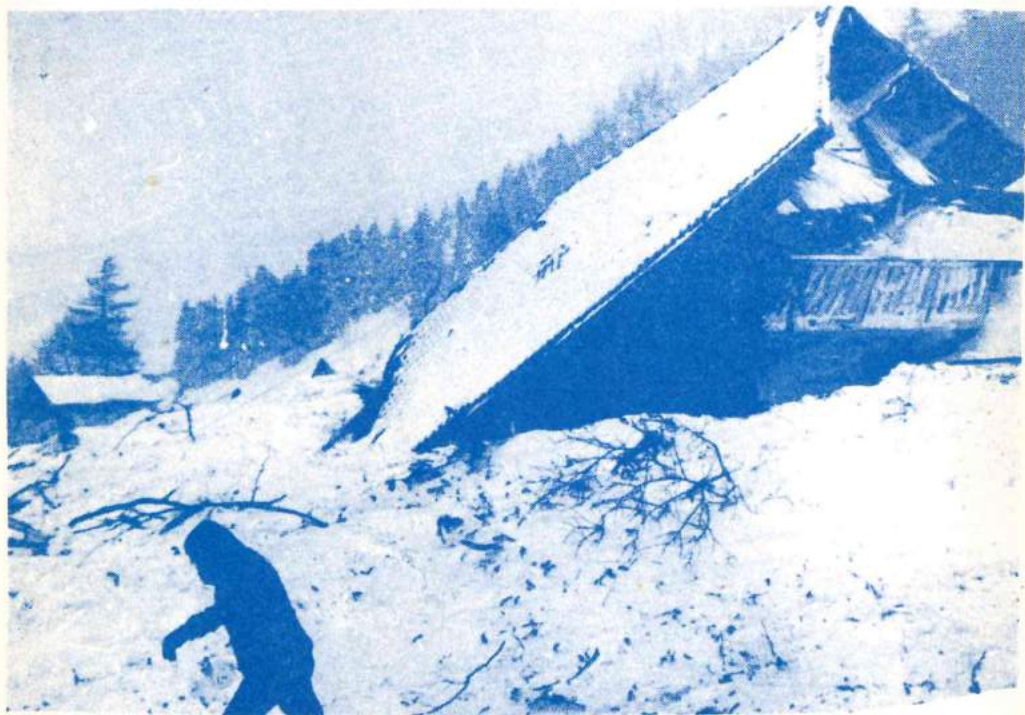


The *JOURNAL of METEOROLOGY*



One of the nine chalets at La Morte, Isère, S. E. France, destroyed by an avalanche on 21 January 1981.

Volume 6, number 59

May-June 1981

THE JOURNAL OF METEOROLOGY

*Published in association with
The Tornado and Storm Research Organisation*

Edited by Dr. G. T. Meaden, Cockhill House,
Trowbridge, BA14 9BG, England.

Telephone: Trowbridge 2872 (STD 02214)

Research papers, letters, news items, conference information, books for review, and other communications on all aspects of meteorology and climatology are to be addressed to the Editor.

Contributions for publication should be typed, or neatly handwritten, with double spacing and 25 mm wide margins. In the case of typescripts, a duplicate copy would be appreciated. Every paper should commence with a short abstract summarising its significant and/or original content. Recent issues of the journal should be consulted as a guide to the layout of papers. Metric units are strongly recommended. Line drawings may be prepared up to 2 or 3 times oversize, but their quality should be good enough for direct reproduction. They should be drawn with a black pen on good-quality white paper, with lettering symbols large enough to be legible after reduction. Figure captions should be numbered and collected in sequence at the end of the paper. Each table should have a number and a short title, and be on a separate sheet at the end of the manuscript.

The usual language of the journal is English but a few contributions will be acceptable in French. Correspondence with the Editor's office may be in English or French.

Responsibility for the opinions expressed in the signed articles rests with their respective authors.

Please note that, for citation purposes, the recommended abbreviation for the title of this journal is *J. Meteorology, U.K.*

Subscriptions for 1981, Volume 6, including surface post: U.K. £13.50; rest of world £15.50. Subscription including airmail £21.00.

Back issues are available for purchase either as complete volumes or singly. Volume one, 12 issues, 408 pages, £7.50; volume two, 12 issues, 388 pages, £7.50; volume three, 10 issues, 332 pages, £8.50; volume four, 10 issues, 332 pages, £9.50; volume five, 10 issues, 344 pages, £11.50. Single issues, *pro rata*.

Published by The Artetech Publishing Co., Cockhill House, Trowbridge, Wiltshire, BA14 9BG, England.

Printed by The Dowland Press Ltd., Frome, Somerset.

© Artetech Publishing Company

ISSN 0307-5966

JOURNAL OF METEOROLOGY

"An international journal for everyone interested in climate and weather, and in their influence on man."

Editor: Dr. G. T. Meaden

Vol. 6, No. 59, May-June 1981

ON THE HALOS IN THE HANDBOOK OF UNUSUAL NATURAL PHENOMENA

By R. WHITE

Department of Mathematics, University of London King's College

Abstract: An investigation has been carried out to determine whether explanations in terms of known phenomena can be given for the 'rare and difficult-to-explain halos' and the 'non-circular (geometric-optics, ice-particle) halos' in the *Handbook of Unusual Natural Phenomena*. In virtually all cases, at least tentative explanations are offered; as a result, it is felt that many of the apparent anomalies arise from errors of observation or interpretation of common phenomena.

It has been particularly investigated whether there is any evidence for a class of halos centred at points on or near a halo circular about the source, and passing through or near the source. The answer seems to be negative. It was examined whether those, which could not be interpreted as secondary halos, were highly oblique parhelic circles. The finding was that it is quite possible that they were normal parhelic circles, and that the difficulty of estimating verticals at high elevations caused the apparent anomaly.

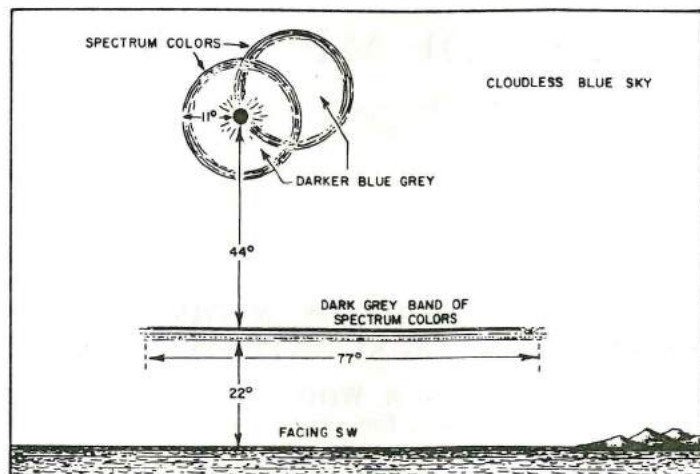
The *Handbook of Unusual Natural Phenomena*¹ is a fascinating book, containing many records of unexplained geophysical effects. One can have nothing but admiration for the labour of its editor, and the Sourcebook Project deserves the support of all scientists.

The *Handbook* contains, on pages 184-192, reprints of articles relating to observations of halos, which do, at first sight, appear to be inexplicable in terms of the standard theory of halos. In the present paper, an attempt is made to offer explanations of these observations. Each will be analysed in turn, but it is desirable to begin by making one or two general points.

Many of the observations seem to relate to halos seen passing through or near the source, and centred at or near points on an ordinary circular halo centred at the source. There seem to be two possible explanations of phenomena of this type. Firstly, they may be secondary halos, produced by secondary scattering of light from the source that has already been scattered once, most usually in such a manner as would produce a parhelion. A point that is often missed in this connection is that it is not necessary for the parhelion to be visible to an observer of the secondary halo. The second possibility is that a displaced (oblique) parhelic is involved, produced by crystals with their sixfold axes of symmetry directed to a point other than the zenith.

The present paper is confined to halos produced by geometric-optics-scattering by ice crystals. Reference will occasionally be made to the notation for groups of crystals according to their orientation introduced by Hastings².

In what follows, the section headings are those of Corliss from the *Handbook* pages 184-192. Diagrams of all the observations are given in the *Handbook* and are reproduced here.



RARE SOLAR HALOS³

My first reaction to this display (Figure 1, J. A. Crabbe) was to take it at its face value, and assume that a halo of unusual radius was seen about the sun. A halo of 8° - 9° radius is fairly well known, and considering the approximate character of the measurements, this is reasonable agreement with the observed radius of 11° . The halo passing through the sun can then be interpreted as a secondary halo of the same radius. This would, however, be rather unlikely to be produced by secondary scattering of the light from a parhelion of the 8° - 9° halo, because such a parhelion would not, in general, be on the primary halo. It seemed altogether more likely that the secondary halo was centred on the bright contact point of a tangent arc with the 8° - 9° halo.

Given this hypothesis, it was necessary to address the problem of where the contacts are located. Taking local noon as the time of observation, a source elevation of 69° is computed for the given date and latitude. We have three possible classes of crystal (in the form of right hexagonal prisms with pyramidal caps, perchance truncated) to consider: that in which the horizontal axis of rotation is the sixfold symmetry axis, and those in which it is respectively a major and minor axis of the hexagonal cross-section. For the first class, we find that there are two possible points of contact, with position angles from the sub-source vertical 64° and 151° . Only the first of the other two classes gives any other contacts, in fact superior and inferior tangential arcs, which clearly are not what we require.

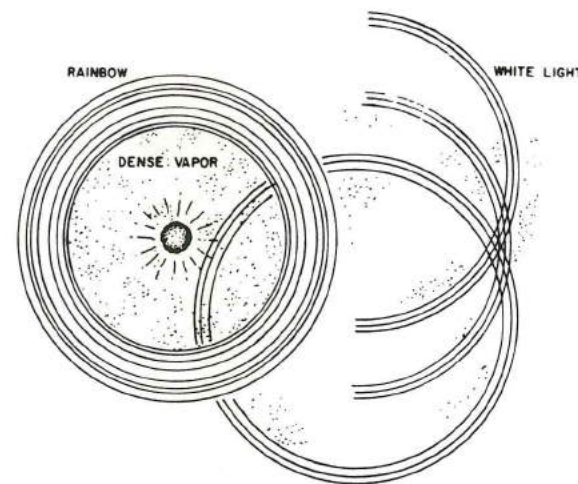
Neither 64° nor 151° look right for the centre of the secondary halo shown in the illustration in the *Handbook*, but if we consult Crabbe's original letter, we find that it was centred at a point in a NNW-ly direction from the sun, which latter was very high in the sky. This would leave 151° as a possibility. However, it also seemed possible that, with the difficulties in judging direction with the sun so high, accentuated by having to crane the neck at an awkward angle, the supposed secondary halo could well have been centred vertically above the source. I was also unhappy with the fact that only one of four possible points of contact for B^1 crystals with pyramidal caps was producing any effects. Further, no trace of this contact point itself was seen, which,

in spite of what has been said above, is surprising when the whole circumference of the supposed secondary halo was visible. Also, no other phenomena which might be expected to be produced by the B^1 crystals with pyramidal caps, nor by the randomly oriented crystals, were observed. Further, it became apparent that there are not isolated bright sharp points of contact at this source elevation, but rather the halo and tangent arc are almost coincident over a considerable portion of the circumference of the former. This led me to examine other hypotheses.

There is one halo in this observation which we can identify with a fair degree of confidence. That is the horizontal bar of colour: this is clearly the circumhorizontal arc: it is at just about the right distance from the sun for the relevant elevation of the latter. The description of it as a bar of grey cloud will be familiar to all halo watchers, who will be aware that cirrus near the horizon often looks like this. The presence of the circumhorizontal arc suggests the presence of either A group or B group crystals. I am inclined to reject the latter, because some types of Parry arc produced by the B group were not observed. It may be objected that we could equally reject the A group on the grounds that the parhelic circle was not seen (the parhelia and the circumzenithal arc cannot be produced for this source elevation). Or was it?

For the solar elevation in question, the parhelic circle is much the same radius as the halo of 22° . Can it be that a radius of 22° was recorded in error as a diameter of 22° , and that the 'halo of 11° ' round the sun was the halo of 22° , and the supposed secondary halo nothing but the parhelic circle? This is the hypothesis to which I am now inclined, which has the merit of requiring no fortuitous distribution of crystal types over the sky.

There does seem to be one substantial objection: the halo passing through the sun was stated to be of prismatic colours. Could it be that this was an irised parhelic circle? Theory would, in fact, predict a slightly sharper inner edge to such an irised circle, particularly at higher source elevations. Equally the statement that both circles were darker inside than out could have been a mistake.



A DESCRIPTION OF A HALO OR CORONA OF GREAT SPLENDOR⁴

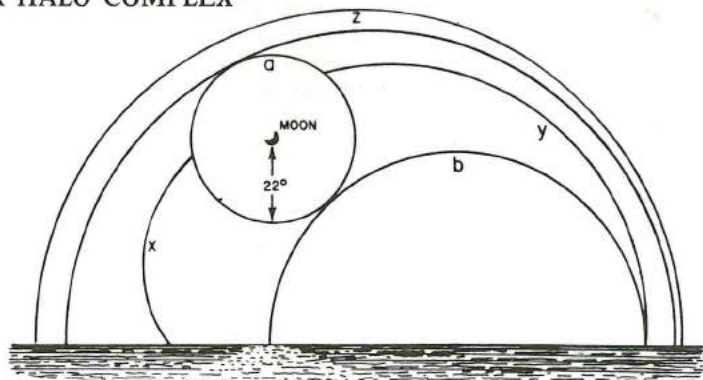
The problem which I think must be addressed in consideration of the significance of this observation is the reliance which can be put on the description given (Figure 2, A. T. King). It is evident that the observer's knowledge of halos, and indeed, of physical science and its nomenclature in general, is somewhat limited. This, of itself, is insufficient to merit regarding his description as unreliable.

However, let us look at the circumstances. Consulting the original account, one finds that the observation was written up nearly four weeks after it was made. This, I feel is very unwise in someone who is not familiar with halos. Such a person would have to make a sketch on the spot to be sure of getting everything right. I agree with the opinion of the late Mr. E. C. W. Goldie, that it is very desirable to have a knowledge of the theoretical forms of halos in order to make useful observations. Someone who does not have this knowledge is much more likely to make mistakes writing up, than someone who does.

King was unsure even of the total number of rings seen. His account indicates that many persons in the town of Greensburgh saw the phenomenon, and the possibility that it was based in part on hearsay cannot be ignored.

Therefore, it would be unwise to take every statement in King's article as precisely correct. One respect in which mistakes are particularly likely is that any curved arc might be assumed to be part of a circular halo. I suspect that what was actually seen was a 22° halo, parhelic circle, and probably anthelic arcs. The solar elevation in question is about 57° .

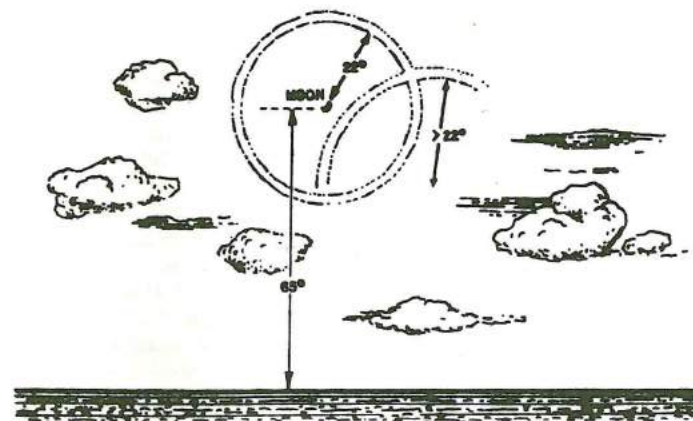
LUNAR HALO COMPLEX⁵



A careful reading of this account⁵ shows what the journal editor apparently, and also possibly the *Handbook* editor, seem not to have noticed: that this is a description of the motion of a single arc, of which successive positions are shown in the diagram (Figure 3), relative to a lunar halo of 22° . It does not represent arcs visible simultaneously. In all probability this was a band of cloud moving across — perhaps not of much greater optical depth than the rest, but composed of crystals more efficient as producers of the 22° halo, or at least of its tail.

UNUSUAL LUNAR HALO⁶

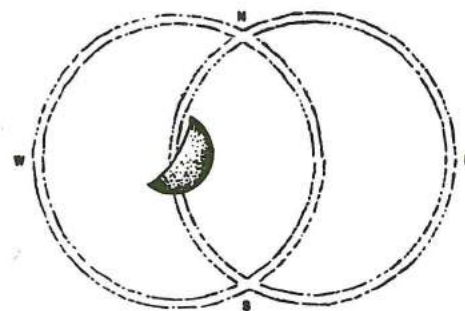
This is shown in Figure 4, and is probably a secondary halo round a paraselene, despite the opinion of the editor of *Marine Observer*. The account



only says that the secondary halo was 'of apparently slightly larger radius'; a very slightly larger radius of maximum radiance is to be expected from an extended source like a paraselene. Since the lunar elevation was 65° , we must assume the axes of the systematically-oriented crystals to be directed to a point other than the zenith. It is not really significant that the paraselene was not seen, because only part of the circumference of the secondary halo was seen. It may even possibly be that the paraselene was hidden by the cumulus for the five minutes for which its presence is implied by the observation. All halo watchers will be familiar with the way in which circular halos sometimes remain visible for hours at a time, with parhelia or paraselenae appearing intermittently in odd patches of cirrus that blow across. It is even possible that the paraselene was present but mistaken for a bright patch of cloud, if the cirrus was rather non-uniform.

HALO AROUND THE MOON (Figure 5)⁷

I have not actually consulted an almanac for the date in question, but the moon seems to be drawn such that a vertical in the diagram is a celestial vertical. The 'W' and 'E' must be interchanged. I do not know the exact elevation of the moon, but it must have been about 50° . This would make interpretation as a secondary halo about a paraselene improbable: it would be expected that the secondary would not reach as far as the moon. More probably, a displaced

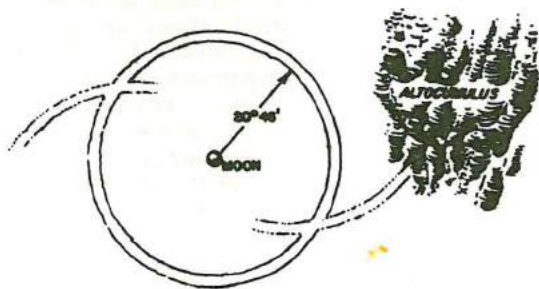


paraselenic circle was involved, the crystals having their axes directed to a point other than the zenith.

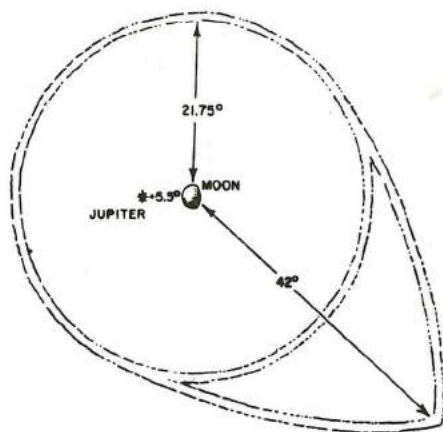
There is another possibility, that we are again dealing with an observer who is unfamiliar with halos, and that it is the West and East points that are correctly marked. He has perhaps not recognised that the compass points cannot be marked in the same order on an observed portion of the celestial sphere as on a map of the earth's surface. This opens the possibility that the halo passing through the moon was a true paraselenic circle: my estimates indicate that NE and SW would be more accurate than E and W in that case, but it is certainly within the bounds of possibility. It seems that the observer experienced difficulty in drawing the relationship of this halo to the moon properly, which may have been caused by drawing the moon at its correct inclination to the horizontal, and the rest of the diagram on a different orientation. Note also that he had thought initially that the halo through the moon was larger. The observation was written up about a fortnight after the event.

UNRECOGNISED HALO PHENOMENON (Figure 6)⁸

I suspect that two portions of a paraselenic circle were seen, one of them being drawn the wrong way up by mistake, and the fact that they tended



towards the moon being missed. The radius as drawn is about right relative to the 22° halo, for the given lunar elevation.

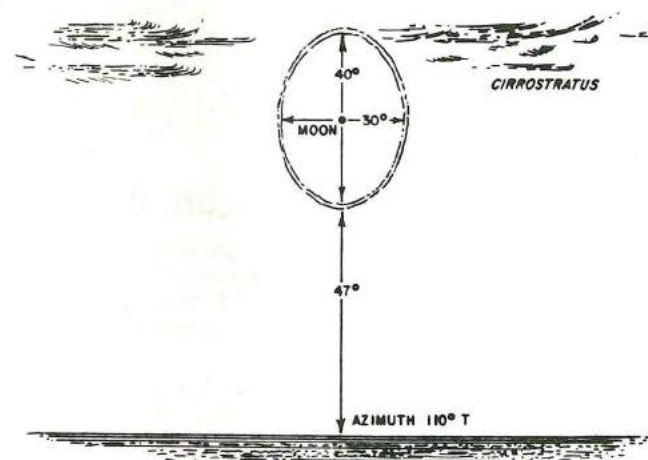


PECULIAR ARCS AND LUNAR HALO⁹

This is a genuinely unusual observation (Figure 7), of which I can, at present, give no confident account. At the time of observation, the moon would have been close to the meridian, and in the 10°-20° zenith distance range. It would seem that the moon should have been some 6.5° from Jupiter, rather than 5.5°. With the moon so high, it would take only a small displacement of the effective zenith (defined by reference to the orientation of the crystals) from the true zenith, to make the axis of symmetry of the display the effective celestial vertical (analogously defined) through the moon. Even then, it is not easy to identify the arcs, although their form bears at least some resemblance to that of part of the Hastings III arc, for a source elevation in the 40°-50° range. I must admit, however, that I only noticed this as a result of miscalculating the lunar elevation as being in this range. It would, in fact, have been in that range some three hours earlier: the Jovian distance would then have been about 5°, and the axis of symmetry of the display approximately vertical.

NON-CIRCULAR HALOS

The first of these descriptions (ref. 10, no figure given) has nothing in it inconsistent with an ordinary circumscribed halo, and we shall turn to the second (ref. 11, Figure 8). It appears that there are two typographical errors in



the appended diagram, the sun being marked as 'moon', and the elevation of the bottom of the halo indicated as 47°, when calculation based on the place, date and time of observation suggests that this is altogether more likely to be the elevation of the sun. The form of the halo matches fairly closely that which would result from two reflections, one in a horizontal face, another in a face inclined at 10° to the horizontal. It is certainly unusual, however.

CONCLUSION

We have been able to put forward explanations of most of the ice-particle geometric-optics halos in the *Handbook of Unusual Natural Phenomena*, in some cases tentatively, in others with considerable confidence. It is felt that some of the reports were from inexperienced observers: particular caution is

needed in order to be sure that such persons have seen something unusual, rather than mistaking a common effect.

In particular, no evidence has been found for an unexplained class of halos centred at points on or near a circular halo about the source, and themselves passing through or near the source. The possibility that some of these are displaced (oblique) parhelic circles, apparently not previously considered has been examined, but in all cases it was found within the bounds of possibility that true parhelic circles were involved. It seems that the difficulty of judging the vertical direction at large elevations, particularly the fact that verticals are nothing like parallel here, and converge to the zenith, is responsible for many apparently anomalous reports. Such matters are particularly likely to cause difficulty to inexperienced observers.

It is felt, at least, that for many of these reports, the present paper has shifted the burden of proof on to those who wish to show that something unusual was present. It is as much a problem in source criticism as in physics.

REFERENCES

1. CORLISS, W. R. (Ed.): *Handbook of unusual natural phenomena*, Sourcebook Project, Glen Arm, Maryland (1977).
2. HASTINGS, C. S.: A general theory of halos. *Mon. Weather Rev.*, 48, 322-330 (1920).
3. CRABBE, J. A.: Rare solar halos. *Weather*, 10, 359 (1955).
4. KING, A. T.: A description of a halo or corona of great splendour. *Amer. J. Sci.*, 1(40), 25-27 (1841).
5. DAVISON, I. C.: Lunar halo complex. *Marine Observer*, 34, 73 (1964).
6. HAZLEWOOD, H. W.: Unusual lunar halo. *Marine Observer*, 21, 16-17 (1951).
7. PRYER, H.: Halo around the moon. *Knowledge*, 1, 521 (1882).
8. DICK, W.: Unrecognised halo phenomenon. *Marine Observer*, 24, 143 (1954).
9. ROBERTSON, A. I.: Peculiar arcs and lunar halo. *Marine Observer*, 21, 217 (1951).
10. GOBLE, C. J.: Elliptical lunar halo. *Marine Observer*, 6, 221 (1929).
11. CHAPMAN, E. G.: Elliptical halo. *Marine Observer*, 29, 116 (1959).

NOTES ON MARCH 1981 AT LUTON, BEDFORDSHIRE

In this part of the country we did not experience the weather-related excesses — flooding, gale damage, heavy snowfalls — which afflicted many western and northern parts of the kingdom, but March 1981 was nevertheless a month worthy of note. The month's weather is encapsulated in the following summary for Luton:

Mean maximum 10.7 °C	Difference from 1941-70 mean +1.3 °C
Mean minimum 5.7 °C	Difference from 1941-70 mean +4.0 °C
Highest maximum 17.8 °C on 28th	Lowest maximum 3.4 °C on 4th
Highest minimum 10.9 °C on 8th	Lowest minimum -1.2 °C on 17th
Total Rainfall 107.3 mm	Difference from 1941-70 mean +62.3 mm
Total Sunshine 55.8 hrs.	Difference from 1941-70 mean -53.2 hrs.

The synoptic climatology division of the Meteorological Office, Met. O. 13, have kindly supplied some information about the sea-level circulation for March 1981. Pressure was very much below normal in a belt extending from New York to southern Norway with centres of -16 mb at 45°N 40°W, -12 mb at 55°N 10°W, and -11 mb at 58°N 0°W/E (an even larger negative anomaly was centred south of the Aleutians, -19 mb). There was therefore a marked south-westerly cyclonic anomalous flow over most of Britain, and this is consistent with the dull and wet but quite warm conditions observed in many parts of the country.

The mean maximum temperature at Luton, although the highest since 1972,

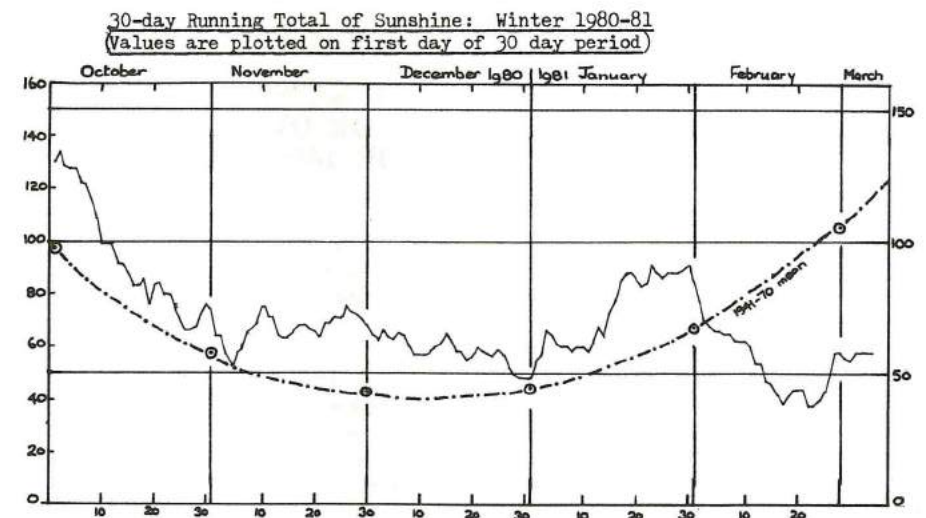
was not remarkable, but the mean minimum ranks second only to March 1957 when it stood at an exceptional 6.0 °C, the deviation from the 1941-70 mean of +4.3 °C being the greatest positive deviation for any month for this element. The night-time warmth in March 1981 is emphasised by the facts that 15 night minima were above the growth-threshold of 6 °C, and four were above 10 °C. Until this year, the highest March minimum was 10.6 °C (i.e. 51 °F) registered on 17th in 1957 and 30th in 1920, but alongside these we may now place 10.9 °C on 8th, 10.0 °C on 9th, 10.7 °C on 10th, 10.7 °C on 11th, and 10.7 °C on 25th in 1981.

There is no reason to question, then, the advanced state of spring plant-growth towards the end of the month, estimated at two to three weeks ahead of 1980 and four to five weeks ahead of 1979 and 1978. Nonetheless the statistical and phenological evidence was not mirrored by public opinion — some people even considered it to have been a cold March. Evidently, this was response to the excess of rainfall and deficiency of sunshine, uncontradicted by anybody.

As far as rainfall was concerned March 1981 ranked fourth this century, following so recently upon the second-ranking March 1979, while March 1980 also fell in the top quintile. Total sunshine was the lowest in the 82-year composite record, and examination of the near-homogeneous records from nearby Rothamsted indicate that this was the dullest March in this part of the world since systematic sunshine recording began in this country in 1880. It is not known at the time of writing how extensive was the area registering a new low record, but it is unlikely quite to match the widespread dullness of March 1980.

Some other interesting facets emerge from a study of the daily sunshine figures:

- (i) There were only 18 individual complete hours of sunshine, the smallest number for any month in the last five years excepting December 1978, compared with for example 78 in the average March of 1976.



- (ii) The total represents a mere 51% of the long-term average; occurrences of 50% or less have hitherto been confined to the four least sunny months of the year, one November, five Decembers, one January, and two Februaries.
- (iii) This is the first time, probably since 1880, that March has been the least sunny month of the winter. This is quite astonishing when one considers that the March mean is two and a half times the December mean, and that the sun is above the horizon for 123 hours longer.

The accompanying diagram illustrates the running 30-day sunshine total from October 1980 to March 1981 (Fig. 1). The contrast between persistently sunny conditions until late-February and the subsequent dullness is particularly clear, with the normal seasonal improvement completely reversed between 22nd February and 25th March. It can be seen that the most marked deficiency of sunshine occurred in the 30 days commencing 22nd February, although the subsequent recovery has been erratic and unreassuring.

The cold, wet, dull nature of recent springs was discussed by Shone (1980) and March wetness in particular has been noted before by the present writer (Eden, 1980). The mean sea-level pressure chart for the twelve Marches 1970 to 1981 (not shown) suggests a westerly flow over the British Isles appreciably veered from its usual direction and stronger over southern Britain than over Scotland. There is something of a trough near the Greenwich Meridian with a diffuent pattern over the North Sea and adjacent continent. Mean pressure differed little from the 1941-1970 mean in the South-west Approaches, but was close to 3 mb below the long-term mean over eastern and northern parts of the country, approaching 4 mb below near the east coast between East Anglia and the Moray Firth.

There is no obvious reason to suspect that the recent trend towards colder, wetter, duller Marches represents part of a longer-term trend, but some may argue with a measure of justification that Marches in the period 1920 to 1961 were anomalously warm, dry and sunny, and that we are now reverting to a pattern which was common before 1920.

G. PHILIP EDEN

FREQUENCIES OF MONTHLY RAINFALLS OF 101.6 mm (4.00 inches) OR OVER IN SOUTH HUMBERSIDE 1860-1979

By P. C. SPINK

Abstract: An analysis is given of monthly precipitation of 101.6 mm or over during 12 decades from 1860 to 1979 within a radius of 16 kilometres of Ulceby in South Humberside. The analysis reveals some interesting variations, notably the dominance of October over the first 50 years only to be displaced by July during the second 50 years.

I have records of rainfall for 120 successive years in this area: from 1860 to 1872 at New Holland (about 9 km distant), from 1873-1893 at Brigg (16 km distant), from 1894 to 1946 at the Earl of Yarborough's estate at Brocklesby (9 km), and from 1947 to 1979 at my home, Thornton Hall, at Thornton Curtis, near Ulceby. All the recording stations lie below the 30-metre contour. The frequencies of monthly totals of 101.6 mm (four inches) or more are given in Table 1.

It will be noted that in the first decade there were only five such occasions. This reflects a particularly dry decade which recorded nine successive years at or below the average mean. This was followed by the two notoriously wet decades of 1870-1879 and 1880-1889. The latter recorded the highest number of frequencies over the full period.

It is interesting to note that over the first fifty years October showed by far the most frequencies with fifteen occasions followed by August with eleven. In the second fifty years July was the most prolific month with twelve occasions (compared with only six in the first five decades) whereas the number for October was only four — a remarkable reversal. In both half-centuries August was in second place; indeed over the entire 120 years August recorded the highest total, closely followed by October and then July.

The number of months recording 127 mm (five inches) and over were as follows:

October 11, July 8, August 7, December 7, January 3, June 2, September 2, November 2, and May 1.

The three wettest months in the 120 years were July 1888 with 170 mm, October 1908 165 mm, and December 1978 163 mm.

The annual total for 1882 was 940 mm, the wettest of the 120 years (the 1941-1970 average is about 630 mm). In 1882 five months had over 101.6 mm, and in 1875 there were four months.

In the period 1860-1979, March recorded only three occasions with more than 101.6 mm, so it is of especial interest that the March 1981 total of 117 mm was the highest March total in 122 years. The previous wettest March was in 1947 which followed the severe snowstorms and rains at the end of that notable winter.

I am grateful to the Brocklesby Estate for the use of their long-established rainfall records which began in 1894 and fortunately still continue.

TABLE 1.

Decade	J	F	M	A	M	J	J	A	S	O	N	D	Total
1860-69						1		2		1		1	5
1870-79							2	3	2	2	3	1	13
1880-89						2	2	2	1	4	1	2	14
1890-99	1						1		1	5	1	1	10
1900-09			1				1	4	1	3	1	2	13
1860-1909	1		1			3	6	11	5	15	6	7	55
1910-19			1			2	2	3	1			3	12
1920-29	1	1		1	1		3		1	3	1	1	13
1930-39	1				1		4	2	1	1	2	1	13
1940-49	1		1				2		2		3		9
1950-59	1				2	1	1	3			1		9
1910-59	4	1	2	1	4	3	12	8	5	4	7	5	56
1960-69	2			1	1		1	3	2	1	1	1	13
1970-79		1					1	1	1	2	1	2	9
1860-1979	7	2	3	2	5	6	20	23	13	22	15	15	133

WINTER 1980-1981 IN THE ALPS

By H. J. SCHUG

Sonthofen, West Germany, and University of Innsbruck, Austria

The winter of 1980-1981 was a very remarkable one^{1 2}. On the northern side of the Alps it was the snowiest since at least 1951, with correspondingly disastrous consequences (avalanches, blocked roads, stranded tourists). Yet the southern side had an extreme drought, with bush-fires and with empty hotels in the ski resorts.

TABLE 1

Mean climatological data for the winter 1980/81 at Alpine CLIMAT-stations.

Station	Alt.	Temp.	Diff.	Rain	%	Sun	%
06660 Zürich	569	-1.2	-0.6	164mm	78	179h	110
06680 Saentis	2496	-9.3	-0.8	523	74	401	114
06700 Geneva/A	420	-0.4	-2.2	195	110	169	87
06770 Lugano	276	+3.1	+0.2	5	2	429	119
10866 München/A	528	-2.1	-0.6	170	104	238	141
10961 Zugspitze	2962	-13.1	-2.0	870	184	396	112
11035 Wien	212	+0.8	+0.8	135	105	280	150
11120 Innsbruck/A	598	-3.5	-2.0	171	109	285	116
11150 Salzburg/A	435	-2.2	-0.7	235	113	252	107
11146 Sonnblick	3106	-14.5	-2.0	489	146	370	110
11231 Klagenfurt/A	452	-6.0	-2.5	87	64	331	143
11240 Graz/A	342	-3.1	-0.9	60	53	395	162
16044 Udine/A	92	+2.1	-2.1	92	32	422	X
16080 Milano/A	103	+1.7	-0.2	19	10	420	X
16090 Verona/A	74	+1.5	-0.7	58	38	X	X
16105 Venezia/A	2	+1.4	-1.9	96	56	418	X
16110 Trieste	20	+4.3	-1.4	160	71	393	X

To support these facts, I provide in Table 1 mean values for the period December 1980 to January 1981 for all CLIMAT-stations in the Alps³. Averages refer to the W.M.O. standard period 1931-1960.

The past winter was in most places very cold but especially in the valley stations such as Innsbruck and Klagenfurt. Nevertheless, Lugano reported a positive anomaly of +0.2 °C which was probably an effect of the frequent northern föhn (on 1st January Lugano had a maximum temperature of 16.0 °C).

The monthly precipitation totals show the results of the constant north-westerly streaming, with three-monthly totals up to 870 mm (Zugspitze), and yet with only 5 mm at Lugano. Locally, there might have been higher totals (e.g. Tyrol, Vorarlberg, southern Bavaria), while at the other extreme some stations in the Italian Alps might have been rainless. In the Swiss Tessin-area the past winter was the driest since observations began in 1864. (Further afield, the southern part of the Iberian peninsula was also very dry, Seville reporting 8 mm, 4%).

TABLE 2.

Mean climatological upper-air data for the winter 1980/81 at Alpine radio-sonde stations at the 500 mb-level.

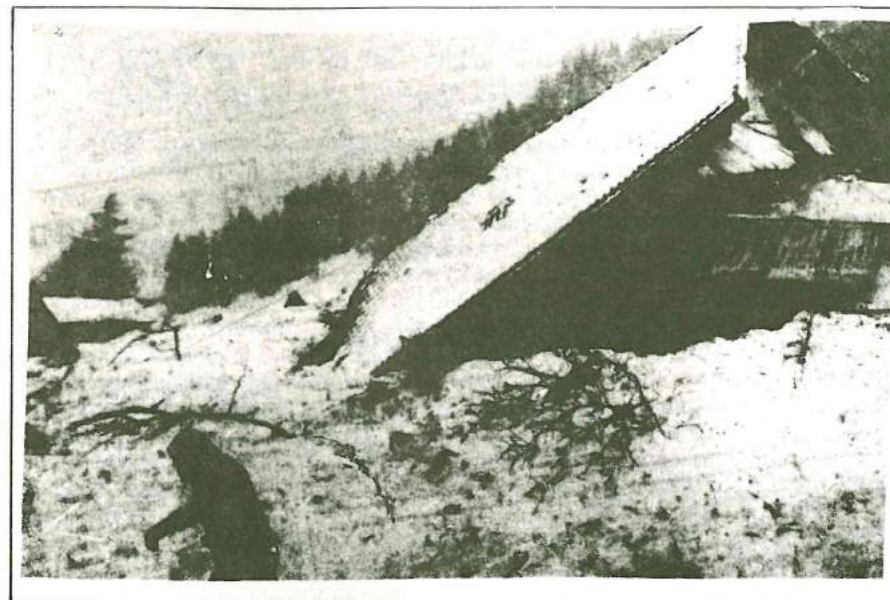
Station	Alt.	Height gpm	Temperature °C	Wind degrees
06610 Payerne	491	5522	-25.6	330
07480 Lyon/Satolas	240	5529	-24.4	340
10739 Stuttgart	315	5486	-26.5	320
10868 München	484	5479	-26.9	X
11035 Wien	212	5456	-28.3	310
16044 Udine	94	5479	-27.3	320
16080 Milano	103	5516	-25.8	330

Sunshine totals were commonly above normal and at the southern side of the Alps sums reached more than 400 hrs (Lugano: 429 hrs).

Table 2 shows the mean upper-air data of Alpine radio-sonde stations for the winter 1980/81, which demonstrate rather clearly the predominance of the N/NW streaming³ (3).

REFERENCES

1. NEWMARK, D.: Climatological Observers Link, No. 130, p14.
2. World-Wide Weather Disasters: January 1981. *Journal of Met.*, Vol. 6., No. 57, p90-93 (1981).
3. Klimatologische Übersicht Dezember 1980, Januar 1981 und Februar 1981. *Beilagen zur Berliner Wetterkarte*: 5/81 KEU XII/80; 31/81 KEU I/81; 41/81 KEU II/81.
4. Climatological Normals (Clino) for Climat and Climat Ship Stations for the period 1931-1960. W.M.O., No. 117, T.P. 52, Geneva 1971.
5. Witterungsbericht vom Februar 1981. Schweizerische Meteorologische Anstalt, Zürich.



One of nine chalets at La Morte, Isère, S.E. France, destroyed by an avalanche early on 21 January 1981.

DEATHS IN BRITAIN FROM THE WEATHER DURING 1980

By ALBERT J. THOMAS

This month-by-month list contains all deaths directly attributed to weather hazards, i.e. thunderstorms, blizzards, floods, gales, etc. Indirect deaths, such as road accidents due to fog, ice, etc., are also tabulated for each month but only important groupings are specifically mentioned; maritime casualties are also included (For details of how deaths are tabulated see *J. Met.* Vol. 1 No. 5, pp 168-169).

January: The first direct weather death of 1980 occurred on the 21st when a tree, blown down during gale struck a car on a road between Larne and Carrickfergus, Northern Ireland, killing one person. At least 10 indirect deaths occurred during the month, six on the 14th in road accidents due to snow and ice, and three on 20th, including two people who fell down mountain in Glencoe in snowstorm. There were 3 maritime deaths during the month, all on 6th, when a motorboat capsized in high winds and heavy seas off New Brighton, Merseyside.

February: The mildness of the winter to date was reflected in the continuing low number of casualties, there being only two direct deaths this month, both on the 17th at Partreath, Cornwall, when a man and his daughter were washed off a rock in heavy seas. There was one indirect death, on the 3rd. Another three maritime deaths occurred this month, on the 22nd, when a fishing vessel, the *Norfolk Spinner* grounded in heavy seas/fog at entrance to Aberdeen harbour.

March: Two direct deaths this month, one on the 18th at Wixoe, near Haverhill, Suffolk, when a car became stranded on a bridge over a river; the two occupants evacuated the vehicle, but one was swept away. The other death occurred the following day, the 19th, during a blizzard on the Brecon Beacons, Powys, Wales. There was one known indirect death during the month.

April and May: No deaths.

June: This month saw no less than four lightning deaths, three of which occurred on the 5th; one was a 69-year-old woman, struck in the village of Sellafirth, island of Yell, Shetland; another was a 14-year-old schoolboy at Accrington, Lancs., where an additional five were injured; the third death occurred at Brownhills, in West Midlands, when a 13-year-old schoolboy was killed and two others were injured. On the 15th, high winds whipped up heavy seas at Blackpool, sweeping a youth to his death. On the 19th, high winds and rough seas swamped a canoe at the head of Loch Nevis, western Scotland, drowning two army canoeists. The fourth lightning death of the month occurred on the 25th, when a 47-year-old woman was struck at Compton Bassett, near Calne, Wiltshire. This month saw a total of seven direct deaths, the highest monthly total of the year. There were five indirect deaths on the 14th, all in road accidents during heavy rain in Suffolk and Essex.

July: No direct deaths but five indirect ones on the 1st, when a car skidded off rain-slicked road and fell into a dyke at Shippey Hill, Suffolk.

August: Three direct deaths this month. On the 15th, when high seas hit the coasts of Cornwall and Wales, a bather was drowned on Fistral Beach, Newquay, Cornwall; on 29th a sharp thunderstorm touched off a flash flood along Hockley Brook, Handsworth, Birmingham, which left two dead. No indirect deaths this month.

September: Again three direct deaths this month. During strong to gale-force winds over much of U.K. on the 12th, a small boat overturned on Lake Windermere, leaving one dead; gales claimed two dead on 18th, at Newry, Co. Down, Northern Ireland, when a tree was blown down onto a car; no indirect deaths this month.

October: There were three direct deaths in October, all due to heavy seas whipped up by autumn storms. On 7th a woman was swept to her death at Morecambe, Lancashire; on 19th a man and his son were swept to their deaths off Long Hengh breakwater at Hartlepool; there were five maritime deaths

this day in the same storms, one off Whitby when a motor cruiser capsized and another four off Llandudno when a cabin cruiser capsized. For the third consecutive month there were no known indirect deaths.

November: There was one direct death, on the 16th, when a canoe capsized on the rain-swollen River Dee at Tower Bridge, Llangollen, Wales. Three indirect deaths occurred on 29th, when a car skidded on a slushy road and collided with a lorry at Warlingham, Surrey. Maritime casualties during the month totalled seven, three on the 14th when the trawler *Pitje Antje* capsized in a gale 32 km S.E. of Start Point, Devon; on the 15th auxiliary sloop *Rosalba* was grounded in a gale at Pembrey, near Llanelli, Wales, leaving four dead.

December: No direct deaths but four indirect deaths during the month, including three on the 26th when two cars collided on snow-covered road in north Perthshire, Scotland.

The total number of direct deaths for 1980 is therefore 22; indirect deaths totalled at least 29.

The number of known direct weather-related deaths in the last six years are as follows:—

1975: 26, 1976: 76, 1977: 28, 1978: 27, 1979: 31. 1980: 22.

May I take this opportunity to thank all people who have sent me news-cuttings via Dr. Meaden and the proprietors of *Lloyds List* for permission to use extensively from their newspaper.

VARIOUS HAPPENINGS

KEW OBSERVATORY FOR SALE

Following the departure of the Meteorological Office on 1st January this year from the splendid building which was Kew Observatory (see *J. Meteorology*, vol. 5 [issue 49], pp 137 and 161), the building has been put up for sale by the landlords, the Crown Estate Commissioners. It is described by the estate agents, Cluttons of Mayfair, as 'a superb potential residence with six-acre garden'. Cluttons say it would make a beautiful private house or company headquarters. It contains 17 rooms, some octagonal, with galleries and spiral staircases, and was built in 1769 for George III. The king had it built to look at Venus, but now only a weather-vane remains of the fine meteorological equipment which was kept there before the weather men moved to Bracknell. There is a small weather station in the nearby Royal Botanical Gardens.

The lease is expected to cost about £500,000. Several institutions have made inquiries, as well as individuals. Depending on the suitability of the proposed use, the building will go to the highest bidder. It is a grade-one listed building, which restricts any changes and ensures that it will be kept in its present condition.

1980 HAIL DAMAGE RECORD IN U.K.

It was reported recently in *Lloyds List* that provisional figures indicate that the total cost of hail damage in the U.K. in 1980 will exceed anything previously experienced. The cost to insurance companies and Lloyd's is likely to exceed £2 million, but the total cost is certainly much higher because some

farmers still carry their own risk. Insurance broker Stewart Wrightson of Maidstone said that fruit and hop farmers will remember 1980 for the several severe and widespread hailstorms. 'The cost of hail insurance is high, some might say excessive, and the dilemma for a fruit grower must be agonising, but another year like 1980 could be disastrous.'

Summer 1980 and the Period 4 to 13 July (Correction to letter by K. J. Hosking, p. 94, March 1981 issue). The penultimate line should read:

In the summer of 1979 the number of 'very warm days' between 4th-13th July was two . . .

WORLD-WIDE WEATHER DISASTERS: March 1981

1-13: Torrential rains touched off floods and landslides in Andes mountains, Peru, sweeping away homes and livestock and blocking roads; some 5,000 families homeless, at least 20 dead, and 50 missing, damage at least \$6 million. Rains also ended a three-year drought. *Lloyds List*.

1-18: Torrential rains touched off by slow-moving tropical depression, which has elevated rainfall totals by 700%, have caused serious floods in Tahiti which have inflicted heavy damage and contaminated water supplies. *L.L.*

4: A tornado hit areas of Mymensingh and Comilla districts of north-east Bangladesh, destroying 5,000 homes, downing power and telephone lines, and uprooting huge trees, 15 dead, 800 injured. *L.L.*

4: Avalanche buried large number of cars and trucks in Alborz mountains near Tehran, Iran, over 50 persons feared dead. *International Herald Tribune*.

6: 'Cyclone', followed by torrential rains, hit town of Narang Mandi, north-east Pakistan, homes destroyed, trees and electricity poles uprooted; 61 dead, 600 injured. *L.L.*

7-8: Cyclone 'Freda' caused heavy damage in northern sector of New Caledonia, with crops 50-100% destroyed.

8: M-bulk carrier *Mezada* sank in storm approximately 120 km east of Bermuda, 12 dead, 12 missing. *L.L.*

9-13: Heavy rains, floods in many areas of England and Wales, roads blocked and homes flooded, worst-hit area included Dorset, Somerset, Derbyshire, Sussex and East Anglia; in south and west Wales, widespread floods after 230 mm of rain in four days. On 10th 18 hurt when lorry and coach collided on M6 in heavy rain at Cresswell, near Stafford. On 11th young boy swept away by River Rhymney in Cardiff and on 12th thunderstorm touched off flash flood on Bradford Beck, Bradford, Yorkshire leaving 2 dead. *Daily Telegraph, Birmingham Evening Mail*.

10: Ice-storm hit Leningrad, U.S.S.R., streets, cars and buildings coated in ice 6.5 mm thick. *D.T.*

11-12: Cyclone 'Max' struck north Australian coast near Darwin with winds gusting to 140 km/h and with 137 mm of rain, no serious damage or casualties. *L.L.*

11-31: Heavy rains and melting snows have caused widespread floods and landslides in Yugoslavia, with serious damage. Water levels on rivers Danube and Sava reported at highest levels this century, some 740,000 acres inundated, at least 500 homes destroyed, 5,000 other buildings flooded, leaving

10,000 homeless; at least four dead in floods, but most serious incident occurred on 22nd when Nis-to-Beograd express hit by landslide at Stalac, south of Beograd, landslide pushed two passenger cars into river Morava, leaving 39 dead and 35 injured. *L.L.*

12: Multi-vehicle pile-up on fog-shrouded motorway near Parma, Italy, left 3 dead, 60 injured. *D.T.*

13: Mfv *Daito Maru No 55* sank in rough seas and winds gusting to 35 knots some 610 km N.W. of Adak, Alaska, U.S.A. 26 dead. *L.L.*

13 (reported): Heavy rains and melting snow has caused widespread floods in southern East Germany. R. Werra burst banks and flooded 4,000 buildings in town of Meiningen, in Suhl area same river flooded 850 homes, thousands of hectares of agricultural land submerged, road and rail links cut. *L.L.*

13 (reported): Serious floods in western Czechoslovakia, 7,500 acres of farmland flooded and many ships stranded on rivers because of high waters, some of which are 4 metres above normal. R. Ohre in western Bohemia region was flowing at its fastest rate in 28 years, river Labe also seriously flooded. *L.L.*

13 (reported): Serious drought in eight northern states of Brazil, much suffering. *D.T.*

14 (reported): Severe hailstorm in Andhra Pradesh State, India. Lumps of ice weighing up to 1.3 kg (3 lbs) fell, crops worth \$1 million destroyed, six dead, 'scores' injured. *L.L.*

18: Mfv *Celebrity* sank in gale and rough seas in Pentland Firth, northern Scotland, 6 dead. *L.L.*

18-21: Heavy rains, after two years of drought, touched off floods in Djibouti, Africa, which left 10 dead and about 100,000 homeless. *L.L., I.H.T.*

19: Flash floods along Waipapa river, North Island, New Zealand left one dead. *B.E.M.*

19 (reported): Week of floods, rain, landslides in Bahia state, central eastern Brazil, left 17 dead, 10,000 homeless. *I.H.T.*

19 (reported): Severe drought in Spain, described as worst since 1943, widespread crop and livestock losses. *I.H.T.*

21-22: Gales, rain, floods in southern and Midland areas of England, winds gusted to 97 km/h in Midlands, no serious damage. On 22nd high seas swept youth to death from his garden at Coddan Beach, near Bexhill, East Sussex. *D.T., B.E.M.*

22: Winds, gusting to 80 km/h, toppled trees in Brussels, Belgium, leaving 2 dead. *D.T.*

22-27: Gales and torrential rains in eastern Cape Province, South Africa, culminated in serious floods on 26th in and around Port Elizabeth which left four dead, six missing. Winds in area reached 135 km/h and in a 24-hour period 436 mm of rain fell near Port Elizabeth; in addition two died when tornado hit town of Witkop (date unknown). *L.L.*

25 (reported): Drought in Hebei province China, coupled with floods in Hubei province has brought food shortages to 40 million people. *D.T.*

28: Avalanche in La Vanoise Massif, French Alps, 7 dead, 2 missing. *B.E.M.*

31: Sirocco winds from Sahara Desert swept through Sicily and Italy, winds gusted to 106 km/h in western Sicily, where one died in Palermo when house collapsed, two wind-fanned forest fires burnt in Catania area, roads and

rail lines blocked by fallen trees, temperatures rose to 85 °F (29 °C) in Sicily. In northern Italy warm winds brought heavy rains and landslides in Alpine areas. Winds carried fine red dust to Switzerland and Germany. *L.L., I.H.T.*

31 (reported): Floods along Danube river in Romania reportedly highest this century. *I.H.T.*

ALBERT J. THOMAS

BALL OF LIGHTNING ON 7 OCTOBER 1980

The enclosed report of an exploding ball of lightning may well interest other readers of *J. Meteorology*. It is taken from the *Oxford Mail* of 8 October 1980. The thunderstorm which swept across the city between 12.15 and 12.45 p.m. on the 7th was accompanied by squalls, lashing rain, and a spectacular fall of hail which whitened pavements and roofs with drifts in recesses.

The first outbreaks of deep cold air over north-west Europe in autumn are invariably accompanied by vigorous convection over the still warm sea. With strong west winds this shower activity sweeps far inland over southern England via the Bristol Channel. Similarly, a north-west wind often carries widespread shower activity through the Cheshire Gap into the north Midlands.

A freak ball of lightning exploded only feet from where workmen were sheltering from a thunderstorm. The lightning shattered windows in at least ten houses and smashed a concrete path as it came to earth in New Marston, Oxford.

"It was like a big ball of white light," said workman Malcolm Turner, who was sheltering from the rain in a garage on the building site at William Street. "It came down just in front of us. There was a big bang and it just exploded," he said. "After it was over we dashed out to have a look. It had hit three trees and blown a big hole in the path. There was six inches of concrete and kerb stones blown right out," he said.

Nearby, workmen Eric Homent and Jim Ligget watched in amazement as the lightning blew a door off and ran along the floor of the house they were working in before exploding in a corner. "There was a bright white light. The noise was fantastic, it sounded like a gas explosion," said Jim.

The lightning struck during yesterday's thunderstorm and today people living in neighbouring Feilden Grove were still counting the cost. People living in houses backing on to the building site returned home to find all their rear windows shattered and some window frames blown in by the explosion. At least ten houses had windows either shattered or cracked.

The lightning had struck at the bottom of No. 10 Feilden Grove, home of lecturer Dr. Doris Taylor, "I don't know where to start," she said as she surveyed the damage. Mrs. Noushy Mohanna, of 7 Feilden Grove, dashed home after hearing the lightning strike, from Pullens Lane, Headington. "I

was quite a distance away from the lightning but the whole of the building I was in shook," she said. "We moved here nine months ago from California where we came through earthquakes, bush fires and floods with no problems. We come to peaceful England and this happens."

Yesterday Mrs. Mohanna and friend Mrs. Nina Holton were helping to clear up the mess at the house of research scientist Mr Mehrdad Sohirad at 8 Feilden Grove. Mr. Sohirad was on a trip to Leamington Spa and did not know about the damage. "All the windows have been blown in. It was very lucky because Mr. Sohirad normally sits right in front of one of them to do his studying," said Mrs. Holton.

Oxford

J. D. C. WEBB

(On the same day, there occurred the hailstorm at Wokingham, Berkshire, which was described in the February 1981 issue of *J. Meteorology*, pp 44-46.).

TEMPERATURES AT SCOTT BASE, ANTARCTICA, FOR 1980

The following temperature data for Scott Base, on the continent of Antarctica, have been assembled from the monthly issues of the New Zealand Gazette (subscription donated by Mr. R. A. Crowder, Lincoln College, Canterbury). The station is 16 metres above sea-level at latitude 77°S, longitude 167°E. Temperatures for 1976-1979 are to be found in *J. Meteorology*, vol. 3, 311-312; vol. 4, 214-215, and vol. 5, 326.

	Mean Max	Mean Min	Mean Temp	Diff. from normal	Max (date)	Min (date)
January	-2.5	-8.3	-5.4	-0.3	+2.7(17)	-15.5(12)
February	-6.1	-1.39	-10.0	+0.6	+1.1(11)	-23.5(28)
March	-15.3	-24.4	-19.9	+0.3	-6.1(14)	-35.0(28)
April	-16.6	-26.7	-21.7	+2.6	-8.8(28)	-40.6(18)
May	-16.5	-27.8	-22.2	+6.2	-7.1(16)	-41.3(27)
June	-22.0	-35.0	-28.5	-2.3	-12.8(25)	-44.8(16)
July	-20.2	-31.7	-26.0	+3.8	-10.3(20)	-47.5(17)
August	-19.3	-32.3	-25.7	+5.4	-9.9(31)	-45.1(7)
September	-22.4	-32.9	-27.7	+0.5	-10.6(1)	-42.4(17)
October	-16.7	-26.2	-21.5	+1.3	-4.6(30)	-45.9(5)
November	-7.2	-14.6	-10.9	+1.1	-1.8(21)	-22.2(9)
December	-0.4	-6.7	-3.6	+1.7	+4.4(31)	-15.9(3)

TORRO THUNDERSTORM REPORT: November and December 1980

By KEITH O. MORTIMORE
*Director, Thunderstorm Division,
Tornado and Storm Research Organisation,
77 Dicketts Road, Corsham, Wiltshire*

November

November opened with cold continental air covering the British Isles. The leading edge of the advancing airflow was marked by a slow-moving frontal system along the western seaboard of the Irish Republic. There was a good deal of heavy rain near this zone by 1800 GMT on 2nd, 140 mm had fallen at Valentia in the previous 36 hrs. Some of the rain turned thundery in places on 2nd with thunder at Roches Point, near Cork, and in Co. Mayo and Co. Galway. On 16th a cold front moved quickly across England and Wales from the west. Many places had showery rain and just before noon there was a thundery outbreak at Portland Bill, Dorset. On 17th an active trough moved east across most of the British Isles, accompanied by heavy showers and local thunderstorms. In the early afternoon there were storms in central Eire, followed by further outbreaks, locally, in Co. Antrim and Co. Down in Northern Ireland. It became 'very dark' in the Newry/Warren Point area where there was a fall of large hail. As the trough-line continued to move across the British Isles, there was thunder in Gloucestershire, west Kent, and at Eskdalemuir (southern uplands of Scotland), and later, during the evening, in Yorkshire and south Durham. Distant lightning was observed from Edinburgh, Exeter, and the Channel Islands. On 18th wintry showers affected many parts of Scotland and adjacent sea areas, and thunder was heard at Lerwick in the afternoon.

An unstable north-north-westerly airstream spread to most parts of Britain on 27th. During the evening a marked trough moved south across most parts, intensifying and concentrating the hail and snow shower activity, and thunderstorms were reported in north Staffordshire, Derbyshire, north Nottinghamshire, parts of Yorkshire and Humberside. The trough crossed southern counties of England in the early hours of 28th, giving further scattered thundery showers in Suffolk, the Greater London area, Kent, Surrey and near Bournemouth. Heavy snow showers affected many eastern areas on 28th and there was thunder at times, particularly near north-eastern coasts of England where some places saw frequent thundery showers. There was also local thunder very early in the day on Deeside, later in the morning in Shetland and later in the day in north Norfolk. During the early hours of 29th there were further thundery showers in north Norfolk and in Cleveland.

Thunder was heard somewhere in Great Britain and Ireland on 2nd, 16th, 18th, and 27th-29th, seven days compared with the normal of 13. No station reported more than one day apart from Redcar, where two days were recorded.

In the Netherlands there was thunder on six days, 11th, 12th, 18th, 21st, 27th and 28th, one day more than the normal for November. The most thundery day was the 28th when storms developed widely over the country in a north-westerly airstream off the North Sea. Thunder was also reported on 16th, 18th and 25th.

December

A very cold Arctic airstream covered the British Isles on 6th, and sleet, snow or hail showers affected many northern and eastern areas. During the evening, as a polar low formed off southern Norway and moved south towards the Netherlands, showers turned thundery, locally, along the coast of north-east England. Further thundery showers affected some exposed areas of western and north-western Eire on 13th and lightning was observed around midnight from Oban in western Scotland. There was a brief thunderstorm at Galway in western Eire early in the afternoon of 14th. Showery troughs crossed much of Britain on 15th and were particularly active in southern counties of England and Wales. Thunderstorms affected parts of Devon and Cornwall and south-west Wales in the early hours, and some southern coastal areas of England around the dawn period, particularly from the Isle of Wight to Sussex. Heavy rain, hail or sleet fell in places and after a storm at Hastings hail covered the ground to a depth of about 12 mm, which lay for nearly one hour and caused dangerous traffic conditions, locally. Further scattered storms affected some south-western coasts again in the early afternoon, and lightning was observed from Spurn Point in the evening. Exposed coasts of northern and western Britain were affected by a few thundery showers in the evening of 17th and again during the early hours of 18th with thunder also in south Wales and Guernsey. Around dawn, brief thunderstorms were still affecting north and west Scotland and the Northern Isles; there was also a storm near Newquay in north Cornwall, while lightning was observed from parts of east Scotland and south Dorset. In the afternoon there were thundery showers in the western Highlands of Scotland and around Merseyside. On 20th there was an early afternoon storm at St. Helier in Jersey, and in the evening an area of thunderstorms affected Merseyside and parts of Cheshire. At Knowle, near Broxton in Cheshire, a number of houses were struck by lightning. On 22nd there was thunder at Lerwick in Orkney, while the Northern Isles again reported thunder late on 24th. Early on 25th there was thunder at Valentia in Eire, and in the far north of Scotland, and during the course of the day thundery showers developed locally in western and northern Scotland, the Northern Isles, western Ireland, south Yorkshire, Lincolnshire, and in west Cornwall, Avon and north Somerset. Again, on 26th, there were thundery showers in west and north Scotland and adjacent Isles. During the evening of the 31st thunder accompanied a hail and snow shower at Wishaw (Lanarkshire), and lightning was observed from Prestwick.

Thunder was heard somewhere in Great Britain and Ireland on 6th, 13th, 15th, 17th, 18th, 20th, 22nd, 24th-26th and 31st, 12 days against the December normal of 11. Thunderstorms were most frequent near western and northern coasts, Galway reporting three days.

The Netherlands were particularly thundery with thunder on 4th-7th, 9th, 15th, 16th, 18th, 25th, 26th and 31st, 11 days against the normal of three. The high incidence of thunder-days being due to frequent Polar airstreams off the North Sea. In Belgium there was thunder on 5th, 15th and 26th, three days against the normal of a little over one. Munchen-Riem in West Germany reported thunder on 26th.

The TORRO Directors wish to thank all observers who have contributed to these thunderstorm summaries during the past 12 months. More observers are required, particularly in the lesser populated areas of the west and north of Britain.

TORRO THUNDERSTORM REPORTS:

January and February 1981

By KEITH O. MORTIMORE

Director, Thunderstorm Division,
Tornado and Storm Research Organisation,

77 Dicketts Road, Corsham, Wiltshire

January 1981

Thunderstorms were reported somewhere in Great Britain and Ireland on eight days during January, well below the normal of 13. As is often the case at this time of the year, thunder was mostly associated with polar outbreaks, and frequently accompanied snow and hail showers.

On the 1st wintry showers which affected many northern and western areas of Britain, were carried along by storm-force winds in the north, and thunder was reported from the Northern Isles. A strong north-westerly airstream covered the country on 4th and, as bands of showers moved south-east, there was thunder before dawn in the Hebrides and north-east Grampian, and around mid-morning at Gainsborough in Lincolnshire. With northerly winds over Britain on 9th snow and hail showers developed widely later in the day, particularly in northern areas and there was an isolated thundery outbreak to the north of Liverpool. The 12th brought the first widespread storms of the month on a cold front that turned thundery as it moved south-east across southern Britain; thundery showers were reported south-east of a line from south Yorkshire and Lancashire to Avon. Many of the storms were accompanied by hail and snow and tornadoes were reported at Ely and Buckingham. Snow and hail showers again developed widely on 14th. There was thunder at Stornoway in the morning and in other parts of Scotland in the afternoon; in the evening thundery showers affected Merseyside, Manchester, parts of Yorkshire, London and the south-east. In the early hours of the 15th thunder was again heard in the Merseyside area. There were isolated thundery showers at Scarborough in Yorkshire and in south-east Essex during the morning of 19th. On the 24th wintry showers were sometimes accompanied by thunder in the Northern Isles of Scotland.

Thunderstorms in the Low Countries were much more frequent than normal due to the frequency of polar airstreams off the North Sea. Thunder in the Netherlands was heard on 12 days, 1st-6th, 13th-16th, 19th and 20th, the normal being three days. In Belgium there was thunder on six days, 3rd, 4th, 14th, 17th, 19th and 20th, the normal being a little over one. The North Sea coast of West Germany was similarly affected with two or three days, and up to six days were recorded over the hills of central West Germany (four at Düsseldorf) and there were one or two days further south towards the Alps. In the northern Alpine regions up to three days were reported. Storms in Switzerland were confined to north-eastern areas with a single day, and in the Jura mountains between Switzerland and France with up to three days.

February 1981

Thunderstorms were reported somewhere in Great Britain and Ireland on only three days during February, well below the normal of 10. As in January thunder developed in polar outbreaks and was associated with snow and hail showers.

On 3rd scattered thundery showers affected some coastal areas of northern and western Scotland and a particularly long-lasting storm (for winter) moved

south-east across parts of Strathclyde during the late afternoon. On 4th snow and hail showers again developed widely and in the afternoon there were scattered thunderstorms in Norfolk. Finally, during the afternoon of 6th, when storm-force winds were sweeping northern Britain, there was thunder in the Shetlands.

In the Netherlands there were isolated storms on four days, 4th, 5th, 10th and 11th, which is one day more than the normal; in Belgium there was thunder only on the 4th, which compares with a normal of two days. In West Germany thunder also occurred on only one day, in central and north-western parts of the country.

LETTERS TO THE EDITOR

MYSTERY SPIRALS IN CEREAL FIELDS

I was interested in the 'mystery spirals' discussed in the March 1981 issue of *J. Meteorology*. During the period 1956-1961 I was stationed in Yorkshire and made relatively frequent journeys to London by train. Along some parts of the route the railway line runs along embankments and these give the opportunity to observe the fields on each side of the line when passing through agricultural areas. I would say that on at least five occasions I observed what appeared to be spirals similar to those described in your article, but obviously no detailed observations were possible. I also observed in corn fields, etc., damage tracks which appeared to be of the type associated with minor tornadoes. It was in fact the above observations which convinced me that minor tornadoes were far more common than was generally credited in meteorological literature, and this stimulated my interest in collecting reports of tornado activity.

Anglia Television Ltd., Norwich

MICHAEL HUNT

RAILWAY ACCIDENTS CAUSED BY THE WIND

In your March 1981 issue you asked for information on wind accidents to railway premises or vehicles (page 84). Several such occurrences are described in *Red for Danger* by L. T. C. Rolt (Pan Books, M168, published 1960 and 1966), and two (as well as the Tay Bridge disaster) are given in some detail. The earlier of these occurred on 22 December 1894 at Chelford in Cheshire on the London and North-Western Railway when, during shunting operations, a wagon was blown out of a siding by the gale, collided with other wagons and blocked the main line in the path of an express train. Fourteen people were killed. The second was on 30 January 1925, on the Londonderry and Lough Swilly Railway. A train of three carriages was blown off the track while crossing a viaduct, the parapet of which failed to hold them and the coaches toppled over. Other accidents are mentioned in less detail. On 27 February 1903, ten coaches of a train on the Furness Railway were derailed by a 100 mph gale, while crossing the viaduct over the Leven estuary. On various dates in 1898-1899, three trains were blown off the lines in the west of Ireland. After one of these accidents, at Quilty in the west of County Clare, an anemometer was installed and the stationmaster was required to take specified precautions when the wind speed reached 60 mph and to stop all traffic at 80 mph.

This book, which 'makes death and disaster on the line most attractive reading', also lists many crashes by snow, by railway cutting slip after heavy rain, and of course by fog. Add to these a fair sprinkling of boiler explosions and a lot of human error and stupidity, and the whole makes compulsive reading.

Yatton, Avon

A. H. WEEKS

A MARCH SINGULARITY

Mr. Colin Finch's review of singularities in the London area 1947-1980 notes March 25th as the warmest day of the month with an average maximum of 54.1 °F (12.3 °C) not equalled again for two weeks (*J. Meteorology*, vol. 6, 51-54).

I started keeping records in Newark in 1949. A striking feature in the early years was the regularity with which a warm spell occurred just after the Spring Equinox. I have thus calculated

daily mean maxima for March 20-26 for 1949-1980; the figures and other salient points are given in the table.

Date	Mean Max (F)	A	B	C
March 20	50.4	0	0	4
21	48.6	5	16	5
22	50.0	14	7	9
23	51.3	11	8	9
24	50.6	10	11	7
25	52.6	13	4	10
26	50.5	4	11	3

(Column A: no. of days 3 °F warmer; Column B: no. of days 3 °F colder;
Column C: no. of maxima over 55 °F)

A point of popular mirth is the coldness of the 'first day of spring' (March 21), and this is borne out; it averages nearly 2 °F colder than March 20 and is colder than that day by at least 3 deg. nearly one year in two. After that, the trend is virtually steadily upward to March 25 to 52.6 °F and with 55 °F exceeded nearly one year in three. The 26th is significantly colder on average; it has been 3 °F or more warmer only about once in a decade.

Riverside Road, Newark, Notts

I. T. LYALL

TEMPERATURE EXTREMES FOR STRETTON, STAFFS

I have compiled the attached table of temperature extremes observed at Stretton during the last twelve years (January 1970 — March 1981). I hope this may be of interest, and I would hope that it might lead to comment from others. I am interested in establishing extreme limits that may be experienced in this part of the country. I would add that my station is some 54 metres above sea level and it is adjacent to open fields although with a fair number of trees nearby. The landscape comprises a rather flat river terrace, gravel soil chiefly, with some clay.

	Highest		Lowest	
	Max	Min	Max	Min
January	13.9	10.5	-11.5	-16.2
February	15.0	8.3	-3.3	-9.4
March	18.3	11.5	0.0	-7.8
April	22.8	11.7	2.8	-5.6
May	27.0	14.4	7.2	-2.8
June	33.9	18.9	11.5	3.3
July	33.9	19.4	13.9	5.6
August	33.9	21.1	13.9	3.3
September	26.1	17.2	11.5	0.0
October	22.8	16.1	6.1	-2.8
November	17.2	13.3	-2.2	-7.2
December	15.0	11.7	-1.7	-6.7

(Note: Some of these Celsius values have been converted from Fahrenheit readings, and therefore represent the nearest Celsius equivalent. All readings are 24-hour extremes.)

Church Road, Stretton, Burton-on-Trent

D. J. STANIER

ROUNABOUTS AND SWINGS

As the table shows, the 1980-1981 winter rainfall in Yatton (near Clevedon, in Avon County) was only one half of average.

	1980-81	Mean	%
December	58.2	93	63
January	29.2	83	35
February	32.7	63	52
	120.1mm	239mm	50%

By contrast, the total rainfall for March was 142.5 mm. The February total was passed on 8th March, the combined January-February total of 9th, and the winter total on 22nd. March's total was 250% of average. There was certainly not a proverbial 'peck of March dust' to be around here.

13 Stowey Park, Yatton, Avon

A. H. WEEKS

TWO SCARCE BOOKS FOR SALE

Weather Lore, a collection of proverbs, sayings and rules concerning the weather. Compiled and arranged by Richard Inwards. 1893. London. 190 pages. 235 x 155 mm. Original binding; reasonable condition. £10.00, \$24.00.

The Shepherd of Banbury's Rules, to judge of the changes of the weather, grounded on forty years experience, by which may be known the weather for several days to come, and in some cases for months; to which is added a rational account of the causes of such alterations, the nature of wind, rain, snow, etc. By John Claridge, Shepherd. A new edition, 1800. London. 64 pages. 220 x 130 mm. Original binding, but broken. £20.00, \$48.00.

Please add £1.00 towards cost of postage and insurance.

Apply to the Editor, Journal of Meteorology, Cockhill House, Trowbridge, Wiltshire, England.

Book Reviews

STATISTICAL ANALYSIS OF WEATHER MODIFICATION EXPERIMENTS

Edited by E. J. Wegman and D. J. E. Priest, Marcel Dekker Inc., New York. pp. 145. S.Fr. 55.

Weather modification experiments are not well-known in the United Kingdom, but such experiments have been extensively conducted during the past thirty years, mostly in the U.S.A. but also in several other countries including Australia, France and Israel. Most experiments are designed to increase precipitation in relatively arid areas, but other experiments have been attempted to decrease hail, to produce more sunshine by dissipating stratus clouds, or to decrease winds in a hurricane.

It is not disputed that a suitably chosen cloud may be made to rain (or snow) by introducing silver iodide crystals into it, either from an aircraft or from burners on the ground, and there are even commercial cloud-seeding operators in the U.S.A. However, the recognition that a cloud can be physically changed by the introduction of silver iodide does not prove that the overall rainfall over a 'target' area is increased, and it is very difficult to design and analyse an experiment which enables conclusive evidence to be obtained on this question.

Statistical advice is essential to conduct such trials, but even though eminent statisticians have been involved in some famous experiments, the problem has been so complex that the results have often been open to argument. The interest of the (mainly American) statistical profession in cloud-seeding is shown by several recent articles or collections of papers, namely Braham (1979), *Journal of American Statistical Association*, 74, 57-104, which includes a discussion of Braham's paper by ten other discussants, and two special issues of *Communications in Statistics* (1979), A8 numbers 10 and 11, which include seven papers and a bibliography on the subject, and has some overlap with the present book. This book is based on the proceedings of a

'Workshop on the Design and Analysis of Weather Modification Experiments' held at Florida State University in 1978. It is a collection of papers and discussion, some of which was presented at the Workshop and some of which appears to have been written afterwards. Much of the discussion centres on one particular experiment, the Santa Barbara Convective Seeding Test Program Phase 1, which was conducted from 1967 to 1971 in an area near Santa Barbara, California. This experiment, like most others, suffered from several problems, both physical and statistical, and so provides a good illustration of the difficulties involved in weather modification.

Turning to the specific contributions in this book, three papers, by Bradley, et al, Hanson and Barker, and Scott, are by statisticians based at Florida State University and deal with various statistical techniques that were used in the Santa Barbara experiment. At first sight it appears that seeding had an effect, but when various explanatory variable (covariates) are allowed for, the seeding effect disappeared. There is some argument about whether the covariates themselves were affected by the seeding, and therefore should not have been used. Two further papers by other statisticians (Gabriel and Kempthorne) discuss statistical problems associated with weather modification experiments in general, and with Santa Barbara Phase 1 in particular.

Papers by non-statisticians (Court and Elliot) similarly discuss the physical problems associated with cloud-seeding. In addition, there is a paper, unrelated to the Santa Barbara experiment, by Neyman, which describes some developments in probability and statistics which have been directly generated by problems in meteorology. Finally, there are short contributions from Bradley and Neyman which comment on the previous papers. It appears that there is a Phase II Santa Barbara experiment where lessons learnt from Phase I are being incorporated.

For anyone wishing to learn something about weather modification experiments and some of their problems this book provides a useful starting point, including many references to earlier work. However, for non-statisticians a few of the papers will be unreadable in places. There are relatively few misprints, and most are easily spotted, but there are some omissions from list of references in two of the Papers.

Mathematical Institute, University of Kent

I. T. JOLLIFFE

Books

AN INTRODUCTION TO ATMOSPHERIC PHYSICS, Second Edition. By Robert G. Fleagle and J. A. Businger. Academic Press, New York 1980, London, Jan. 1981. 432 pp. \$34.00, £19.20.

This book relates major atmospheric properties and phenomena to their fundamental physical principles. Its chapters are devoted to gravitational effects, atmospheric gases, cloud particles, atmospheric motions, radiation, transfer processes, and signal phenomena.

The first five chapters cover the major subdivisions of atmospheric physics. Each chapter builds on preceding ones to provide a coherent account of how the atmosphere functions. The final two chapters develop two primary themes: energy transfer and transmission of information through the atmosphere. Exercise problems are included at the end of each chapter along with

their solutions.

The second edition of this popular text has been revised to include advances made through recent research. It considers atmospheric motions for the first time and presents an extended discussion of energy transfer and remote sensing of atmospheric properties.

The text assumes a background in general physics and elementary calculus but no specific background in the study of the atmosphere. It provides students with the knowledge necessary to undertake specialized graduate study in the areas of physical meteorology, cloud physics, dynamic meteorology, turbulence, and remote sensing.

AN INTRODUCTION TO ATMOSPHERIC RADIATION. By Kuo-Nan Liou. Academic Press, New York 1980, London Jan. 1981. 392 pp. \$37.50, £21.00.

CLIMATE AND WEATHER IN THE TROPICS. By Herbert Riehl. Academic Press, New York, Oct. 1979, London 1980. 604 pp. \$59.00, £28.00.

As tropical countries begin to play an important part in world affairs, the effect of tropical climates on agriculture, economic development and even global political relationships is increasingly felt. Therefore it is important that we understand the mechanisms of tropical weather systems and climates. New techniques with satellite and radar are available to help in gaining greater knowledge and international meteorological research has not been slow to exploit the advances made. The publication of these findings has made available much new information. With the current tendency to over-specialize within the broad meteorological spectrum has come a sudden burgeoning of related knowledge.

This book aims to present clearly and comprehensively the factual bases of the latest advances in tropical meteorology and their interpretation. Satellite and radar information is used extensively in the analysis of convective processes. Ferdinand Baer has contributed an extremely thorough chapter on numerical hurricane prediction: his discussion of the important advances made in the use of computers is applicable outside his particular field.

This book, primarily intended as a textbook, will be of particular use to meteorology students who are familiar with the basic theories. It will serve as a handbook for professionals in atmospheric sciences and in the related areas of physics and engineering, and should also be useful to those working in the social sciences who find it necessary to update and improve their knowledge of the tropics.

THE ANGLIA TELEVISION WEATHER SERVICE LIST OF RECOMMENDED BOOKS

The books listed below represent only a small percentage of the very many weather books which are available. Text books involving advanced mathematics have been deliberately avoided and also those books which, by reason of cumulative price increases, have become very expensive.

Anglia Television does not supply any of the books and all books should be obtained from your local bookseller. The prices mentioned are as at March 1981 and it is suggested that a check be made as to the up-to-date price before ordering any book.

All books listed are considered good value for money.

THE WEATHER GUIDE
by A. G. Forsdyke.
Hamlyn All-Colour Paperbacks
159 pages
£1.75

KNOW THE WEATHER
Know the Game Series.
Educational Productions Ltd.
48 pages
70p

**INSTANT WEATHER
FORECASTING**
by Alan Watts.
Hart-Davis Educational
64 pages
£2.95

WEATHER IN BRITAIN
by L. G. Humphrys
Blackwell's Learning Library
60 pages
£1.60

**GUINNESS BOOK OF
WEATHER FACTS AND
FEATS**
by Ingrid Holford.
Guinness
240 pages
£6.50

**METEOROLOGY:
FORECASTING THE
WEATHER**
by Heinz Wachter.
Collins
128 pages
£4.95

EARTH'S AURA
by Louise B. Young.
Pelican
320 pages
£2.50

For the general reader and the student. Originally published in 1969 and thus a few of the entries are slightly out of date, but this book with its clear coloured diagrams and accurate text is still a 'best buy'.

An attractive booklet for those having a general interest in weather matters.

An ingenious and moderately successful attempt to deal with weather forecasting by the amateur observer. Various coloured cloud photographs and skylscapes are analysed and possible developments suggested. This book is recommended *but* its principal interest and value will be to those who already have some knowledge of elementary meteorology.

A pleasant little book for young children of ages a little older than is implied by the illustrations on the cover.

Potential readers should not be misled into thinking that this is simply a record of climatic extremes. It is in fact a readable and well illustrated book which can be recommended for all those interested in various facets of weather in many parts of the world. An excellent book for a school library.

Very attractively illustrated, partially in colour, and wide-ranging in its contents. Not a highly technical book, so might be regarded as an ideal present for a young student with an interest in our weather environment.

This Pelican book, published in 1980, is described as 'A Layman's Guide to the Atmosphere'. It is written in a slightly discursive, but attractive, style. Nevertheless, it is a mine of accurate information about the earth's immediate atmosphere and also those outer regions where it thins and merges with the inner regions of space.

**METEOROLOGY FOR GLIDER
PILOTS**
Third International Edition
by C. E. Wallington.
John Murray
331 pages
£8.50

BASIC WINDCRAFT
by Alan Watts.
David and Charles
96 pages
£2.95

**MOUNTAIN WEATHER
FOR CLIMBERS**
by David Unwin
Cordee.
60 pages
£1.00
MOUNTAIN WEATHER
by David Pedgley
Cicerone Press
110 pages
£2.00

**BASIC STUDIES IN
GEOGRAPHY: THE EARTH
AS A SETTING FOR HUMAN
LIFE**
by Eric Young.
Edward Arnold
65 pages
£1.75

**WORLD WEATHER AND
CLIMATE**
by D. Riley and L. Spolton
Cambridge University Press.
120 pages
£4.25

CLIMATE AND WEATHER
by Hermann Flohn.
Weidenfeld and Nicolson
253 pages
£2.95 paperback

This book is a classic in its field, but it will also be of interest to those who fly powered aircraft. The explanation of temperature height diagrams in chapter 20 can hardly be bettered, and the Technical Notes at the end of the book will be of value to forecasters as well as pilots.

The sub-title of this book is 'Using the Wind for Sailing'. The author gives precise and extremely well-illustrated information on both the mechanics and the meteorology of such usage. Small-scale wind patterns are dealt with in detail and the dinghy sailor or yachtsman, who is armed with the information given in this book, will certainly stand a good chance of being ahead at the finishing line.

) These two little books adopt very different
) approaches and are really supplements to
) each other. They should certainly be read
) by all those who climb or trek in hilly or
mountainous districts.
) (Anglia Television Weather Service has
) available a free pamphlet *Mountain*
) *Weather and Safety in the British Isles*.
)
)

A good mixture of environmental geography and weather studies. Well illustrated in colour.

Very well illustrated in black and white and recommended for advanced level geography students. The illustrations include typical synoptic weather maps covering many parts of the world. Much information is compressed within its 120 pages.

An excellent publication for the serious reader and the student studying geography to advanced level or beyond.

WEATHER MAP OF THE BRITISH ISLES

Compiled by David Houghton.
Bartholomew
size 1 metre × 750 mm
95p

BRITAIN'S WEATHER AND CLIMATE

by Harry Etherington.
Ginn & Co. Ltd.
64 pages
£1.80

THE AGRICULTURAL CLIMATE OF ENGLAND AND WALES

Technical Bulletin 35
H.M.S.O.
147 pages
£2.40

WEATHER WORKSHOP

by Michael Hunt and Michael Weale.
The Ely Resource and Technology Centre,
Back Hill, Ely,
Cambridgeshire.
43 pages
£1.40 to schools

WEATHER MAPS

by A. H. Perry and V. C. Perry
Oliver & Boyd
61 pages
£1.90

THE OBSERVER'S BOOK OF WEATHER 1980 edition

by Robert Pearce.
Warne
191 pages
£1.80

Despite its title this is a large wall chart giving a series of pictures and diagrams illustrating in an interesting way many facets of British weather.

A well illustrated (black and white) account of the climate of the British Isles and the causes thereof. Although primarily a school text book, the general approach is a lively one.

As its title implies it is a highly technical summary of month by month climate in 52 different areas covering England and Wales. The climatological information is based on the 1941-70 averages and includes radiation, illumination intensities, soil temperatures, irrigation data, etc. Essentially a reference book.

This booklet came about as a result of an exhibition and a series of practical weather study sessions which were held in a number of educational centres in Cambridgeshire about six years ago.

This book is concerned almost exclusively with the analysis and interpretation of weather maps as required in the relevant sections of the GCE examination geography syllabi.

This latest edition is *totally* different from two earlier editions in that it is a miniature text book and not a general guidance book for the so-called average member of the public. It is very up-to-date, particularly in the field of satellite meteorology, and also covers in some detail tropical meteorology. Hardly a book for beginners but should certainly be available in secondary school libraries.

CLOUD CARD SETS

Set 1: Cloud Formation and Types
Set 2: Clouds and Associated Weather
BP Education Service,
P.O. Box 5, Wetherby,
West Yorkshire.
£2.50 per set but special reduction for schools, etc.

Each set consists of about 13 large cards each with 4-colour photographs/diagrams. Strongly recommended. The same photographs are also available in the form of wall charts, slides and film-strips. (Details are available from the address given).

GENERAL NOTES

1. Some good books are, sadly, out of print, and it is recommended that a check be made with local libraries as to whether or not they have available the following:

Climate and the British Scene by Gordon Manley

The English Climate by H. H. Lamb

The Elements Raga by F. W. Lane

Weather Lore by Richard Inwards

Cloud Study by F. H. Ludlam and R. S. Scorer

Weatherwise Gardening by S. A. Searle and L. P. Smith

2. Her Majesty's Stationery Office publish sectional catalogues which list the official publications of various Government Departments. Copies of any of these Sectional Lists can be obtained by writing to H.M.S.O., Atlantic House, Holborn Viaduct, London EC1P 1BN.

The Meteorological Office Sectional List is No. 37 and it includes details of publications which give climatological information for the British Isles and/or the world. For example, Part III (Europe and the Azores) of Met 0 617 gives climatological data in tabular monthly form for some 630 places in Europe and the Azores. (The individual reference number of Part III is Met 0 856c).

3. A number of Meteorological Office technical publications are obtainable solely from Meteorological Office sources. This will normally be the Meteorological Office Headquarters, London Road, Bracknell, Berkshire RG12 2SZ, unless there happens to be a designated Meteorological Office Weather Centre for public services within your area. Details of the publications available are given in Met 0 leaflet No. 12, Publications which is mentioned below.
4. A number of brochures/leaflets are available (normally no charge is made) from the Meteorological Office headquarters, London Road, Bracknell, Berkshire RG12 2SZ. They include the following:

Weather Forecasting Today

Weather Advice to the Community (Met 0 leaflet No. 1)

Hydrometeorological Services

Services for Agriculture

Sail Weather Wise

Weather Bulletins, Gale Warnings and Services for the Shipping and Fishing Industries (Met 0 leaflet No. 3)

Services for Civil Aviation

Weather Services for Builders

Publications (Met 0 leaflet No. 12)

Anglia Television Weather Service, Anglia House, Norwich, Norfolk, U.K.

WORLD WEATHER REVIEW: February 1981

United States. *Temperature:* a very warm month; cold only near Gulf of Mexico (—1 deg.); +6 deg. in N.E. Montana and North Dakota, +7 deg. in N. Maine. *Rainfall:* wet in three main areas: North Dakota to Maine and as far as S. Kentucky; the S.E. states; the N.W. from Washington to W. Wyoming. Over 200% from E. Iowa to L. Michigan, in C. Ohio, near L. Erie, C. Pennsylvania to S.W. Maine, S.E. Alabama, W. Georgia. The drought in the S. and N.E. eased considerably. Under 50% in much of S.W. quarter; under 25% in band just E. of Rockies. (E. Montana to N. and S.W. Texas).

Canada and Arctic. *Temperature:* warm over the whole of Canada and Alaska; +4 deg. in C. Alaska and most of Canada except periphery; +6 deg. in C. Alberta, N.E. Manitoba, S. half of Quebec. Cold in Iceland, Spitzbergen, Franz Josef Land, most of Greenland except N. *Rainfall:* wet in E. half of Canada except Maritime Provinces and from S. Quebec to Hudson Bay; wet also in S. half of Alaska, S. British Columbia, W. coast of Greenland, from S. Iceland through Spitzbergen to Franz Josef Land; over 200% in S.W. Alaska; from Victoria Island S.E. to Hudson Bay, S.W. Quebec, C. Quebec to S. Baffin Island and S.W. Greenland. Under 50% in and just E. of Canadian Rockies, Mackenzie Basin, extreme N. Canadian Arctic islands, N. Iceland, Nova Scotia, Newfoundland; under 25% in S. Saskatchewan and S. Manitoba.

South and Central America. *Temperature:* warm from Colombia to Guianas, E. Brazil through to Chile and Argentina to at least 40°S; also West Indies and N.W. Mexico; +2 deg. in S.E. Brazil, N.W. Mexico. Cold from N. Bolivia and N. Paraguay to W. Brazil; E. and S. Mexico; —2 deg. in last area and E. Bolivia. *Rainfall:* wet from S.W. Bolivia and W. Paraguay to Uruguay and N. Argentina; interior S. Mexico, most of West Indies and probably Venezuela and Guianas. Over 200% from W. Paraguay to N.E. Argentina and Uruguay; interior S. Mexico. Dry in C. Chile, C. Argentina, at least S. half of Brazil, most of N. and coastal Mexico, Bahamas. Under 50% in parts of W. Argentina; under 25% in E. Brazil; rainless in parts of W. and coastal Mexico.

Europe. *Temperature:* warm E. of a line from E. Netherlands through E. Austria to W. Bulgaria (except N. Scandinavia, —2 deg. in N. Finland); +4 deg. in E. half of European Russia; also warm in parts of Scotland, Eire and S. Iberia. Cold in W. Europe, —2 deg. in C. and S. France, much of Italy, S. Greece. *Rainfall:* except for European Russia (wet from Ukraine northwards) wet only in small areas: S.W. Norway, S. Sweden, N. Poland, N. England, S. Eire, N.E. Spain, S. Italy, coastal Yugoslavia. Under 50% from S. France through S. Germany and S. Poland to N.W. Bulgaria; also S.W. Iberia; under 25% in S. Spain, S. France, N. Hungary; under 10% in N. Italy. Provisional sunspot number 144.

Africa. *Temperature:* warm in coastal countries (except Mediterranean ones and on coast from Spanish Sahara to Liberia); +3 deg. in N. Namibia. Cold in interior N. of Equator, near Mediterranean and from interior Cape Province to Zimbabwe; —2 deg. in Libya and N. Transvaal. *Rainfall:* mainly dry N. of Equator (though little data near Equator), W. Namibia, S.W. Cape Province; under 25% in Kenya, rainless in S.W. Cape Province. Wet in S.W. Morocco, S.W. and N.E. Algeria, S. Tunisia, much of South Africa, at least S. Mozambique; over 200% in parts of all these areas.

U.S.S.R. *Temperature:* mostly warm, except Taimyr Peninsula, E. of L. Baikal and N. of Kamchatka; +5 deg. in Urals, +6 deg. at 68°N 115°E. *Rainfall:* dry from White Sea through Urals to W. Caucasus and Aral Sea; N.E. of L. Balkhash, from E. of L. Baikal to Sakhalin, most of N.E. Siberia. Wet elsewhere, over 200% S. of Moscow, E. Taimyr Peninsula and around Okhotsk.

Middle and Far East. *Temperature:* warm generally, +4 deg. in E. Turkey. Cold in N. and E. Saudi Arabia, Mongolia, N.E. China, C. Japan, extreme S. Korea, much of Indonesia; —4 deg. in Mongolia. *Rainfall:* wet from interior Turkey to head of Persian Gulf, Afghanistan and Pakistan; also Bengal, N. Burma, much of E. China; S.E. Asia very mixed. Over 200% in and around Iraq, Bengal, locally in Afghanistan and Pakistan, very locally in E. China. Dry in much of China, especially W., and nearly all of India, Korea and Japan; under 25% widely in India and W. China.

Australia. *Temperature:* warm in E., +2 deg. in interior S.E.; cold in W., —2 deg. round Perth. *Rainfall:* mainly wet, over 200% on N.W. coast, from Brisbane to Canberra and locally in South Australia. Dry in extreme N. and S.W., from Alice Springs nearly to S. coast and much of S.E. quarter away from E. coast.

M. W. ROWE

MARCH 1981 WEATHER SUMMARY

For England and Wales the month of March 1981 was the second wettest, after 1947, in the 255 years for which national comparative records are available. At the same time it was a cloudy month, with low sunshine totals and unusual night-time warmth (the mean minimum anomaly approached +4.0 °C in places). Rainfall percentages ranged from 150% in east Devon to beyond 300% in parts of Wiltshire, Wales, Cheshire, Lancashire and some other localities, with even 400% in Fylde. The wetness was due to numerous depressions passing across or very near to the British Isles, their vigour strengthened by the moistness and warmth of southerly air interacting with deep polar air.

The first of the depressions had a central pressure of 974 mb at 0600 on the 1st when over S.W. Ireland. Britain was rather cloudy with showers or longer periods of rain or thunderstorms; one such storm produced a splendid tornado-waterspout which caused damage at the village of Beachley adjacent to the Severn Bridge in the Severn estuary. At a few rainfall stations (e.g. Oxford, Newcastle) it was the wettest day of the month. As the depression filled over northern France on the 3rd, a brief anticyclonic interlude began with most British climatological stations recording their coldest days on the 3rd, 4th and 5th (maxima 3-5 °C). On the 6th and 7th a complex area of low pressure formed to the west of Britain, and from the 7th onwards warm air progressively invaded England and Wales. Warm frontal rain fell upon England and Wales for much of the 9th, and again on the evening and night of 10th-11th. These were the wettest days of the month for a large number of stations (see Table), although for some others, subjected to heavy showers or thunderstorms on the 12th, this latter was the wettest. Except in northern areas, the 13th (and in the east the 14th) was also very rainy as a depression

slowly crossed Britain eastwards.

The next important depression, with central pressure below 973 mb, passed from Iceland on 17th to Norway on 19th; this brought wet wintry weather to Scotland, N. England and N. Ireland on 18th-19th. Then from 19th to 21st several depressions formed along a frontal zone stretching west-east from Ireland to Denmark, giving widespread unsettled conditions. A depression, 966 mb at noon, crossed central England during the 21st bringing heavy rain and gales on 21st-22nd; a 24-hour total of 129 mm was measured at Penybrynysaf in Snowdonia at 0900 on 22nd. Yet another depression approached and crossed Scotland on the 23rd (central pressure 969 mb), and continued on to Denmark and Sweden. The remainder of the month was also unsettled, but fairly warm, over Britain as a vast area of low pressure dominated the weather over the whole of the Atlantic west of Europe.

TEMPERATURE TABLES: MARCH 1981

	MEAN		HIGHEST		LOWEST		GRASS	A	G
	Max	Min	Max	Min	Max	Min			
AUSTRIA: I'bruck	12.9	2.8	20.4(v)	12.9(30)	3.3(18)	-3.6(19)	-6.1(5)	8	14
BELGIUM: Houw'rt	13.5	4.6	21.7(29)	12.0(25)	3.6(4)	-2.6(18)	-3.2(1)	6	9
.. Uccle	12.9	6.0	20.7(26)	11.8(11)	2.0(5)	-0.4(18)		2	
.. Brugge	12.2	5.7	18.8(30)	11.8(11)	3.4(5)	0.0(17)		0	
DENMARK: Fano	5.3	1.2	13.7(31)	5.7(26)	-0.6(1)	-8.2(4)		9	
.. Frederik'd	5.6	0.2	15.0(22)	5.9(22)	-1.0(15)	-5.9(4)	-8.0(4)	13	22
FINLAND: Helsinki	-2.3	-10.4	6.0(31)	1.0(25)	-9.0(6)	-27.0(7)		30	
FRANCE: Paris	12.9	7.0	23.0(25)	15.0(11)	5.0(4)	-0.0(17)		2	
.. Montpellier	15.1	7.7	21.0(12)	12.0(v)	8.0(1)	0.0(5)		0	
.. Nice	15.0	8.7	21.0(12)	13.0(v)	9.0(6)	3.0(19)		0	
GERMANY: Berlin	10.5	3.5	20.1(22)	9.8(31)	1.3(4)	-2.7(1)	-5.6(2)	5	9
.. Hamburg	9.2	3.0	18.8(22)	11.0(8)	1.1(1)	-2.4(v)	-5.0(10)	8	8
.. Frankfurt	12.6	4.3	19.8(25)	11.8(11)	5.2(5)	-2.6(6)	-5.3(6)	7	11
.. Munchen	12.3	2.9	19.9(29)	10.1(11)	2.3(4)	-4.4(19)	-7.7(20)	8	17
.. Sonthofen	10.9	1.4	21.4(29)	5.9(29)	0.8(18)	-6.6(19)	-11.0(19)	8	14
GREECE: Thessalon	16.4	10.7	23.8(12)	12.4(28)	10.6(3)	3.6(6)	-3.5(6)	0	
ITALY: Venice	12.6	5.5	20.0(28)	13.0(31)	4.0(1)	-0.0(1)		2	
.. Casalecchio	15.9	7.9	19.0(v)	5.0(1)	12.0(v)	1.0(5)		0	
.. Rome	16.3	8.1	25.0(31)	19.0(31)	12.0(18)	1.0(20)		0	
.. Naples	16.9	8.6	28.0(30)	21.0(31)	10.0(18)	3.0(20)		0	
MAJORCA: Palma	17.8	6.8	26.0(12)	12.0(29)	14.0(18)	0.0(18)		0	
MALTA: Luqa	17.9	10.4	21.2(30)	16.2(31)	12.0(19)	4.6(19)	2.1(6)	0	0
NETH'S: Schettens	9.6	4.2	15.5(28)	8.8(25)	3.6(4)	-1.9(18)	-5.7(18)	6	7
.. Monnick'dam	10.4	5.8	16.4(28)	10.9(11)	2.6(3)	-0.6(18)	-2.7(18)	2	7
.. Ten Post	10.0	4.1	16.2(28)	9.8(8)	3.3(3)	-1.9(18)	-5.9(18)	6	9
PORTUGAL: Lisbon	17.4	10.3	25.0(10)	15.0(12)	13.0(30)	6.0(16)		0	
SICILY: Palermo	16.6	12.8	30.0(30)	25.0(30)	13.0(18)	9.0(6)		0	
SPAIN: Madrid	16.9	6.1	24.0(25)	13.0(12)	12.0(20)	-1.0(2)		1	
.. Barcelona	17.8	8.7	26.0(12)	12.0(12)	14.0(10)	3.0(19)		0	
.. Alicante	21.6	11.0	32.0(12)	18.0(13)	16.0(9)	5.0(19)		0	
.. Malaga	21.7	10.6	30.0(12)	17.0(13)	17.0(30)	7.0(18)		0	
SWITZ'D: Basel	13.6	5.3	23.7(25)	13.5(25)	4.2(4)	-1.2(19)		3	
.. Geneve	12.4	4.3	20.7(25)	11.4(26)	5.2(18)	-3.0(19)		5	
TURKEY: Istanbul	12.6	5.6	24.0(19)	16.0(19)	2.0(1)	-1.0(3)		1	
YUGO'IA: Belgrade	14.8	4.7	25.0(26)	12.0(27)	5.0(19)	-4.0(1)		2	
.. Dubrovnik	15.3	7.7	22.0(30)	11.0(v)	9.0(v)	3.0(1)		0	
EIRE: Straide	11.0	4.8	15.3(31)	10.9(11)	5.6(3)	3.0(22)		0	
.. Galway	10.2	6.0	14.7(24)	10.0(11)	6.1(4)	1.4(22)		0	
N.IRE'D: Bessbrook	10.5	3.8	15.6(30)	9.4(8)	3.9(4)	-0.5(5)		2	

	MEAN		HIGHEST		LOWEST		GRASS	A	G
	Max	Min	Max	Min	Max	Min			
SHE'T'D: Whalsay	6.3	1.9	11.2(29)	5.8(12)	1.9(5)	-3.5(6)	-8.0(6)	3	17
.. Fair Isle	6.1	3.1	9.4(29)			-1.4(5)	-5.6(10)	3	9
SCOT'D: Braemar	6.8	-0.2	14.9	5.8	0.6	-5.5	-7.4	18	24
WALES: Lampeter	10.2	5.5	14.6(29)	10.0(10)	4.8(3)	-2.4(4)	-10.2(3)	2	8
.. Pembroke	10.8	6.2	17.0(29)	9.5(11)	6.4(4)	1.9(4)	-1.0(17)	0	1
.. Carmarthen	9.9	5.4	14.4(30)	8.7(28)	5.9(4)	-1.5(4)	-4.6(4)	1	5
.. Gower	10.3	5.8	17.0(30)	8.8(25)	5.2(4)	-0.6(4)	-3.6(4)	1	5
ENGLAND:									
Penryn, Cornwall	11.8	7.4	16.5(29)	11.4(25)	7.2(4)	3.9(16)		0	
Denbury, Cornwall	11.1	5.4	14.0(26)	10.0(25)	7.1(3)	-2.0(4)	-6.0(15)	2	7
Gurney Slade, Som	9.7	3.8	13.0(23)	9.0(25)	3.2(4)	-3.5(4)	-6.0(4)	6	8
Yatton, Avon	11.7	6.4	16.5(28)	11.5(25)	5.5(3)	-1.5(4)	-4.6(4)	1	6
Corsham, Wilts	10.6	5.9	14.5(23)	10.6(11)	3.3(4)	0.2(5)	-4.2(18)	0	6
Trowbridge, Wilts	11.2	5.8	15.2(28)	10.9(11)	4.1(4)	-0.4(18)	-6.6(18)	1	9
Codford, Wilts	11.1	5.1	14.9(11)	10.4(11)	4.0(4)	-2.5(18)	-10.0(18)	4	12
Reading, Berks	11.1	6.0	16.2(28)	10.6(8)	3.4(4)	-0.1(18)	-5.2(18)	1	6
Sandhurst, Berks	11.9	5.4	18.3(28)	10.5(25)	3.9(4)	-2.8(17)	-4.0(17)	3	6
Newport, Wight	11.0	6.4	16.2(28)	10.6(25)	5.0(4)	-0.5(18)	-3.2(18)	1	4
Horsham, Sussex	10.9	5.8	17.1(28)	10.5(8)	4.5(4)	-0.6(18)	-5.0(17)	2	6
Brighton, Sussex	10.3	5.9	16.1(28)	9.4(29)	5.0(4)	-0.1(17)	-5.1(17)	2	2
Hastings, Sussex	9.7	5.2	16.2(29)	9.6(30)	4.6(4)	0.6(17)	-2.1(17)	0	4
E. Malling, Kent	11.5	6.2	18.1(28)	11.0(8)	3.7(4)	-0.2(17)	-4.5(17)	1	6
Gillingham, Kent	11.2	6.2	19.4(28)	11.1(8)	3.3(4)	-0.6(17)		2	
Epsom Downs, S'rey	10.8	5.9	17.5(28)	10.8(11)	3.5(4)	-1.7(18)	-4.8(18)	3	4
Reigate, Surrey	11.4	5.9	17.7(28)	10.3(11)	4.5(4)	-0.9(18)	-3.0(17)	3	3
Guildford, Surrey	11.1	6.3	17.7(28)	11.0(25)	3.9(4)	-0.4(17)	-2.4(17)	1	3
Sidcup, London	11.9	6.2	18.5(28)	10.9(25)	4.1(4)	-0.1(18)	-5.1(18)	1	7
Hampstead, London	10.9	5.5	18.2(28)	10.6(8)	3.9(4)	-0.6(17)	-5.4(17)	1	6
Royston, Herts	11.0	5.9	18.5(28)	11.0(v)	4.3(4)	-0.4(17)	-2.0(17)	1	4
Loughton, Essex	10.6	5.0	18.3(28)	10.0(25)	4.0(3)	-1.1(18)	-3.1(18)	3	6
Leigh/Sea, Essex	11.6	6.0	18.9(28)	10.8(8)	4.3(4)	-0.3(18)	-3.7(18)	1	7
Buxton, Norfolk	10.9	5.3	19.0(28)	11.3(25)	4.2(5)	-1.6(5)	-4.4(5)	5	7
Ely, Cambs	10.9	4.6	18.9(28)	10.0(v)	3.5(4)	-0.9(5)	-3.0(18)	4	6
Luton, Beds	10.7	5.7	17.9(28)	10.9(8)	3.4(4)	-1.2(17)	-4.9(17)	2	8
Oxford (Radcliffe)	11.1	6.4	15.9(28)	11.3(11)	3.5(4)	1.1(17)	-2.5(18)	0	6
Buckingham, Bucks	10.5	5.3	16.1(28)	10.6(25)	3.4(4)	-1.2(17)	-5.3(17)	2	6
Birmingham Univ	10.2	5.2	15.1(25)			0.0(5)	-3.0(17)	1	10
Kettering, N'hants	10.8	5.0	16.8(28)	10.8(11)	3.3(3)	-1.2(17)	-3.8(17)	3	8
Hinckley, Leics	10.4	5.1	15.3(28)	10.5(11)	3.0(4)	-0.4(17)	-4.1(17)	1	5
Cosby, Leics	10.3	5.4	15.5(25)	11.1(25)	3.9(4)	-0.8(17)	-3.5(23)	2	7
Newark, Notts	11.0	5.0	16.5(28)	11.3(8)	4.1(3)	-1.0(5)	-5.0(23)	2	9
Nottingham, Notts	10.9	5.0	16.6(28)	11.3(8)	3.8(3)	-0.1(17)	-3.1(17)	2	8
Burton, Staffs	11.0	5.4	16.1(25)	11.5(25)	4.0(4)	0.0(17)	-5.5(23)	0	9
Keele Univ	9.7	4.3	13.9(28)	9.9(11)	2.5(4)	-0.9(17)	-4.1(17)	2	9
Southport, M'side	10.7	5.2	16.1(28)	11.2(8)	5.1(4)	0.3(22)	-2.4(23)	0	8
Sheffield, S. Yorks	9.5	4.1	14.9(28)	10.0	4.4	-0.2(22)	-4.4	1	10
Cottingham, H'side	10.9	4.6	17.4(25)	11.7(8)	4.7(3)	-0.4(23)	-4.5(23)	2	6
Pickering, N. Yorks	10.1	3.4	16.1(28)	11.0(8)	3.4(3)	-2.4(23)	-6.0(16)	4	9
Durham Univ	9.6	3.1	16.0(11)		3.0(3)	-1.5(4)	-5.8(5)		16
CANADA: Halifax	4.3	-3.0	11.1(29)	3.1(30)	-1.7(18)	-6.5(26)		30	
CANARY: L. Palmas	22.6	16.0	31.0(11)	21.0(2)	19.0(v)	13.0(4)		0	
MADEIRA: Funchel	20.4	14.3	29.0(10)	17.0(v)	16.0(8)	12.0(31)		0	
SENEGAL: Dakar	26.1	19.4	32.0(10)	21.0(v)	23.0(v)	17.0(8)		0	
ALGERIA: Algiers	20.5	8.9	27.0(12)	11.0(v)	15.0(18)	2.0(19)		0	
JORDAN: Amman	17.6	7.7	29.0(19)	13.0(19)	8.0(2)	1.0(2)		0	
BAHRAIN: Airport	25.6	19.0	33.4(24)	23.2(25)	19.0(6)	15.2(8)		0	
THAILAND: Bang'k	34.0	24.5	36.0(30)	27.0(29)	32.0(5)	23.0(23)		0	
HONG KONG	22.9	18.8	28.0(14)	23.0(v)	18.0(v)	12.0(16)		0	
JAPAN: Tokyo	13.0	5.2	21.0(26)	11.0(20)	8.0(31)	-1.0(3)		1	

RAINFALL TABLES: MARCH 1981

	Total	%	Wettest Day	Days pptn	Snow/Sleet	Hail	Thunder		Total	%	Wettest Day	Days pptn	Snow/Sleet	Hail	Thunder
Innsbruck	47.3	110	8.0(15)	17	4	0	0	Gillingham	93.2	160	13.7(30)	26	1	1	1
Houwaart	94.0	159	16.2(14)	25	2	2	3	Epsom Downs	109.3	140	14.6(9)	24	3	3	2
Fano	78.5	199	10.4(8)	20	5	0	0	Reigate	113.5	218	12.8(9)	26	2	1	0
Frederikssund	59.5	178	11.4(8)	18	12	0	0	Guildford	107.3	187	10.7(1)	27	0	3	0
Montbonnot	101.7		20.3(23)	12				New Malden	106.4		12.7(12)	26	2	2	2
Montpellier	81.0		28.0(31)	20				Hayes	97.6	248	13.1(9)	24	2	1	2
Nice	95.0		48.0(15)	10				Sidcup	100.4	230	14.2(9)	26	3	2	2
Berlin	116.5	376	28.0(11)	20	5	0	1	Hampstead	112.2						
Hamburg	148.9	392	21.6(10)	23	3	0	0	Royston	77.5	179	18.5(9)	25	5	3	1
Frankfurt	108.3	301	18.0(2)	19	1	0	1	Loughton	107.5	220	19.0(2)	25	2	2	1
Munchen	55.4	109	10.6(12)	18	4	0	0	Leigh/Sea	83.1	166	13.8(30)	27	2	1	0
Sonthofen	144.5	140	27.7(12)	19	6	0	2	Pulham St. M	83.6	210	20.8(9)	26	2	1	1
Thessaloniki	31.3		22.0(20)	9	0	0	0	Buxton	90.5	207	20.5(9)	21	1	0	1
Casalecchio	55.3	74	15.0(18)	9	0	0	1	Ely	91.9	199	25.3(9)	24	3	0	1
Luqa	11.4		6.4(18)	3	0	0	1	Luton	107.3	207	14.8(9)	26	4	1	1
Monnicken'm	120.2		26.7(10)	23	2	2	1	Stroud	129.3	236	18.6(21)	24	0	1	0
Schettens	107.8	308	22.6(11)	26	2	2	0	Oxford	129.7	316	19.8(1)	25	0	2	2
Ten Post	131.7	289	20.5(12)	23	3	0	0	Buckingham	110.0	254	14.2(1)	25	3	2	0
Gene've	80.2		19.5(13)	19	2	0	0	Birmingham U	121.4	238	20.6(9)	26	4	2	1
Basel	89.0		18.5(3)	20	5	—	0	Edgbaston O	110.3		19.7(9)	26			
Galway	121.3	185	24.6(12)	20	1	1	0	Hail Green	111.6	231	19.2(9)	25	2	4	2
Straide	149.2	210	20.6(5)	26	2	1	0	Northampton	83.2	181	10.4(10)	24	0	0	0
Bessbrook	139.5		16.0(18)	25	3	0	0	Kettering	98.5	194	17.3(9)	26	4	0	0
Whalsay	129.2	222	21.4(7)	23	17	11	0	Cosby	92.9	186	24.1(9)	23	6	2	1
Fair Isle	79.4	123	13.8(10)	24	14	7	—	Hinckley	91.5	183	23.0(9)	20	4	0	3
Braemar	78.5		15.0(1)	21	15	0	0	Boston	91.9		20.0(9)	25	1	—	—
Lampeter	241.6		46.2(21)	24	4	1	0	Louth	111.0		19.0(9)	27	3	0	1
Pembroke	206.3	264	29.1(10)	24	0	0	0	Newark	87.2	185	13.8(9)	23	3	1	2
Carmarthen	312.4	377	50.4(10)	25	1	2	0	Nottingham	85.1	187	19.1(9)	20	4	2	1
Gower	224.9	284	39.2(10)	26	0	1	0	Markeaton P	107.6	196	19.9(9)	22	—	—	—
Penryn	201.4		31.4(10)	24	0	2	0	Hulland	138.7	239	24.5(21)	22	5	1	3
Denbury	229.4	266	43.6(21)	23	2	0	0	Middleton	177.1		37.7(21)	25	9	1	2
Gurney Slade	223.9	234	40.5(9)	29	0	2	2	Keele	129.2	160	31.1(21)	22	3	1	1
Yatton	142.5	250	32.5(9)	25	0	1	3	Meir Heath	143.3			22	6		1
Long Ashton	162.3		28.8(9)	24	0	0	1	Burton/Trent	88.4	220	23.2(10)	30	3	0	1
M. Norton	200.1		25.1(9)	25	0	2	2	St. Helens	167.1		25.5(21)	21	1	0	0
Marshfield	190.8		22.1(10)	23				Southport	175.0	353	43.5(21)	19	2	1	1
Lyneham	149.2		17.3(10)	22				Leigh	138.2	279	22.1(21)	23	—	0	0
Corsham	163.3	308	16.3(21)	24	1	2	1	Sheffield	149.0	198	23.5(21)	24	5	0	0
Bradford-on-A	159.6	307	19.2(12)	22	0	2	2	Cottingham	116.1	221	14.0(9)	25	5	2	1
Trowbridge	154.5	322	20.1(12)	22	0	2	2	Cawood	104.0	274	13.3(9)	21	3	1	0
Codford	164.5	219	23.1(9)	25	0	2	—	Northallerton	77.0		20.5(20)		4	0	0
Reading	111.4		12.6(12)	26	0	1	1	Pickering	131.9	306	21.8(21)	27	6	0	0
Maidenhead	125.3	303	11.1(10)	25	2	0	1	Durham	113.5	231	31.7(21)	27			
Sandhurst	116.9	269	13.6(2)	24	0	1	0	Carlisle	114.0	200					
Romsey	147.7		21.2(9)	26	0	1	0	Newton Rigg	111.1	176					
Newport	208.5	290	32.5(2)	25	1	1	0	Kendal	281.1	290					
Horsham	122.2	249	16.6(9)	26	0	0	0	Hawkshead	313.1	224					
Brighton	156.2		26.2(9)	27	1	0	0	Coniston	404.0	218					
Hastings	132.2	207	20.6(9)	—	1	0	0	Thirlmere	385.6	201					
E. Malling	86.3	215	8.6(9)	26	2	1	1	Seathwaite	418.0	183					
								Honister	496.0						

62.0(10)

BINDING ARRANGEMENTS FOR VOLUME FIVE

Readers who would like the 10 issues of volume 5 made into a permanent book, splendidly sewn and bound with royal blue cloth and with gold lettering on the spine, may do so for a remittance of £7.50. The price is inclusive of return postage and packing costs; however, readers who can collect their bound volumes personally from the editor (either at the office or elsewhere by arrangement) need only remit £6.50. The monthly covers will be excluded from the volumes unless readers instruct otherwise.

Please send a cheque with your order, before 1 July if possible, *but do not send us your loose copies*. Instead, we shall be sending you a volume into which have been bound mint copies. This will improve our service to you, at no extra cost to yourselves.

RECENTLY PUBLISHED

(1) *Hydrological Memorandum No. 44: Maps of average monthly rainfall over the British Isles for 1941-1970*. By K. E. Woodley. 26 pp. 1980. Met. Office, London Road, Bracknell, Berkshire.

(2) *Environmental Hazards in the British Isles*. By A. H. Perry. 10 chapters. 191 pages. £12.00 hardback; £5.95 paperback. 1981. Allen and Unwin, Park Lane, Hemel Hempstead, Herts.

(3) *The second issue of the new magazine Jet Stream*. This magazine of world weather includes maps of sea surface temperature anomalies and generalised atmospheric flow patterns for both hemispheres, besides weather data and articles. *Jet Stream* is being published at 2-monthly intervals, the first volume comprising 6 issues totalling about 192 pages. Personal annual subscription (cash with order) £13.20; standard subscription (incl. binder) £19.20. A sample issue with full subscription details will be sent free. Enquiries and orders to: Westwind Services, 60 Talfourd Avenue, Reading, England.

JOURNALS FOR SALE

British Rainfall from 1875, *Weather* from 1946, *Quarterly Journal Royal Met. Soc.* from 1871, *Marine Observer* from 1948, *Proceedings British Met. Soc.*, *Symons Meteorological Magazine*. Books on meteorology.

FREE LIST: G. L. GREEN, 104 Pitshanger Lane, Ealing, London W5 1QX (telephone 01-997-6454). Bookshop open Wednesdays to Saturdays.