</i>	2.5	-2.9	9.4(3)	-18.8(13)	-18.2(13)	54.3	95	10.6(7)	12	0	
Birmingham Univ'sity	2.5	-2.4	10.5(3)	-12.9(13)	-23.1(13)	126.9		25.6(13)	20	1	
Kettering, <i>Northants</i>	2.2	-4.0	10.0(3)	-17.8(13)	-20.0(13)	57.2	87	11.6(13)	12	0	
Hinckley, <i>Leics</i>	2.8	-2.9	10.0(3)	-13.6(13)	-17.6(13)	54.7	88	11.8(13)	18	0	
Cosby, <i>Leics</i>	2.0	-3.6	10.0(3)	-15.5(13)	-18.0(13)	49.1	76	12.2(13)	15	0	
Louth, <i>Lincs</i>	3.0	-1.9	11.1(3)	-8.0(17)		58.5		13.8(13)		0	
Newark, <i>Notts</i>	1.8	-3.0	11.2(3)	-12.6(13)	-17.3(19)	53.9	94	22.2(20)	17	0	
Nottingham, <i>Notts</i>	2.5	-3.0	11.4(3)	-11.6(13)	-15.1(13)	45.7	84	9.3(20)	15	0	
Middleton, <i>Derby</i>	1.7	-2.6	9.4(3)	-7.6(26)	-12.4(19)	97.0		18.9(20)	20	0	
Burton, <i>Staffs</i>	2.3	-3.2	11.0(3)	-17.0(13)	-17.1(13)	74.6	123	15.3(13)	21	0	
Meir-Heath, <i>Staffs</i>	1.3	-2.4	8.6(3)	-9.9(13)	-15.8(23)	107.9	101	29.9(13)	22	0	
Keele, <i>Staffs</i>	2.0	-2.2	9.1(3)	-12.5(14)	-23.1(13)	66.3	89	10.1(20)	21	0	
Sefton Park, <i>Merseyside</i>	3.0	-1.6	11.1(4)	-14.0(12)		81.6	110	14.0(13)	21	0	
Southport, <i>Merseyside</i>	3.0	-1.4	9.8(3)	-11.0(13)	-13.8(18)	68.2		14.5(13)	15	0	
St.Helens, <i>Merseyside</i>	3.2	-2.1	9.9(3)	-12.9(12)		60.7		14.6(13)	14	0	
Sheffield, <i>S.Yorks</i>	2.3	-1.8	10.8(3)	-9.4(18)	-16.5(18)	90.9	123	15.3(14)	17	0	
Cottingham, <i>Humber</i>	3.6	-2.1	11.2(3)	-10.0(18)	-15.2(18)	53.9	88	15.4(3)	15	0	
Pickering, <i>N.Yorks</i>	2.4	-4.7	11.0(3)	-13.6(18)	-13.6(18)	57.0		15.2(13)	17	0	
Durham University	2.7	-3.2	11.2(3)	-12.5(18)	-14.5(18)	58.1	94	13.5(13)	20	0	
Carlisle, <i>Cumbria</i>	2.2	-3.4	10.0(3)	-13.7(18)		15.6	24				
CANADA: Halifax	4.2	-1.3	12.6(3)	-7.8(31)		224.5		43.4(15)	19	1	
" Elora	-1.4	-7.1	5.6(1)	-16.1(20)		28.8		8.5(22)	15	0	
U.S.: San Francisco	13.8	8.7	16.5(19)	4.0(11)		99.3		50.3(29)	11	0	
CANARY: Las Palmas	22.1	16.7	24.0(27)	14.0(27)		1.0			3		
" Lanzarote	22.3	15.6	24.0(v)	13.0(26)		2.0			5		
SENEGAL: Dakar	28.1	21.6	33.0(5)	17.0(25)		nil		nil	0		
MOR'CO: Tangier	17.7	11.6	21.0(1)	4.0(20)		310.0		66.0(10)	22		
ALGERIA: Algiers	19.2	10.0	24.0(30)	3.0(21)		73.0		39.0(3)	12		
ISRAEL: Tel Aviv	20.5	10.3	25.0(23)	6.0(11)		13.0		6.0(24)	8		

DECEMBER 1981

ENGLAND: *Avon*: Long Ashton, 133.1 mm; Midsomer Norton, 150.5 mm; *Wiltshire*: Lynham, 96.9 mm; Bradford-on-Avon, 113.7 mm. *Northampton*: Westone, 48.9 mm. *Lancs*: Leigh, 54.8 mm. *N.Yorks*: Northallerton, 47.0 mm; Cawood, 35.2 mm. *Cumbria*: Appleby, 38.0 mm; Kendal, 50.9 mm; Coniston, 154.0 mm; Thirlmere, 95.6 mm; Seathwaite, 122.0 mm. FRANCE: Montbonnot (Grenoble), 236.2 mm.

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FRONT COVER: Map of the York and Selby area showing the flooding (hatched region) which occurred during early January 1982.