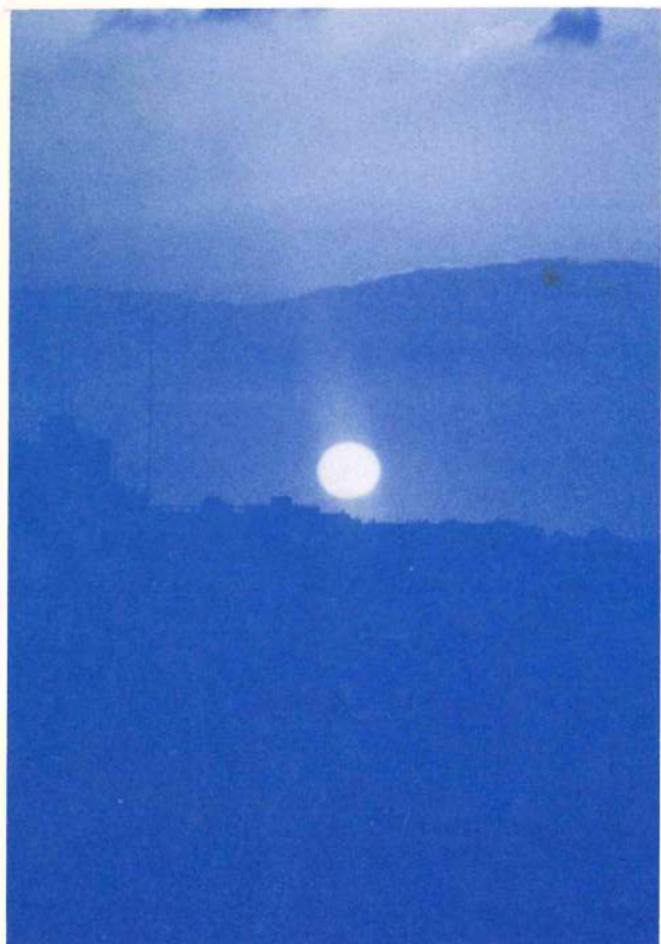


The
JOURNAL of METEOROLOGY



SUNSET OVER JERUSALEM, 27th October 1989

Volume 14, number 144

December 1989

THE JOURNAL OF METEOROLOGY

LE JOURNAL DE MÉTÉOROLOGIE

Published in association with

The Tornado and Storm Research Organisation

a privately-supported research body, serving the national public interest

Edited by Dr. G. T. Meaden, 54 Frome Road,

Bradford-on-Avon, Wiltshire, BA15 1LD, England.

Telephone: National, 02216.2482; international, +44.2216.2482

Research papers, letters, news items, conference information, 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, with a quality that is 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. In the text, references should be made by giving the author's name and year of publication, e.g. Manley (1976).

The usual language of the journal is English but a few contributions will be acceptable in French, Spanish, Italian and German. Correspondence with the Editor's office may be in any of these languages.

Responsibility for the opinions expressed in the signed articles rests with their respective authors, who should also obtain copyright permission where necessary. Please note that page charges may have to be imposed for some articles involving special artwork, complex equations, or numerous photographs or diagrams.

Kindly note that, for citation purposes, the recommended abbreviation for the title of this journal is *J. Meteorology, UK*.

Subscriptions for 1990, Volume 15, *including surface post*, U.K. £45.00; rest of world £55.00; *including airmail* £65.00. *For personal subscriptions from individuals deduct £25.00 from each of these rates.* Subscriptions for students and senior citizens £15.00 only upon request.

Back issues are available for purchase either as complete volumes or singly. Volumes 1-9, £8.00 each; volume 10, £10.00; volume 11, £12.00; volume 12 and 13, £14.00 each; volume 14, £16.00. Single issues, *pro rata*. Please note that some issues are out-of-print, in which case double-sided photocopied sheets will be supplied instead.

Published by The Artetech Publishing Co., 54 Frome Road, Bradford-on-Avon, Wiltshire, BA15 1LD.

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

© Artetech Publishing Company

ISSN 0307-5966

409

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. 14, no. 144, December 1989

A WINTERS TALE

By G. A. SOUTHERN

Corner Brook, Ackhill, Presteigne, Powys

If I had not suffered an acute illness back in the autumn of 1977, the events that befell me in February of '78 would not have happened. After my illness I was invited to spend a few days restorative holiday amongst the foothills of Dartmoor, as an escape from the stress and hurly burly of London.

The attractiveness of the idea was irresistible. I loved Dartmoor, and the people who had invited me were friends of long standing. They knew and shared my love of Dartmoor, and the husband Derek shared by passion for weather and ran his own climatological station for his own satisfaction and to supply data for the Met. Office.

I arrived at my friends' Dartmoor retreat on 1st February 1978, very tired after a further short but debilitating illness, so after a warming meal I was despatched to an early bed. I awoke next morning very much refreshed, both in body and spirit and the prospect of a month with no responsibility, good food, lovely scenery and the vagaries of a Dartmoor winter was deeply relaxing. Over the ensuing week my strength was quickly restored, and my interest in the world about me was renewed.

On 7th February after an indifferent week's weather the wind turned into the east drawing in much colder air from the nearby continent. January had been wet, stormy and quite cold, and snow had fallen frequently no matter what the wind direction. Snow fell heavily and widely on 19th January driven by a strong south wind.

By the 8th February it was very cold, and from 9th to 12th my friend Derek informed me that the temperature in the screen had remained continuously below freezing. We both liked this weather type, bright and crisp with plenty of brilliant sunshine, and there had been no snow to hinder movement. There had hardly been any of this weather type during the mild winters which had characterized the winters of the early and mid 70's.

On the morning of 16th February we woke to 2cm of lying snow with drifting in exposed parts. A more substantial fall of drifting snow greeted us on the morning of 17th, enough to block roads across Dartmoor and other high level roads in the West Country – but the 17th was brilliantly sunny and in the sun it felt quite springlike. That night there was a severe frost.

The weather forecasters were predicting heavy snow with gales for Saturday 18th February. Derek asked me how I would like to experience the start of a blizzard on the tops of Dartmoor. The idea was appealing and exciting, but caution governed my response. "Let's wait and see what tomorrow, Saturday, brings and let's pay heed to the morning's forecast" was my considered response.

Saturday dawned grey and cloudy with a rising easterly wind. Overnight the screen temperature had fallen to -7.3°C ., but no further snow had fallen. The forecast was for gales and heavy snow with blizzard conditions over the high moors in S.W. England.

We breakfasted in the warm Devonshire kitchen. "How about it then", enquired Derek "Game to risk your life?" I laughed, "I'm game, fortune favours the brave". In truth I thought it foolhardy, but the once in-a-lifetime chance of high drama on Dartmoor, could not be lightly dismissed. Besides Derek's wife Ellen knew where we would be and we could exactly pinpoint our position on the O.S. map. We would have a car with a supply of spare warm clothing, rugs and food, so why not! "You're both mad", said Ellen. But all three of us had truly forgotten how awful things could get on Dartmoor with a freezing easterly ahead of warm air trying to push up from the S.W. Such events had not happened since the great winters of 1947 and 1963.

Nevertheless, it was with high spirits that we set off by car despite the fact that the wind was already blowing hard and rising, drifting the lying snow in exposed parts from previous falls. The cuttings made by the snow ploughs were already starting to infill. But we made it without too much difficulty on to the main B3212 Tavistock-Moretonhampstead road spanning the length of Dartmoor.

Our plan was to walk three miles eastward along the B3212 against the wind, thence returning to the car with the wind in our backs. We calculated that in that time we would see and experience Dartmoor winter weather to the full. We would take with us as iron rations cheese and chocolate and a thermos of coffee. We reasoned that would guarantee our safety and, with provisions provided by Ellen stowed on the backseat of the car, we could be marooned in the car for up to 48 hours.

We parked the car at our selected spot at 1147GMT taking rather longer than anticipated because of the drifting that had already taken place. On arrival, flurries of light snow were falling but the views nevertheless were quite magical and the prospect of experiencing the wildness and 'feel' of Dartmoor in wintertime enhanced the moment in time.

We set off, booted and muffled up against the piercing cold into the teeth of a by-now force 8 easterly gale. But it was not daunting, indeed it was exhilarating, so that early fears evaporated in our receding breaths. The whipped-up snow from previous falls cut our faces, but despite the vanguard snow flurries I could see a watery sun – and when the drifting snow allowed, a hard horizon line. "I'm glad I came", I shouted, "It's terrific". We had gotten over half way and I felt good, and with a rising confidence that we would make

it OK so that my early fears seemed childish and naive to the extreme.

It was 1230 and we had made splendid progress despite the headwind and the knee-high drifts in places. I looked back. "Here it comes", I bawled. To the west the horizon was blotted out, the sky charcoal grey, but perversely in our locality it seemed much brighter and the wind dropped away, so much so, that the wind barely ruffled the snow drifts.

I was totally unprepared for the next terrifying minutes. Nothing I had read in literature had prepared me. Neither tales from the Arctic, Cairngorms, or Dartmoor itself. In an instant we were enveloped in a freezing white hell and a screaming wind that tore at us from all directions. We were literally stopped in our tracks, unable to think or walk – or speak or see. In an instant we were blinded, struck dumb by elemental forces beyond imagination. I was metaphorically stripped naked, as helpless as a fly in a spider's web. We were paralysed and crazed with terror. The real terror was the inability to breathe. I was sucking snow into my lungs and my nostrils were furred up with encrusting snow. My only coherent thought was: this is the end, both of us will die within minutes. It was impossible to move in any direction against the swirling vortex of wind.

Then as suddenly as it begun it relented. "For God's sake let's get back" I croaked. I write 'relented', but everything was relative to the initial fury – it was merely blowing a storm-force easterly. I could not see more than a few feet in any direction. We turned with the wind pushing and tearing at our backs, but the wind was veritably amazing and unpredictable. Suddenly it would buffet our faces, scooping up the powder snow, hurling it against us and freezing on impact. My eyebrows froze, my watch froze and the fear of frostbite gnawed away inside our frozen minds. Whirling columns of snow would engulf us, so that no objects could be seen; even the road was invisible – then it would relent. We would flounder knee and waist high in snow, then the vice of wind would release us and we would stumble forward on tarmac road which the wind had swept free.

I know not how long we battled, mind-numbing fatigue leaded our legs. Through the fog of snow I remembered the flask of coffee in the rucksack on my back. "Derek", I screamed, "Coffee!" "God Almighty", he gasped, "I forgot". We sank to our knees and scrambled our way into the cocoon of a frothing snowdrift. Frozen fingers tore helplessly at straps and buckles, to no avail. I literally ripped the rucksack apart and with nerveless fingers tried to undo the thermos. I felt nothing. In desperation I clutched the thermos with my elbow against my waist and wrenched it with my free arm – it gave. Never had coffee tasted so wonderful. I gnawed at the frozen cheese block, crunched up frozen chocolate. But, oh that marvellous hot coffee! It was indeed a life saver – although the full trauma of a Dartmoor blizzard lay ahead of us in the unknown.

We were in the darkness of a white hell; there is nothing so black as the unseeing darkness of a featureless nothingness. Without speaking (speech was too much effort) we arose as one and crawled back to the unspeakable horror

of a road that was going nowhere and we were the only people on it. To stay put was to die. How long we were on that road I shall never know for time had no meaning from the moment the initial squall engulfed us. How we stayed with the road was a miracle for we shambled locked together as a couple of drunks, buffeted this way and that by the eddying wind. I swear to God that there were tornadoes imbedded in that terrible banshee wind.

But the gods were with us. A lull came in the wind, although the atmosphere was still thick with choking powdery snow and shapes could be discerned, and, within a stone's throw was the blessed hump that could only be the car, as indeed it was. Drawing nearer it was possible to see that much of the car was exposed with snow piled up to the offside and rear.

Unfeeling fingers scrambled for the car key, but then came the awful realisation that the lock was hopelessly frozen. So near to shelter from the raging blizzard, but we might as well have kept shuffling along the road. I could have howled with frustration, exhaustion and a terrible fear. Fear that I was very near to the limits of my strength. I could have waited patiently for help inside the car. The car was provisioned with hot food and drink, and by the judicious use of the car engine could have kept a reasonable temperature within the car's confines.

Desperation leads to desperate methods. "Derek", I shouted, "Watch me". I knelt in the snow beside the passenger door and with my face pressed hard against the door lock and my storm-weather hood sheltering the lock from the wind, I put my mouth over the frozen lock, and using my tongue as an oiling and warming agent endeavoured to thaw the ice-bound lock, also using my tongue as an oiler to ensure that my lips did not freeze to the car's metal. When I deemed the lock thawed I withdrew, but by the time frozen fingers had located the key and trembled their way to the lock, the lock had already re-frozen – or more likely my puny efforts had not thawed out the offending lock.

It was Derek's turn, silently he took the key from me and put it in his mouth, and he too knelt with his mouth over the door lock with the key jutting out from the side of his mouth. What in effect seemed an eternity, perhaps only minutes, he signalled to me. Instinctively I held the protruding part of the key as he backed off and I slipped the key into the hoped-for freed lock. Would it turn? Turn it did and the door crashed open. We piled in slamming the door shut. Even inside the car the wind had forced snow through cracks. That mattered nothing, bliss it was to be out of that merciless wind. Something hot was the immediacy of the moment. Using the same technique to open the thermos, there wafted out the wonderful aroma of Ellen's home-made soup. There is nothing like hot soup to revive body and spirit.

Fortunately I retained the presence of mind to keep the car key in hand and after much fumbling inserted the key into the ignition. Choke full out, amazingly the engine roared into life. We let the engine run for 30 minutes and slowly the car warmed up. We remembered the safety rules and let one window down an inch to let air in and to stop ourselves being overcome by

carbon monoxide fumes. We wrapped ourselves in rugs and settled down to wait for deliverance. Every now and again I would stop the car engine and wind the window back, until the freezing chill began reasserting its clammy icy hold.

Slowly, painfully slowly, feeling returned to frozen fingers although feet remained like blocks of ice. But we felt safe, we were not going anywhere it was impossible for the car to move. At times the car rocked as giant gusts of wind slammed against the car's exposed side. We couldn't see a thing out of the windows.

Time passed. We took turns in dozing or sleeping, it was imperative that one slept while the other kept wide awake. One could still freeze to death within the confines of a car despite the rugs. It was impossible to ascertain whether it was day or night, and that was how it had been since the original squall had blotted out the day. Always at the back of the mind was how could anybody reach us despite our position being exactly known and pinpointed by Ellen. Meanwhile, outside in the black white-out the blizzard continued unabated, and fear slowly reasserted its grip upon our weakened sensibility.

The sense of loneliness and isolation increased and compounded our anxiety. It was becoming increasingly difficult to stay awake; the urge to let go, to drift away into a pleasant dreamworld of unconsciousness became increasingly irresistible. The beckoning dreamworld warmed itself into the very core of my being.

Suddenly an electric surge of pain shot down my left arm and a comforting velvet of cushioning darkness cloaked me in a warm fleece and I felt at peace with myself and sank into a cosy oblivion.

A blinding light was in front of me, and a lesser irritating light was trying to intrude into my deep lassitude. I stretched instinctively towards the blinding friendly light, but the lesser damnable light intruded more and more.

Flashes of light – suddenly into a terrifying wakefulness. A deep fear grabbed at me. Where was I. Who were the people crowding round. Had I died? "You fainted, the doctor said. Recognition dawned. I was in intensive care – a heart attack.

"Wake up!", said the urgent woman's voice. "Wake up – help is to hand". It was Ellen. "God, am I glad to see you", whispered Derek. "Amen to that", breathed I. "Came by tractor", shouted Ellen. "Got two chaps with me. Lazy sods both of you sound asleep". We were unceremoniously bundled out of the car and into the waiting tractor and within the hour we were thawing ourselves in my friends' warm kitchen, and after hot food and drink revival was quick. However, we were both extremely fatigued and it was with some incredulity that I registered the time by the kitchen clock as only a few minutes after midnight. Our adventure had lasted only a little more than 12 hours. I was firmly of the opinion that our time in the car was very much longer.

It was not until the following morning, lying in bed and mulling over the events of the previous day, that a deep unease disquieted me. Why had I

relived the experience of my major heart attack? My heart attack back in early September of the previous year had nearly cost me my life. If it had not been for the dedication and skills of the doctors and nursing staff I would have died. I was brought out of cardiac arrest by electric shock treatment.

The unanswered question that I had posed was too much for my tired mind to cope with. I shivered, turned over and drifted back into unconsciousness.

I shall not bore you with the tittle-tattle of the converse with my friends – I kept my reservations to myself. Since my Dartmoor adventure, I have taken up the reins of everyday living and to all intents and purposes everything is back to normal but with one tremendous difference. I no longer feel that anything is normal. I am dogged constantly by an unrelenting air of unreality. In the lines of the poet: 'Do I wake or sleep, was it a vision or a waking dream?' To convince myself of my existence I have written down these lines as the bare bones of a drama that in effect have completely changed the tenor of my life.

CIRCLES MADE BY A WHIRLWIND, AVON COUNTY, 5 AUGUST 1989

By PETER D. RENDALL

TANNASG Research, 46 Partridge Road, Pucklechurch, Bristol, BS17 3SP.

Having been told of a whirlwind report in my village of Pucklechurch, I undertook to investigate it, accompanied by the eyewitness Miss Jacqui E. Griffiths whose own account was as follows.

"Date 5th August 1989, time approximately 1320 BST, 1220 GMT.

While driving south-west out of Pucklechurch on the B 4465 towards Mangotsfield, I was passing the Remand Centre entrance and approaching Dennisworth Farm on my right, when I noticed what appeared to be a whirlwind in the field on my right.

I pulled over to stop and watch. The whirlwind was in the field and appeared to be as tall as the trees which bordered the farm grounds; these trees were rushing to and fro as if in a gale. I could see tufts of grass, twigs and bits of cut straw whirling round (this is what first attracted my attention).

The whirlwind appeared to move towards and then over the hedge, where it appeared to 'lose' its bottom part, came over the road and then died.

It was a very hot and windless day".

TANNASG Report

The next afternoon I returned to the site with Jacqui Griffiths and we inspected the field in which she had seen the whirlwind originate. Much to our surprise, we found several swirled patches of flattened grass and straw near to where the wind was thought to have been. Nothing was found in the corner of the field where the trees were, and nothing where the whirlwind was



thought to have crossed the hedge. This would be grid reference ST 695761.

The swirled patches resembled effects seen in the fields of cereals which had been affected by the crop circles effect. A further visit was made later on Sunday 6th August with Roger Davis, during which photographs were taken. The effect was reported to CERES/TORRO at the first available opportunity.

The upper figure shows one of the areas, slightly elongated with a major diameter of about three metres and swirled predominantly anticlockwise. This was a double-centred swirl, created by an anticlockwise-turning vortex which interacted with the grass in two stages. One of the neatly-formed centres is seen in close-up in the lower figure. It seems the central region had been depressed by a downward force, while just beyond the perimeter of this central region (lower figure) the grass had been subjected to the rising counterflow currents responsible for the levitated debris spotted by Miss Griffiths.

(Further Notes: The track of the whirlwind was roughly north-south, on a cloudless anticyclonic day when the maximum temperature was around 27 degrees C).

MEMORIES OF THE WEST LONDON TORNADO OF 8 DECEMBER 1954

By PHILIP EDEN

Philip Eden Weather Consultancy, 33 Mountfield Road, Luton, Beds.

Following a brief radio broadcast recounting the events of the 8th December 1954 when one of Britain's best known tornadoes carved a path across west and northwest London, correspondence was received from a number of listeners who, 34 years on, still retained a very vivid memory of that night. The tornado, or maybe the first of a family of tornadoes, was first sighted on the Hampshire coast near Portsmouth at 3.30 pm, and the last authentic sighting was in east Hertfordshire about two hours later.

In the western and northern suburbs of London there were twelve known injuries, half of them at Gunnersbury tube station which had part of its roof ripped off. A car was reported lifted 15 feet into the air in Acton. Mr. Owen Allen, who lived in Acton at the time, now writes from Chesham:

"I noticed during the very cloudy afternoon lightning flashes in the distance – a bit late in the year I thought. Quite suddenly, the whole world seemed to be filled with a deafening roaring wind. This fearsome noise lasted just for a very few minutes, then suddenly it was gone. Looking out into the street, there were chimney pots, slates, bricks and debris everywhere. The whole of Acton must be devastated, I thought. What of my wife and baby son, barely a mile away?

"I hastily grabbed the phone before anyone else did, expecting the worst. It seems, however, that this awesome experience was exclusive to comparatively few of us because my wife knew nothing of it. It seems the whirlwind came from Chiswick way and waltzed its narrow path through parts of Acton and Harlesden on its way to goodness where".

Miss Jessica Morton now living in southwest London also remembered the day clearly, even though she did not experience the full force of the tornado:

"I have a lasting memory of the morning after this event. It was the year before I moved to my present address and I was then living in an upstairs maisonette on the south side of Belsize Grove off Haverstock Hill (southern fringes of Hampstead). From the upstairs back window of the attic bedroom I had a view of the surrounding roofs. The houses round there are almost all conversions, with bits stuck on and built on at all angles, and – possibly due in the main to war-time shortages – they were nearly all finished off with roofing felt.

"When I looked out of the window that morning all I could see was yards of loose, flapping and missing roofing felt – not my own, luckily. I spent the rest of the day trying to match up the roofs with the front doors – no easy matter – and then knocking up the amazed occupants to alert them to the fact that they

no longer (in a manner of speaking) had a weather-proof roof over their heads, since clearly they would be the last to know of it. I've forgotten long ago – as one does – lots of worse weather, but never that 'morning after'."

From Long Ditton, Mr. R. F. Penfold sent in this memory:

"I am 66 years old and the year 1954 is remembered by me for two events. It was the year I got married, and it was the year of the tornado.

At that time I was working in my father's Estate Agency at Willesden Green, and I bicycled every day to work from Kingston-on-Thames – 12 miles each way. I left the office for home at about 5.30 pm on 8th December. It was a dirty night, raining and blowing, and I think there was also some thunder. I had my cycling cape on and cycled along Sidmouth Road, NW2, and then into All Souls Avenue, NW10. The latter road runs in a SW-NE direction and at the southern end there is quite a southerly slope and it is possible to see tall buildings at Isleworth as one travels in a southwesterly direction. I was half way down this incline when conditions deteriorated considerably, the wind increased and there was a roaring sound. I quickly dismounted from my bicycle, got onto the pavement, and crouched by the side of the dwarf wall in front of a house, drawing my cycle cape and bicycle over me. The roaring increased and slates and various objects flew about.

It only lasted a short time, after which I continued on my way and very soon came upon evidence of the damage caused with hoardings blown down across the road, etc. To this day I am still able to pick out scarred roofs in the line of the tornado, and at Willesden Green the wind ripped off some zinc sheeting from the roof of our office building and hurled it several hundred yards.

I hope that these recollections will be of interest. I know one's memory is inclined to play tricks after the passing of so many years, but I spent my whole working life in Willesden Green and did more-or-less the same journey for about 40 years, so my memory was kept refreshed regarding what happened, and where, that night."

Chiswick and Acton lay in the path of the tornado during its most intense phase, so Helen Warth's story from Antrobus Road on the Chiswick-Acton border is particularly interesting. Mrs Warth now lives in East Grinstead.

"I was 14 at the time and I remember the night of the tornado very well. We were sitting in our living room listening to the wind when suddenly an extra strong gust came and all the windows made loud cracking sounds. At the same time we heard other crashes round the house. It was very frightening and we all rushed into the hall to get away.

We were lucky and only suffered minor damage, even though a neighbour's chimney went through our roof. After the storm I walked round the streets and saw the damage others had suffered. It seemed to be houses and shops on corners which suffered most. One house I specially remember in Rothschild Road had the whole side blown down exposing all the rooms inside. I heard of a man in the same road who had just finished building up a special car (his pride and joy) and the wall fell on it.

If the newspaper the *Acton Gazette* is still published and they keep back copies, you will find that they had a big coverage on this with pictures of Gunnersbury station minus the roof."

Clearly, a night to remember!

REFERENCES

- ABBOTT, S. G.: Thunderstorms and Tornadoes of 8 December 1954 *Weather*, vol.10, p.142.
BULL, G. A., and HARPER, W. G.: West London Tornado, December 8, 1954 *Meteorol-Mag.* vol.84, p.320.

FURTHER EYE-WITNESS ACCOUNTS OF THE WEST LONDON TORNADO OF 8 DECEMBER 1954

By MICHAEL ROWE

About a dozen letters describing this tornado have been received as a result of TORRO's appeal for information in local newspapers over the past seven years. Considering that this was one of the most powerful tornadoes in Britain this century, and that it occurred in a very densely populated area, it is surprising that more letters have not been received. (We have 40 letters about the Birmingham tornado of 14 June 1931 and 30 about the Wendover-Linslade tornado of 21st May 1950). The most obvious explanation is that witnesses assume that TORRO must already be well-informed about a powerful tornado that happened in the capital city. Extracts from some of our letters follow.

Mrs J. P. Trunks sent a cutting from the *Acton Gazette* which states that "in Acton Vale a house and a factory collapsed and an 80-foot chimney was blown on to the Royal Standard Laundry, Bollo-lane. Trees blocked East Acton-lane and in a line from Gunnersbury Station through Acton towards Willesden rubble lay thick on the roads. Yet not one person was killed and, so far as is known, few people were seriously injured. The first blow struck at the home of widow Mrs L. Mudge, a shopkeeper, at 261, Acton Vale. The whole of one side of the house collapsed into Uxbridge-road a few minutes before 5p.m., just before home-going crowds filled the street. The ceilings and windows of all the rooms in the house were blown in and glass was shattered everywhere".

Mr. B. L. Pavitt was living in Bollo Lane at the time. "It became very dark and there was a swishing sound and it became very windy." He mentions the collapse of the laundry chimney and continues: "It also smashed house and shop windows, brought brick walls down and even tore down sections of houses".

Mr. G. W. Morris worked at the laundry that lost its 80-foot chimney. "The sky was so dark and lightning lit up the sky. The whirlwind came down the railway line as if to follow it . . . coming straight for us, and boy was it moving, tearing up a laundry chimney 80 feet high as if it was papier mâché. When it

was over only 10 feet was left, and no roof was on the laundry".

Mrs. Megan Wall was on a bus in Acton when the tornado struck. "I saw a pram . . . turn completely over. The bus 'shuddered' but moved on slowly and . . . at the start of East Acton there were many very large, very old oak (I believe) trees uprooted. Further into Acton itself a building very near the railway bridge across the lower part of the High Street had its side wall demolished and I remember seeing a bed practically hanging from the upper floor".

Mr. Stanley Mott, then a schoolboy, was sitting on Chiswick Station at about 4.30p.m. "Thunder rolled in the distance, and the sky was leaden. Large spots of rain started to fall, and I sat with another boy in a platform shelter. We noticed about a mile away that one of the clouds appeared to be hanging a little lower than the others. To our amazement the cloud appeared to descend to the ground. Our train then arrived, and we lost sight of the cloud . . . The next morning I read in the national press that a freak wind had hit a small area of west London. Buildings were seriously damaged, and Gunnersbury Station was virtually destroyed when the roof was lifted clean off. This was precisely where we saw that peculiar cloud".

One of those injured in Acton was Mrs. L. H. Allum, who wrote: "I had a very lucky escape, as the fence I was clinging to was blown down with me underneath it. I finished up with a badly broken wrist that took a year to mend and three days in hospital, but on seeing the damage at the spot where I had been standing I consider I was lucky to be alive . . . I am still very afraid of high winds" (a comment often made by correspondents who have experienced a tornado).

TORNADO AND STORM RESEARCH ORGANISATION TORRO HAILSTORM DIVISION: FOURTH ANNUAL SUMMARY

DAMAGING HAIL IN GREAT BRITAIN AND IRELAND IN 1987

By JONATHAN D. C. WEBB
T.O.R.R.O., Oxford.

Abstract: This paper reviews and summarises the extensive data collected by TORRO on British and Irish hailstorms of 1987.

INTRODUCTION

The occurrence of hail in the British Isles during 1987 is reviewed with details of: (1) known cases of large hail (over 10mm diameter), and (2) other instances when smaller or unspecified sized hail fell with noteworthy

intensity. Those occasions when the hailfall was sufficient to inflict damage as described on the TORRO hailstorm intensity scale (*J. Meteorology*, issue 129, vol.13, pp.166-167) are summarised in Table 1. The locations of these damaging storms are plotted in Fig.1.

There were 14 days on which "damaging" hail is known to have occurred in 1987. This is in line with the average observed during periods of effective reporting (see *J. Meteorology*, issue 129). The most important hail event of 1987 was the storm of 22nd August in Essex and Suffolk, which is discussed in detail in a special article to be published in 1990.

January: Following a changeable start to the month, an exceptionally cold outburst of Continental arctic air affected the British Isles during the second week. Associated convective activity was especially vigorous over the North Sea and adjacent coasts. There was sufficient depth of cumulonimbus cloud for isolated thunder to occur near to coasts of north-east England on the 12th and 13th for which there is an unconfirmed report of "very large" hailstones falling at Redcar, Cleveland.

February: The isolated reports of thunder were again mostly confined to the north-east coast of England during a spell of cold north-easterlies in the third week. Concurrent reports of hail referred to snow pellet-type precipitation.

March: A cold easterly type prevailed during the first two weeks. From mid-month the weather was cyclonic with unstable Polar maritime airstreams frequently affecting the British Isles. A deep depression moved south-east into the northern North Sea on the 18th-19th, introducing a strong north-westerly airstream of arctic origin in which bands of wintry showers were carried south. Thundery showers affected the north coast of Co. Mayo, Ireland, in the early hours, and one shower at Straide was accompanied by hailstones 15-20mm diameter, these consisting of aggregates of smaller stones. The depression filled and drifted north-westwards on the 20th; during further wintry showers Harborne, near Birmingham, reported hailstones averaging 11mm in diameter in mid-afternoon. A very deep depression crossed Northern Scotland on the 27th bringing severe gales to many parts of England and Wales; in its wake a very unstable north-westerly airstream was accompanied by widespread thundery showers, many with hail, on the 28th.

April: In marked contrast to April 1986 there was a conspicuous absence of unstable polar airstreams during this month. Consequently hail was observed infrequently, although it was rather widespread on the 9th during thundery showers which developed in a rather unstable westerly airstream. One such shower at Tilehurst near Reading was accompanied by hailstones up to 13mm diameter.

May: Warm spells alternated with outbreaks of cold, showery, northerly winds. A small depression moved rapidly south-east into the North Sea on the 2nd introducing a cold unstable north-westerly airstream. Squally showers were accompanied by local hail and thunder. Hail fell with sufficient intensity to damage blossom at Burton on Trent, Staffordshire, while at East Dereham, Norfolk, hailstones accumulated to a depth exceeding 25mm during a



Fig.1: Location of damaging hailfalls in 1987.

thunderstorm which occurred between 1120 and 1210.

Although surface pressure was recovering on the 3rd a brisk northerly airstream continued to affect Eastern England, while at 500mb a very deep upper trough was evident across the North Sea and Western Europe (500mb thickness values had fallen below 528mb over most of England). Hail and thunder were quite prevalent during showers in central and eastern England. An early afternoon shower at Dover, Kent, was accompanied by spherical hail up to 12mm diameter, conical and jagged varieties also being observed. At Worcester Park, Surrey, an apple tree in full bloom was stripped of petals, while another brief but vicious hailstorm affected Loughton in Essex.

Following a short warm spell around the 9th another plunge of cold northerly winds occurred on the 11th-12th. Widespread thundery showers on the 12th were accompanied by locally sharp hailstorms. The cold spell was reinforced by a small depression which dived south-east into the southern North Sea on the 14th. Following a thirty-minute thunderstorm at Dover, Kent, pea-sized hailstones covered 75% of the ground, lying up to 25mm deep

in places. During a ten-minute storm at Stamford, Lincolnshire, the pea-sized hail pierced holes in rhubarb leaves, also scoring the stems.

The 26th was a very warm day in Southern England (24°C at Bournemouth for instance). A shallow depression drifted north-eastwards from Biscay and some outbreaks of heavy rain and thunderstorms affected south-western England during the late afternoon and evening. A heavy thunderstorm lasted just over one hour at Gurney Slade in the Mendip hills, Somerset; hail up to 10mm diameter stripped soft fruit bushes; other foliage was extensively bruised or partially stripped. Patches of hail remained on the ground until the following morning.

June was mainly cool and very unsettled. A back-bent occlusion swung south-east across eastern England on the 4th within the circulation of a shallow depression in the North Sea. Thundery showers affected East Anglia where Levington, Suffolk, reported hailstones over 10mm diameter.

Very deep, cold air covered the British Isles from the 6th to the 17th; during this period thunderstorms developed daily, particularly between the 11th and 16th. The upper trough over the British Isles and the eastern Atlantic was most pronounced around the 12th when 500mb thicknesses fell below 534mb over virtually the whole of Scotland, exceptionally low values for mid-June. By this time a complex surface area of low pressure had become established over much of Europe; an associated shallow trough extended into England and Wales while a slack northerly airflow persisted over Scotland. A small surface 'low' is evident over North Wales at 0000 on the 12th and this provides the only additional clue to the exceptionally severe thunderstorm which burst over North Liverpool between 0600 and 0720 on that day. Hail accumulated to a depth of up to 100mm in the Anfield, Walton, and Clubmoor districts of the city. All trees and plants were stripped of leaves, allotments were ruined, and the torrential rainfall caused severe local flooding.

Lightning damage and flooded roads were reported in south-east England during widespread storms on the 14th, when large hail fell briefly in Central London during the late morning.

A slow-moving area of heavy rain and thunderstorms developed over parts of Cambridgeshire, Suffolk and Essex during the morning of the 15th. Over 70mm of rain fell at Sudbury, Suffolk, while Linton in Cambridgeshire experienced a prolonged hailstorm. Precipitation fell predominantly as hail for an hour from 1030; the hailstones, which were up to 13mm diameter, created a wintry-looking 25mm-to-75mm ice cover. Floods, which were several feet deep in the village, caused tens of thousands of pounds worth of damage at Linton Zoo.

Thunderstorms and hail were even more widespread on the 16th. Hail up to 14mm diameter fell in Stourbridge, West Midlands, between 1004 and 1020, covering 80% of the ground. At Bradford on Avon, Wiltshire, half of the ground was white following a nine-minute afternoon storm during the early part of which hailstones of 12mm-13mm diameter were observed. Towy Castle, Dyfed, also reported hailstones of over 10mm diameter.

TABLE 1: Summary of incidences of damaging hail in UK and Ireland, 1987.

Date	Weather Type*	County	Max Size (approx)mm	Torro Intensity
March 19	N	Ireland (Mayo)	20	H1
May 2	CNW	Staffordshire	less than 10	H1
May 2	CNW	Norfolk	less than 10	H1
May 3	AN	Surrey	less than 10	H1
May 14	C	Kent	8	H1
May 14	C	Lincolnshire	5-10	H1
May 26	E	Somerset	10	H2
June 12	N	Merseyside	c10	H2
June 15	N	Cambridgeshire	13	H1
June 16	U	Wiltshire	13	H1
June 16	U	West Midlands	15	H1
June 17	NW	Powys	less than 10	H1
July 29	CW	Essex	13	H1/2
August 22	C	Essex/Suffolk	38	H4
September 23	SW	Highland	20-25	H1/2
October 5	S	West Yorkshire	15	H1
November 12	C	Gloucestershire	less than 10	H1
November 12	C	Guernsey	15	H1

*Based on Lambs Classification: source *Climate Monitor*

A frontal wave rippled north-west to south-east across Wales, central and south-east England on the 17th. This was responsible for further outbreaks of showery rain with thunder in places; at Brecon, Powys, hail was reported to have fallen to a depth of 25mm.

July was mainly dry until mid-month but was subsequently unsettled. A small depression moved south-east across the North Sea on the 29th, with an associated very moist warm sector. The cold front crossed south-east England early in the afternoon followed by a showery trough and an initially unstable north-westerly airstream. Maximum temperatures reached 22°C in south-east England and thunderstorms broke out ahead of, along, and behind the surface trough. The 1200 GMT 500mb chart shows the axis of an upper trough extending across the North Sea and eastern England into north-west France. An exceptionally severe storm, which broke out between the cold front and the ensuing trough, deposited 53mm of rain within 21 minutes at Thornwood near Epping. Intense hail up to 13mm diameter accompanied this cloudburst, notably near North Weald where one farm's entire crop of brittle oil-seed rape was wiped out. A 50% loss of the rape crop was reported from an adjacent farm.

August: Following a cool start a very warm spell developed in mid month. Some exceptionally heavy thundery rainfall occurred between the 21st and 25th resulting in monthly falls exceeding twice the average in parts of East Anglia; in contrast less than 20% of normal was recorded locally in south-west England. A frontal zone was slow moving across western Britain on the 21st while a shallow depression developed over north-west France. Following one of the hottest days of the year up to 30°C in eastern England) areas of thunderstorms moved north-east across southern England overnight on 21st-

22nd. The storms were severe in Kent: lightning damaged some buildings, 43mm of rain was recorded at Charing, and hail up to 13mm diameter fell at Gillingham. The shallow depression had drifted north into the English Midlands by 1200 on the 22nd while a cold front and preceding trough swung across Southern England and East Anglia in the afternoon. Violent thunderstorms erupted from around 1330 over and to the south-west of London; these drifted north-eastwards to join forces with other storms which "exploded" in mid Essex, possibly assisted by the development of a sea breeze convergence zone. Subsequently quite an organised band of severe thunderstorms, with a precipitation area 40 to 50km wide, became established, extending right across Essex into south-east Suffolk. The Romford, Chelmsford, Colchester and Ipswich areas all sustained serious flooding. A "daily" rainfall of 77.2mm was recorded at Chigwell Row north of Romford, while 41mm rain fell in 30 minutes in Chelmsford, and 33mm in only 20 minutes at Melton near Woodbridge. Hail up to 10mm diameter damaged gardens in Chelmsford but the principal hail-swath extended from a few miles south-west of Colchester north-eastwards to Tunstall Forest in Suffolk. Hailstones up to 38mm diameter were reported from villages just west and north of Colchester, in the Dedham Vale, and at Woodbridge and Ufford in Suffolk. Hundreds of glasshouses were smashed, along with skylight windows and glass roofs. At St. Audry's Hospital, Melton, an average of twenty panes of glass were broken in each ward, one corridor being totally wrecked. Many vehicles had their bodywork pitted, sometimes with hundreds of dents, while windscreens were cracked or shattered. Vehicle repair shops and insurance companies were choked with claims following the storm, damage to cars commonly amounting to £1,000 to £2,000. Caravans on a site in West Bergholt looked as if they had been "machine gunned". The storms cut a swath through one of East Anglia's principal apple-growing areas. One farm north of Colchester reported that 80 acres of orchards were virtually destroyed. Fruit was scarred with deep pock marks; some apples were even split apart by the force of the hail. Some sugar beet and dwarf beans were reduced to stems.

September was a relatively dry month, except in north-west Scotland. Following several warm days up to the 20th, the last ten days were generally cool. A deep and complex depression was situated between Scotland and Iceland on the 23rd. Minor troughs within the basically unstable Polar Maritime airstream were associated with thunderstorm activity over western Scotland; hail of over 20mm diameter was reported from Prabost on Skye. An upper trough over the eastern Atlantic moved eastwards into the British Isles by the 24th; thunder and hail quite widely accompanied heavy showers which developed in the cool unstable north-westerly airstream, large hail being reported at Rugby in Warwickshire.

October was exceptionally cyclonic and wet with depressions repeatedly moving north or north-eastwards over the British Isles while a high pressure block persisted over Western USSR.

An initial warm spell ended on the 5th when an active cold front, preceded

by a thundery trough, swung north-eastwards across western and northern England and Wales. There were violent thunderstorms in northern England in the evening; Preston reported 25mm of rain in 30 minutes, while Castleford, West Yorkshire, was hit by a violent two-minute hailstorm from 1923; winds gusted to force 8 and hailstones up to 15mm diameter completely covered the ground.

A very strong, showery westerly airstream affected the British Isles on the 8th when Slaidburn, Lancashire, reported hail over 10mm diameter. Following the passage of the "Great Storm" of 16th October thunderstorms with hail developed close to southern and western coasts in the unstable polar air. It was reported that hail carpeted an area close to the coast of County Donegal, north-west Ireland.

November: After a dry start to the month the second week was very unsettled. A deep depression moved east across Northern Scotland on the 12th and vigorous convective activity developed over the warm seas in a strong unstable westerly airstream of polar origin. A crop of thundery showers originating over the Bristol Channel area moved east into Southern England in the morning. Following a storm in Gloucestershire 70mm of hail covered the M5 motorway at the Stroudwater Junction causing at least one collision. Thundery showers also affected the English Channel; Guernsey reported hail up to 15mm diameter which accumulated on the ground to 25mm during an early evening storm.

December: After a rather cold and dry two weeks, a very mild south-westerly weather type prevailed after the 14th. Thundery showers affected the western coastal belt of Scotland on the 29th to the rear of a waving cold front; hail over 10mm diameter fell at Colonsay, Strathclyde.

Addition to 1985 Annual Report (J. Meteorology, issue 118, vol.12, pp.114-121). 1985 5th June. (Based on a report by Mr. David Mitchell of Swindon).

A severe hailstorm occurred just to the north of Swindon, Wiltshire, during the early evening. This was possibly part of the same storm complex which was associated with the damaging hail over the North Berkshire downs.

The swath of hail damage extended about ten kilometres in length from just west of Blunsdon St. Andrew, north-west of Swindon, to Sevenhampton near the Oxfordshire border. The largest hailstones were reported to be as big as golf balls. Two people caught in the open suffered facial cuts. Motor vehicles and caravan bodywork were dented, glasshouses were damaged, fruit trees stripped of leaves, and barley and wheat crops seriously injured.

Acknowledgements: The TORRO directors wish to thank all observers of The Tornado and Storm Research Organisation, Thunderstorm Census Organisation and Climatological Observers Link whose invaluable reports have provided the basis for this summary; important information has also been reported in the *Daily Weather Summary* of the Meteorological Office. Many thanks are also due to other amateur meteorologists and indeed members of the general public who again responded very helpfully to inquiries into the major storms.

LITERATURE REVIEWS AND LISTINGS

Book Review

WEATHER SENSITIVITY AND SERVICES IN SCOTLAND.

Edited by S. J. Harrison and K. Smith. Scottish Academic Press. Edinburgh 1989, 180pp.

Industry seems to have realised that information on weather and climate is useful judging by the number of texts appearing in the literature on this subject over the last year. This is a good thing and this particular text must be seen as one of the more important additions.

The book is a collection of studies from the proceedings of a weather-industry symposium held at the University of Stirling in February 1988.

The book is divided into four major sections. The first covers advances in weather forecasting and observing over the contemporary time-scale and suggests that as industry gears itself up to using meteorological data the weather-data provision offices are packaging their output in a more useful way for their clients.

Sections two, three and four look at how specific fields of Scottish – and by extrapolation more widespread – industry utilise weather data and what is provided for them. There is also a fair degree of consideration over what could be provided and what the future holds.

The industrial sectors covered are agriculture, water, gas, construction, wind turbine and, perhaps most importantly for Scotland, tourism. Roads and the effect of weather conditions on maintenance are also looked at in some detail because, after all, the road network is the major artery for the spread of industrial products.

The layout appears confusing at first if one looks at the contents page, with relatively little logical progression, but this is definitely not the case. The papers have been organised so that the argument throughout builds rather than fragments as is often the case with books containing short individual works.

The question arises – is there a need for the sudden plethora of books emphasising the necessary relationship between industry and literature? The editors themselves answer the question in the book: "There is growing evidence that Scotland, like many other countries, is more vulnerable to its own weather and climate than is commonly accepted. Even the routine variability of atmospheric conditions imposes large economic and social costs".

That is an important point which the book does well to point out. It is not the weather extremes and the freak incidents which dramatically slow down industrial output in the long-term, but the incessant attack of the regular climatic situation. Industry ignores the normal weather at its peril.

A piece on the gas industry by R. A. Steel makes this point well. Gas demand fluctuates over the year as does demand for every sort of energy but provision of gas at a sudden demand peak is difficult. A spare supply therefore has to be

available but how much should it be? The gas industry has done a lot of work to calculate this using average weather data and not short-lived extremes for information.

Summing up, Harrison considers the question of whether industry will see improved weather services as being of any value and, more importantly in this profit-making day and age, worthy of purchase. He suggests that work needs to be done to find out what will sell and what is needed (demand and supply) as well as the age-old problem of giving accurate forecasting. This last point is, of course, becoming something of a minor issue as weather data improve apparently year by year.

This is a book which all industrial managers should read. Weather influences their profits and what could be more important than that?

ANTONY CLAY

WORLD WEATHER DISASTERS: MARCH 1989

- 1 (reported): Avalanche in mountains south west of Kabul, Afghanistan left two people dead. *Daily Telegraph*.
- 4: Monsoon rains touched off flash floods along the Badung river, Bali, Indonesia, left one person dead and submerged 500 houses in Badung regency and Denpasar area, some two-thirds of Denpasar were underwater in the floods. *Jakarta Post*.
- 5: Cyclone hit Karonga district of northern Malawi, leaving some 24,000 people homeless. *Lloyds List*.
- 5-12: Rain and floods in central and southern Malawi left at least 50,000 homeless, crops, livestock and communications badly damaged but only a few casualties reported, the floods were believed to be the worst in Malawi for 30 years. *L.L.*
- 6: Avalanche near Tignes, French Alps, left two dead and a third seriously injured. *D.T.*
- 6: Passenger vessel, the *Queen Elizabeth 2* caught in storm 1130km north-east of Auckland, New Zealand, winds reached force 10 and waves up to 12.8 metres high hit vessel, injuring 41 passengers or crew, some damage reported to fittings on vessel. *L.L.*, *International Herald Tribune*.
- 7: Rain, sleet and snow in eastern states of U.S.A., a storm system over North Carolina brought rain and snow to the Atlantic seaboard, snow extended from the mid-Atlantic coast to southern New England and the Ohio Valley. The bad weather was blamed for at least 20 indirect deaths, 'millions' of \$ damage caused to poultry operations in a four state region as poultry houses collapsed under the weight of snow. *L.L.*
- 8: M. oil/chem. tanker *Shoryu Maru* capsized after striking a breakwater at Toyama, Western Japan, in strong winds, leaving two crew dead and another missing. *L.L.*
- 8-18: A forest fire burned through 15000 hectares of forest some 10km

north of town of Bluefields, Nicaragua, no casualties reported. *L.L.*

8-18: Inclement weather in many areas of Great Britain, brief details below:-

8-9th: Strong winds, heavy rains and floods in England and Wales, with Wales being the hardest hit, serious flooding in west Wales compounded by high tides especially in and around village of Amroth, Dyfed, hundreds of acres of farmland in the Mawddach and Conwy valleys in north Wales underwater after torrential rains. Floods also reported in Gloucestershire, north Devon and the Lake District as the worst in 20 years.

10th: Accidents on icy roads left three dead and two injured in Strathclyde and a further three dead in accident near Loughbrickland, Co. Down, Northern Ireland.

13th: Gales and strong winds in areas of Great Britain, winds gusted to 113km/h in Birmingham, one person injured when a car blew over on Coventry Road, near Birmingham Airport. A vessel, the *Secil Japan* foundered in heavy seas off St. Ives, Cornwall, one crewman died during rescue operation.

14-15th: Heavy rains and floods in south Wales, houses flooded and roads blocked.

16th: Land subsided under rail line disrupting services east of Maidenhead on Berkshire to London line, landslide caused by heavy rains.

18th: Avalanche in the Grampian mountains, Scotland, left one dead. *D.T., L.L., B.B.C. Radio News, Birmingham Evening Mail.*

8(reported): Heatwave in South Australia, Australia, damage to agriculture put at A\$ million's, among the hardest hit were the Barossa Valley vineyards, temperatures up to 105°F (40°C) reported. *D.T.*

9-21: Landslides caused by heavy snows caused widespread damage in the southern Rossiyskaya, Gruzinskaya and Checheno-Ingush areas of southern U.S.S.R., in the Caucasus mountains, the landslides came after the heaviest snowfalls in 70 years. About 1000 homes buried in the region bordering Soviet Georgia, leaving 8000 homeless and damage estimated at millions of roubles, although some landslides started on the 9th, the worst occurred on the 18th, the mudslides caused losses to crops and farmlands, no casualties reported as early warnings were given of the landslides. *L.L.*

9-25: Monsoon rains swept across many areas of New South Wales, South Australia, Western Australia and the Northern Territory, some areas reported 559mm of rain in the six days from the 9th to the 15th, it was reported on the 15th that town of Motpana, in the Flinders Range reported nearly 280mm of rain in a 24 hour period - twice the annual average, the rains in central Australia described as worst for 130 years, the floods resulting from the rains caused widespread damage to roads, railways and farms, where many livestock died. The rains cut production at the opal mines at Coober Pedy. *L.L., D.T.*

10: Thunderstorm hit Sydney, New South Wales, Australia, widespread

damage and flooding reported, but no casualties reported. *D.T.*

10: M.v. *Lorenzo Container V* sank in stormy seas while under tow off town of Sipalay, Negros Island, central Philippines, leaving 19 dead. *L.L.*

10-13: The worst fire in the history of the Big Bend National Park, Texas, U.S.A., burned through more than 700 acres, more than 100 campers evacuated, no casualties reported. *L.L.*

16: Tornado hit Dusseldorf, West Germany, with winds of up to 130km/h, five people injured, the tornado hit in the afternoon and lasted four minutes, in that time 200 roofs ripped off buildings, 220 cars destroyed and hundreds of trees uprooted. *L.L.*

20: Tornado hit town of Dong Hoi and Quang Trach district of Binh Tri Thien province, central Vietnam, leaving at least six people dead, many houses destroyed or damaged and 40 boats sunk, tornado hit at 2100 hours local time. *L.L.*

20-29: Torrential rains and widespread floods in South Yemen, left at least 23 people dead, 50,000 others homeless and damage put at \$30 million. In the district of Say'un, Hadhramaut province, 294 homes and 48 Government buildings had collapsed, on the 29th heavy rain in the Al Koshn district destroyed 17 houses and also caused heavy damage in Al Mahrah province. *L.L.*

20(reported): Dry weather in the Great Plains area of U.S.A. contributed to huge dust storms, winds blowing columns of dust up to 3000 metres into air, on the 16th winds up to 121km/h reported from Kansas, over the winter period nearly 4.7 million acres of land were eroded by fierce winds in the Great Plains. *L.L., D.T.*

21: Two ferries, the *Peloritano* and the *Ischia* collided in heavy fog 800 metres from Capo Miseno, Gulf of Napoli, Italy, leaving about 40 passengers slightly injured, the collision occurred at 0722 hours local time. *L.L.*

21(reported): The worst water shortage in seven years reported from Okinawa, water supplies are being cut off for 24 hours every other day. *D.T.*

22-25: Gales and storms in areas of Great Britain, brief details below:-

22nd: Strong winds sucked out window in the West End of London, the window fell 13.7 metres, killing man below.

23rd: Lightning hit oil storage tank at Sullom Loe, Shetland Islands, at 0955, resulting fire put out after 17 minutes, heavy seas, whipped by gale force winds swept youth to his death at Morecambe.

24th: Gales up to 121km/h reported from areas of Britain, high-sided vehicles and caravans blown over on roads in Hampstead, north London, five people were injured when high winds blew slats off the top of a fairground ride, young man drowned after being swept away by heavy seas despite warnings at Blackpool.

25th: Gales continued in Scotland, north of England and the West Country. *D.T., L.L., B.E.M., Sunday Express.*

24(reported): Drought emergency declared in New York City, U.S.A.; a

- severe winter drought has left reservoirs which should be 90% full at this time of year only 55% full on average. *D.T.*
- 26(reported): Torrential rains, described as the worst in many years, left 34 people dead, near the coastal towns of Skushuban Bossasso and Kandala, in eastern Somalia. The rains destroyed houses in coastal areas and carried away hundreds of livestock; roads and bridges also destroyed. *L.L.*
- 29: Avalanche in northern Norway left one person dead. *B.E.M.*
- 30 Mar-3 April: Prairie fire spread over a 65 sq.km area in Inner Mongolia, no casualties reported. *D.T.*
- 31: M.v. *Rahim 3* sank in storm off Abu Dhabi, United Arab Emirates, leaving two people dead and 18 others missing. *L.L.*

ALBERT J. THOMAS

LETTERS TO THE EDITOR

THE FATIMA 'MIRACLE'

With reference to Stuart Campbell's interesting account of this event (Vol.14 no.142), I would suggest that the dust could quite easily have come from the Sahara. It is possible there was a 'cut-off' upper low to the south-west of Portugal during the second week of October 1917. This was then caught up by a deep upper trough approaching from the west. Thus the 'cut-off' became, effectively, the base of the new trough. Within this scenario, dust could initially have travelled north-west from north Africa, well out over the sea, before being taken north-east towards Portugal. It is perhaps surprising that it did not get washed out in the rain earlier in the day, on the 13th, but it may well have been carried to a fair height, perhaps above the rain clouds which should not have been particularly thick so far from the depression centre.

I offer this explanation as at least a plausible one. But no one can know for sure; all we do know is that the event occurred and it must have an explanation. However, there is also another dimension to this; science, including meteorology, seeks to explain *how* things happen. We might also wonder *why*, and here science cannot help us. We are reduced to speaking of 'remarkable coincidences'. Perhaps we should not so easily dismiss the spiritual dimension to life; careful study of it may prove just as interesting and rewarding as does the study of science.

Loughton, Essex.

R. PRICHARD

EMBRYO VORTICES?

While observing cumulus clouds for any length of time (e.g. during sketching) I often note protuberances forming beneath such clouds. They are usually of fairly short duration, although some descend for some distance as if a vortex or waterspout is about to form.

On a number of occasions while snoozing in my deck-chair on a summer's afternoon, I have been awakened by quite strong gusts which on one occasion removed the lid from our dust-bin. On looking skywards on this occasion I noticed a passing cumulus with a pronounced protuberance beneath it.

Are such protuberances caused by embryo vortices? I have noticed that such protuberances often disappear as cumulus clouds cross the coast and pass over the sea, i.e. when convection is breaking down.

River, Dover, Kent.

F. G. THOMAS

SHEEP CIRCLES

The editor's note at the foot of C. A. Andrews's letter on Sheep Circles (*J. Meteorology*, July/August 1989) surely provides a clue to this mystery.

I am informed that mushroom mycelium spores work outwards from a given source, eventually forming a circular ring; hence the 'fairy rings' sometimes seen in fields grazed by herbivores and

which often produce mushrooms on the perimeters. The grass perimeters are of a darker green than that of the field itself, making the rings conspicuous. As suggested, that darker-green grass could be more palatable to a sheep than elsewhere in the field.

Thornton Hall, Ulceby.

PAUL C. SPINK

SHEEP CIRCLES AND CIRCLE-EATING SHEEP

It is possible that Paul Spink's suggestion could be relevant to the Yorkshire case related in *J. Meteorology*, vol.14, 54-55, February 1989, although the ring diameters seem rather huge, but no site investigation was carried out. On the other hand, mushroom spores can have nothing to do with the Cheesefoot Bottom site which is arable and not pastureland. The sheep were only let into the field to clear the post-harvest stubble. But it is possible that what grew over the former ringed circle tasted better. Maybe in Yorkshire the short grass of the pasture had been hit by descending vortex rings.

The editor can however cite an interesting event which took place in Avon County this summer (1989) when a flock of sheep ate a corn circle! They were perhaps the first sheep ever to do so because it is normal for farmers to cut the corn of the circles, so that the sheep, if lucky, get only the stubble. But this time, following the harvest in early August, the farmer generously left a ringed circle intact for the editor's use and research purposes. In September it was the sheep's turn to profit from the circle. When let into the wheatfield, they obviously enjoyed munching the circle and its ring out of sight. What is more, the sheep suffered no ill effects, which goes to counter the scare put out so irresponsibly this summer by publicity seekers from Hampshire who claimed that it could be dangerous for vortex-struck grain to enter the food chain.

G. T. MEADEN

A SPIRAL-CIRCLE IN KENT WHICH OVERLAPPED THE ROADWAY

I observed my first spiral-circle in wheat during the afternoon of Monday 9th August 1989 when I was travelling along a minor road near Paddlesworth just west of the A 260 Canterbury-Folkestone Road. The circle was not perfect due to the road passing through its south-south-west edge. As I had passengers en route and cars behind I could not stop, but it was easy to estimate the diameter as about 8 metres.

The location is on the northern dip-slope just below the crest of the North Downs (about 140 metres in this area). I estimate the altitude of the circle site (NGR TR 220393) as 112 metres above sea-level (there is a spot height at 110m close by to the west). The sea at Folkestone is about five kilometres to the south.

River, Dover, Kent.

F. G. THOMAS

MRS MEADEN'S LIGHTNING SHOCK

During a winter thunderstorm on Sunday 26th February 1989 the wife of Editor Terence Meaden was using the telephone when lightning struck nearby (exact location not known but possibly Whitley substation, Melksham). A clap of thunder was heard at 1842 but on the next occasion at 1847 lightning and thunder were practically simultaneous. A powerful current surged through the telephone line and Mrs Jacquie Meaden dropped the handset upon receiving a mild shock. About the same time the mains power went off and the editor watched his work on the word-processor screen fading away. Within 10-15 seconds power was restored, the safety trip-switch at the mains not having jumped. In fact, this power interruption was general throughout the town. As the telephone had gone dead, the number had to be re-dialled. The file in use on the Amstrad's memory was lost but the data on the disc were unaffected. Mrs Meaden suffered an effect of tingling and/or numbness on the righthand side of her body rather strongly for a few minutes, and said it could still be felt an hour later. The thunderstorm was one of a narrow line of showers which had been tracking eastwards through the Avon Gap from the Bristol Channel towards the London area all afternoon since about 1330 GMT.

G. T. M.

*New Products:***(1) NEW PORTABLE WEATHER STATION FOR RAPID DEPLOYMENT**

Easily erected in a mere five minutes, the Compact Weather Station from the Didcot Instrument Company has been designed with fast deployment in mind. It is equally a truly portable structure – with no component more than 90cm in length and the whole station weighing a meagre 25kg.

The basic package is a mast 2m high with sensors to measure six basic atmospheric parameters. These are wind speed, wind direction, solar radiation, temperature, humidity and precipitation. To this may be added net radiation and surface/leaf wetness. It also includes an expansion facility to allow connection of up to six additional sensors; e.g. soil temperature probes and/or barometric pressure (the latter using two of the expansion points).

The compact mast is unusual because it is supplied completely pre-wired, just one cable to join it to a data-logger housing. Sensors are marked for military connectors and these are installed by simply screwing them into place.

Data are collected by a logger with the capacity to record up to 29,000 readings. If, for example, this were to be hourly averages/totals from one basic sensor, then the station will record for up to 130 days. But this would, of



Fig.1: Didcot's new Compact Weather Station which can be erected in only five minutes.

course, be reduced pro rata were the logger to be set to monitor maxima, minima or other processed values.

Didcot also offers various additional means of data collection, such as software for temporary/permanent connection of the station to an IBM PC or compatibles, modems for use on the switched telecom network and radio and satellite telemetry systems. The Compact Weather Station is typically powered by an in-built rechargeable battery, giving up to three months operation between chargings. On the other hand, options of a mains-powered charger, solar panel or wind generator can be supplied if unlimited continuous operation is required.

The Compact Weather Station is launched to extend the Didcot Instrument Company's existing weather station range. It complements the well-established Budget and Precision models.

(2) DIGITAL MAP OF THE WORLD ON COMPACT DISC

For all those in research and industry who use geobased information, this is the only detailed and accurate map of the world for use on a personal computer.

MundoCart/CD is a digital map of the whole world on CD-ROM (compact disc read-only memory). CD-ROM is a compact and robust medium for the storage of very large amounts of information which can be read by an inexpensive CD-ROM drive connected to a personal computer. *MundoCart/CD*'s one disc contains 20,000,000 map points, including 500,000 separate features and 50,000 names of places and features.

MundoCart/CD enables users to produce maps of all parts of the world at different scales and levels of detail and in different projections. You can transfer data from your own computer files to *MundoCart/CD* maps and export *MundoCart/CD* map data into other software programs and geographical information systems.

MundoCart/CD is also available in 10 regional subsets. It provides base maps for all scientific and commercial undertakings which use geobased information.

For more information contact Paul Holroyd at Chadwyck-Healey Ltd., Cambridge Place, Cambridge CB2 1NR, England. Telephone (0223) 311479, Fax (0223) 66440.

*Product News:***GREEN BOOST FOR VENTUREPRISE**

Growing interest in "green" issues is set to provide a significant business boost to a West Midlands company. Ventureprise Limited of Kensington Road, Coventry, who produce automatic weather stations, are gearing up for a major drive in the environmental market. Local authority environmental health departments which are responsible for tackling pollution problems are Ventureprise's prime target.

The company's weather stations are fitted with a number of different sensors which assist in tracking airborne pollutants such as dust, smell and nuclear radiation. The data produced will prove invaluable for alerting offenders and ultimately bringing prosecutions, if necessary. They can also be used to gather evidence of pollution retrospectively by giving information about things such as wind speed and direction from weeks earlier.

Ventureprise, whose products have a good track record in the agricultural industry where they assist farmers with information vital for the efficient and safe use of sprays and fertilisers, believe several other local authority departments could also benefit by using their weather stations. By charting factors such as wind direction and temperature they can help councils find the best places for siting rubbish dumps, landfill sites, chemical plants or high rise buildings. Highways departments can use them to help forecast extremes of temperatures when roads may be at risk from melting or freezing.

"Councils are keenly interested in weather", said Ventureprise Marketing Director, Peter Ritchings. "Many receive monthly weather reports or have a meteorological officer on their staff. We believe our automatic weather stations will give them a more detailed and sophisticated service enabling them to improve their operations in many directions".

Mr Ritchings joined the company this summer when his own company, Weather Data joined forces with Ventureprise. He had been producing single unit meteorological equipment and had taken the business as far as it could go. The Weather Data product range is now available from Ventureprise. The merger has also enabled Ventureprise to produce sensors for its equipment in-house.

"The value of using our equipment is already being seen by local councils", said Mr Ritchings. "A Kent council is using it to monitor noise levels to assess whether contractors building the Channel Tunnel are contravening night-time noise regulations. And on the South Coast a council has used the equipment to judge whether a proposed location for an outdoor paddling pool is suitable".

For further information, please contact, Peter Ritchings of Ventureprise on 0203 714160. Ventureprise Ltd., Kensington Road, Coventry CV5 6GG.

WORLD WEATHER REVIEW: April 1989

United States. *Temperature:* warm W. of a line from S.W. Minnesota to S.E. Texas; S. Florida; +5degC in Arizona. Cold elsewhere (including Hawaii); -1degC in N.E. and S.E. *Rainfall:* third driest April since 1895. Wet only from C. Oregon through Washington to part of Dakotas; C. Illinois through S. Maryland to S.E. Alabama and parts of E. Florida; S.E. Hawaii. Over 200% in N. Oregon, E. Montana, eastern N. Carolina, S.E. Hawaii. Dry elsewhere; under 50% over a very large area from California to Nebraska and Louisiana; W. Florida; N. Minnesota to Pennsylvania. Rainless from S. California to extreme W. Texas.

Canada and Arctic. *Temperature:* warm in Alaska, N.E. Greenland, Spitzbergen, most of Canada; +4degC in N. Alaska, N. Yukon. Cold from Great Lakes to Iceland and most of Greenland; -2degC in S.W. Quebec. *Rainfall:* wet from most of Alaska and Canadian Arctic

islands across C. Greenland to Iceland. Over 200% in first two areas and N. Iceland. Dry in C. Alaska, extreme N. Greenland and most of Canada; under 50% from C. Alaska through most of Canada.

South and Central America. *Temperature:* mostly warm in South America 15-40°S.; N. Mexico, Bahamas; +2degC in S.E. Brazil, E. Uruguay and N.W. Mexico. Cold in Bolivia, C. Chile, S. Mexico; much of Paraguay (all -1degC at least locally). *Rainfall:* wet in Bolivia, N.W. and S. Paraguay, N.E. Argentina, S.W. Uruguay, S.E. coastal Brazil, N.E. Mexico, Belize, Bahamas; parts of Honduras. Over 200% in all these areas except perhaps the last three. Dry in Chile, N.W. and C. Argentina, E. Uruguay, E. Paraguay, interior S. Brazil, most of Mexico to part of Honduras. Under 50% in all these areas (except perhaps Uruguay), especially Chile, Argentina and from W. Mexico to El Salvador.

Europe. *Temperature:* warm from European Russia (except Urals) to Scandinavia, E. Germany, Balkans and most of Italy; +3degC from N. Norway to Moscow and Romania; Crimea. Cold elsewhere; -2degC locally from S. England to S. Spain and S. Portugal. *Rainfall:* mainly wet; over 200% from England to N. Spain, S.W. Germany and N.W. Italy; Sardinia, Mallorca, E. Czechoslovakia; locally in N.E. Ukraine. Dry in N. Norway, Faeroes, S. Sweden, Bulgaria, Greece, S.E. Italy; much of European Russia (except S. Urals and in and near N. Ukraine); parts of N. Germany, N. Poland and N.W. Yugoslavia. Under 50% at least locally in all these areas except possibly Sweden and Poland; more widely from N. Urals to lower Volga basin; S. Bulgaria, E. Greece. Provisional sunspot number 129.

Africa. *Temperature:* warm in E. Algeria, S. Tunisia, Libya, W. Cape Province; +2degC in N. Libya. Cold from Canary Islands to N. Algeria; in and near Transvaal; -2degC in N. Morocco and N.W. Algeria. *Rainfall:* wet on coast from N. Morocco to N. Tunisia (locally over 200%); Cape Province and S. Natal into Namibia and Botswana (over 200% very widely). Dry from Madeira and Canary Islands through S. Morocco to S. Tunisia (under 50% or rainless); N. Natal and E. Orange Free State into Mozambique (under 50% widespread).

Asiatic U.S.S.R. *Temperature:* warm from Chinese and Mongolian borders to S. Kamchatka and Lena basin; near Bering Strait; +5degC E. of L. Baikal. Cold elsewhere; -5degC in lower Ob basin. *Rainfall:* mostly wet; over 200% from Yenisey Gulf to lower Lena basin; upper Ob basin to E. Kazakhstan; near Bering Sea. Dry near N. Urals, round Caspian and Aral Seas and from Mongolian border through Sea of Okhotsk to E. Siberian Sea. Under 50% widely in all these areas.

Asia (excluding U.S.S.R.). *Temperature:* warm from Turkey to N. Arabia; S. India, Mongolia, Korea, Japan, Thailand, Malaya, Philippines; much of China; +3degC in N.E. China and parts of Korea; +5degC in much of Turkey. Cold in S. Arabia, Pakistan, N. India, C. China; -2degC in parts of first three areas. *Rainfall:* wet in interior Arabia, N. Japan, Laos, E. Cambodia, S. Thailand; much of China; parts of S. Philippines. Over 200% in interior Arabia; parts of E. coastal and N. China and N. Japan. Dry in Turkey, Pakistan, S.E. and N.E. China, Korea, S. Japan, N. Thailand, W. Cambodia; nearly all of India; most of Philippines. Under 50% in parts of W. Cambodia and very widely in the other areas.

Australia. *Temperature:* mainly warm; +1degC in S.E. and locally in W. and N. Cold (-1degC) in C. area. *Rainfall:* mostly wet; over 200% in W., N., N.E. and S.E. Dry on W. coast (locally under 50%) and in interior (under 50% rather more widely).

M. W. ROWE

WORLD WEATHER REVIEW: May 1989

United States. *Temperature:* warm on W. coast, from S.W. quarter to Dakotas and N. Michigan; Maine to E. New York; S. Florida; +2degC from Arizona to S.W. Texas; N.E. North Dakota, N. Minnesota, in and near Maine. Cold elsewhere; -2degC from Illinois to W. Carolina. Hawaii near normal. *Rainfall:* wet in most of E. half; W. Oregon and Washington to N. Montana; N. Wyoming; S. Nevada into California; S. Hawaii. Over 200% very widely from Maine to Ohio and N. Virginia; locally from E. Texas to S. Alabama; N. Washington; S.W. Nevada into California; S. Hawaii. Dry elsewhere; under 50% in S. Florida; S. and W. Texas to S.E. Utah and coastal California; S.E. Montana to N. Iowa; S. Idaho, N.E. Nevada, N. Hawaii.

Canada and Arctic. *Temperature:* warm in E. Alaska, Yukon and most of S. Canada; +3degC near St. Lawrence estuary. Cold in W. and N. Alaska, S. British Columbia, S. Alberta, far N. of Canada, Greenland, Iceland; -2degC in much of Greenland, Spitzbergen and Franz Josef Land near normal. *Rainfall:* wet in S. and W. Alaska, S.W. and N.E. Greenland, Iceland, Franz Josef Land; much of S. Canada. Over 200% in all these areas except perhaps Franz Josef Land, especially in Alaska and from British Columbia to Saskatchewan. Dry in N. and E. Alaska, S. Alberta, S. Manitoba, S.E. Greenland, Spitzbergen (all under 50%).

South and Central America. *Temperature:* warm in parts of E. Brazil and near Buenos Aires; Mexico to Honduras; nearly all West Indies; Bahamas, Bermuda; +2degC in N. Mexico. Cold in most of South America 15-40°S.; -2degC in S. Bolivia. *Rainfall:* wet in interior N. Argentina; very locally in Mexico and S. Brazil; in and near Guatemala; over 200% except perhaps in last area. Dry in most of South America 15-40°S.; most of Mexico to W. Honduras; W. Indies, Bahamas, Bermuda. Under 50% widespread in all these areas except perhaps Bermuda.

Europe. *Temperature:* warm almost everywhere; +3degC in N. Spain; +4degC in W. France and Arctic coast of USSR. Cold from S. Austria and S. Italy to lower Volga basin; -3degC in lower Volga basin. *Rainfall:* wet from Faeroes to Finland and Kola Peninsula; interior Spain, S. Portugal, Mallorca; N. Yugoslavia to W. Ukraine, extreme S. Poland and N. Romania; E. Bulgaria, extreme S. Greece, Crete; Caucasus to S. Urals. Over 200% from Caucasus to S. Urals; locally from S.W. Norway to N. Finland and in S. Portugal, C. and E. Spain, Mallorca, E. Czechoslovakia, S. Greece, Crete. Dry over most of Europe; under 50% from Ireland through S. Sweden and N. Poland to Moscow area, including much of France and W. and S. Italy; N.W. Greece. Under 25% from England and N.W. France to Latvia; S. France. N.W. Italy; below 1931-60 extreme very widely from Dublin to East Germany and parts of W. France. Provisional sunspot number 138.

Africa. *Temperature:* warm from Madeira to Egypt; in and near South Africa (except marginally in S.W. Cape Province); +2degC in Kalahari and parts of N. Algeria. Cold in parts of Tunisia. *Rainfall:* wet in C. Transvaal, much of Orange Free State and locally in Namibia (over 200% locally in all these areas). Dry generally in and near South Africa and from Madeira and Canary Islands to Egypt; mainly under 50%.

Asiatic U.S.S.R. *Temperature:* warm almost everywhere; +2degC from C. Urals to Gulf of Ob; upper Yenisey basin and E. of L. Baikal. Cold from Caspian Sea to Kirgizia; round new Siberian Islands and in lower Amur basin; -2degC in S. Uzbekistan. *Rainfall:* mainly wet; over 200% from N. Caspian Sea to upper Ob basin; locally round Yenisey Gulf and in E. Dry from Turkmenistan to near L. Balkhash; N. Urals to upper Yenisey basin; in and near Kamchatka, and much of N.E. coast and Amur basin (all under 50%).

Asia (excluding U.S.S.R.). *Temperature:* warm in most of Turkey, Middle East and Philippines; much of India and Japan; N. China, Mongolia, Korea, N. Thailand, Malaya; +3degC in Iraq and N. Saudi Arabia. Cold in N.E. India, Burma, S. and C. China, Laos, C. Sumatra; most of Pakistan; parts of E. Japan, S. Thailand and N. and W. Turkey; -1degC in all these areas except perhaps W. Turkey. *Rainfall:* wet in N.E. India, Bangladesh, N. Mongolia, S. Japan, Philippines; parts of N. and S.W. Turkey and C. and E. China. Over 200% locally in E. China, N.E. India, E. Japan, S. and C. Philippines. Dry in S. Mongolia, Korea, N. Japan, Java to Flores; most of Turkey, Middle East, Pakistan and India; much of China. Under 50% locally in N. Japan and widely in the other areas. Thailand to Sumatra and Borneo mixed; few large anomalies.

Australia. *Temperature:* warm almost everywhere; +2degC in E. *Rainfall:* wet in E. and S.W.; over 200% in parts of S.W. and much of E. Dry elsewhere; mainly under 50%.

M. W. ROWE

WEATHER SUMMARY: August 1989

August was a rather warm month over southern Britain with mean temperatures approaching one and a half degrees Celsius above the normal. Over northern Britain mean values were very close to those expected for this

summer month. Temperatures generally attained their highest levels on 19th and 20th reaching 29.0° on the Island of Jersey on the former day and with 30.4° at Coltishall (Norfolk), 29.6° at Wattisham and 29.2° at Shoeburyness (Essex) on the latter. On 6th Romsey (Hampshire) recorded 29.4°, Heathrow 29.3° and Edinburgh 24.5°C. On 2nd temperature rose to 25.6° at Leuchars (Fife). Highest minima were far from extreme with 16.5° at Edinburgh on 9th, 19.5° at Worthing on 10th and 18.4°C at Dover on 15th. Southern Britain saw little cold weather of any consequence but in the north the 1st was very chilly with maxima of 11.1° at Sumburgh (Shetland), 11.8° at Fair Isle and 12.0° at Whalsay (Shetland). On 26th the temperature rose to only 10.7° at Salsburgh, near Glasgow, and 10.3° at Braemar (Highland), and in Wales 15.0° was the highest reached at Aberporth (Dyfed) on 31st. Although no air frost was reported some marginal values were reported during the month. On 28th Eskdalemuir recorded 0.2° and Braemar 0.3° and on 1st St. Harmon reported only 0.9°. Over England 3.6° was recorded at Ringway Airport, Manchester, on 28th and 3.8° was the highest reached at Hurn Airport, Bournemouth, on 23rd. On the grass the temperature on 28th dropped to -4.3° at Glenlee (Dumfries and Galloway) and to -4.0° at Denbury (Devon) and a few incidents of slight ground frost were reported from favoured localities during the month, even in the south. Most parts of England and Wales had a dry month with totals widely below 75 percent of the normal and locally below 50 percent. In southern coastal counties from Kent to Hampshire and in the Channel Islands less than 25 percent was recorded. Western parts of Scotland were very wet and here between 200 and 300 percent of the normal rain fell widely. Apart from local heavy thundery downpours daily falls were not excessive over central and southern parts of England and Wales. It was a different story in the north, though, with 53.3mm at Thirlmere (Cumbria) and 43.8mm at Morcambe (Lancashire) on 13th, 54.8mm at Coniston and 49.7mm at Hawkshead (Cumbria) on 30th and 45.9mm at Fort William on 19th. Away from the very wet north-west where totals were around 75 percent of the normal, sunshine was again very much above the normal, being widely between 130 and 160 percent and in the region of 170 percent over central parts of England.

The weather turned rather more unsettled during August with south-westerly winds more in evidence than at any time since April. However, many parts of Britain were again predominantly dry with prolonged sunshine, heavy rain being mostly confined to north-western Britain. During the opening days of the month high pressure to the south-west kept most parts dry with some sunshine while in the north-west there was some mostly light rain or drizzle from time-to-time. With winds tending to back towards the south the next few days became increasingly warm and humid and thunderstorms developed very locally on some days, particularly over Scotland on 6th and in parts of eastern England on 7th. Most parts of Britain had a good deal of rain on 9th and 10th as active fronts crossed the country and winds reached gale-force in exposed parts of the north and west, and over the following few days

weakening fronts spread further rain to most parts, but chiefly to the north. Thunderstorms developed quite widely over the U.K. on 13th ahead of a cold front as it pushed south-eastwards across the country and heavy rain accompanied another cold front in the north-west on 14th. This latter front was linked to a deep low passing close to western Scotland and in its circulation some stormy conditions affected the north and west for a time. At Pwllheli in north Wales a tornado caused considerable damage to Butlin's holiday camp. After a few days with sunshine and showers southern parts became mostly dry and warm on 18th and 19th and following the passage of a weak cold front on 20th southern parts again turned dry, sunny and quite warm while the north remained unsettled throughout. The 25th and 26th were rainy days almost everywhere and rain was quite heavy through central areas close to the path of a depression that had moved out into the southern North Sea by 27th. The 27th saw showers in eastern parts and after a sunny day on 28th frontal systems crossed all parts on 29th and 30th giving some quite heavy rain in the north and west on the latter day. The month ended on a drier note but showers again developed in the north.

K. O. M.

TEMPERATURE AND RAINFALL: AUGUST 1989

	Mean				Grass				RD	Th
	Max	Min	Max	Min	Min	Rain	%	Wettest		
BELGIUM: Uccle	23.3	13.0	30.3(20)	8.3(29)		36.7	50	15.4(31)	11	-
" Rochefort	23.3	14.1	30.0(20)	4.6(3)		54.4	68	12.0(26)	12	-
" Houwaart	25.2	10.4	32.7(20)	5.9(3)		33.0	42	16.7(1)	14	3
DENMARK: Fanø	18.6	12.9	23.4(20)	7.8(6)		41.3	54	6.4(16)	14	0
" Frederikssund	20.8	12.9	27.3(21)	8.4(30)	4.4(30)	111.2	167	29.7(8)	14	1
GERMANY: Berlin	23.2	12.5	34.2(16)	5.6(30)	5.1(30)	60.5	87	12.3(28)	11	5
" Hamburg	21.5	12.3	29.5(20)	6.9(26)	2.3(30)	114.5	140	61.4(27)	14	2
" Frankfurt	24.4	13.2	34.4(16)	7.5(30)	4.8(30)	39.1	53	12.7(7)	13	5
" Munchen	23.3	12.4	32.0(16)	3.5(31)	-1.4(31)	61.3	55	11.6(9)	17	5
ITALY: Casalecchio	28.2	18.0	32.0(v)	11.0(v)	10.0(v)	71.0	253	38.0(28)	4	3
MALTA: Luqa	31.0	22.7	35.0(12)	18.5(30)	13.4(30)	1.5		1.1(26)	2	2
NETHERLANDS: Ten Post	21.3	12.2	31.1(20)	6.8(26)	2.5(26)	49.1	55	11.6(28)	19	3
" Schettens	20.5	12.8	26.8(20)	7.4(26)	4.4(26)	37.5	46	14.7(27)	13	2
SWEDEN: Valla	20.4	10.2	26.8(21)	1.0(29)		67.3		22.2(4)	17	6
SWITZERLAND: Basel	25.4	13.5	34.5(16)	6.1(30)		69.9		28.4(7)	10	8
EIRE: Straide	18.3	11.5	21.6(5)	3.9(28)	-2.0(28)	163.5	167	29.9(14)	23	0
SHETLAND: Whalsay	14.3	10.1	16.8(14)	7.0(29)	2.7(28)	100.8	124	13.7(14)	24	0
" Fair Isle	13.7	10.2	15.1(7)	7.7(28)	2.4(6)	74.1	119	12.2(30)	22	1
SCOTLAND: Braemar	16.8	8.8	21.9(2)	0.3(28)		70.0	84	16.1(14)	22	-
" Inverduie	18.0	8.6	24.3(6)	2.0(28)	-1.5(28)	74.9	84	7.8(14)	22	1
" Rannoch	16.6	8.3	21.8(6)	1.9(10)	0.8(28)	137.5		24.8(14)	26	1
WALES: Pembroke	20.8	11.9	24.4(5)	7.8(24)	3.1(28)	69.7	70	20.4(9)	15	1
" Velindre	20.9	11.3	25.9(6)	6.2(28)	1.8(28)	59.5	84	29.0(9)	11	1
" Carmarthen	19.5	11.9	23.3(5)	6.1(28)	2.9(28)	136.8	119	39.2(9)	19	2
" Gower	20.3	13.0	23.9(3)	7.4(28)	2.1(28)	84.4	78	36.9(9)	13	3
GUERNSEY: Airport	20.7	14.1	26.0(19)	10.6(29)		9.4		3.0(9)	6	1
ENGLAND:										
Denbury, Devon	22.4	12.1	26.6(6)	6.5(28)	-4.0(28)	61.4	100	30.4(14)	6	1

	Mean				Grass				RD	Th
	Max	Min	Max	Min	Min	Rain	%	Wettest		
Gurney Slade, Somerset	21.8	10.0	26.8(5)	2.7(28)	2.3(28)	52.5	45	16.8(14)	13	1
Yatton, Avon	22.8	12.3	26.8(19)	5.1(28)	3.2(28)	48.5	59	16.2(14)	13	1
Corsham, Wiltshire	22.7	11.5	28.0(6)	6.8(23)	3.1(28)	34.4	41	11.4(14)	10	1
Reading Univ., Berks	23.3	11.8	28.6(6)	7.5(23)	0.1(23)	58.6	115	34.1(9)	7	1
Sandhurst, Berkshire	23.6	10.1	28.3(6)	4.4(28)	2.3(28)	45.0	78	24.0(9)	9	1
Romsey, Hampshire	23.8	10.3	29.4(6)	4.7(18)	0.0(28)	33.4	51	17.9(9)	6	1
Horsham, Sussex	24.0	11.3	28.5(6)	5.0(2)	3.0(2)	24.0	36	5.3(12)	12	0
Brighton, Sussex	22.1	13.0	25.1(19)	7.9(28)		26.3	41	6.2(16)	10	1
Hastings, Sussex	21.9	13.9	25.7(6)	9.9(28)	6.7(29)	17.1	34	5.9(25)	7	0
Dover, Kent	22.6	12.7	27.7(20)	6.2(29)		22.9	38	5.7(13)	10	2
East Malling, Kent	23.8	12.2	28.8(20)	6.1(29)	2.0(29)	26.0	46	9.6(13)	11	1
Epsom Downs, Surrey	23.6	10.8	28.1(20)	5.3(2)	2.5(28)	48.0	84	10.5(13)	10	0
Reigate, Surrey	24.3	11.3	29.4(20)	5.8(29)	5.7(29)	25.9	39	5.4(13)	10	1
Guildford, Surrey	23.5	12.7	28.8(6)	7.2(28)	4.1(28)	36.3	66	8.5(10)	9	0
Sidcup, London	24.1	12.9	29.0(20)	8.5(29)		45.2		10.1(13)	10	1
Hayes, London	23.8	12.1	28.6(6)	7.4(28)	5.2(28)	61.4	116	36.1(10)	8	1
Hampstead, London	23.3	12.9	27.5(20)	8.8(28)	1.7(22)	50.1	68	14.3(9)	8	1
Royston, Hertfordshire	23.2	12.5	28.5(20)	7.0(28)	4.1(28)	32.0	54	11.0(14)	7	2
Loughton, Essex	23.6	12.0	28.2(6)	7.7(29)	3.1(29)	39.1	75	12.0(9)	10	2
Buxton, Norfolk	22.3	11.5	29.7(20)	5.5(29)	5.5(29)	49.2	96	20.7(26)	8	0
Ely, Cambridgeshire	23.4	10.3	29.5(20)	5.7(28)	5.5(23)	32.5	60	8.7(10)	8	1
Luton, Bedfordshire	23.1	11.7	28.3(20)	6.1(23)	1.2(23)	34.8	55	10.2(14)	6	2
Buckingham, Bucks	23.3	10.1	28.8(6)	5.0(23)	-0.2(23)	26.7	47		9	1
Oxford University	23.4	12.3	28.2(26)	7.1(28)	1.2(28)	43.3	74	16.7(9)	9	-
Stourbridge, W.Mid'nds	21.6	11.3	27.0(6)	5.2(28)	-1.0(28)	35.6	49	18.0(9)	8	0
Birmingham Univ'sity	21.6	11.3	26.2(6)	6.2(28)	-0.5(28)	37.8	49	15.9(9)	10	1
Wolverhampton	21.5	11.7	26.5(6)	7.0(28)	1.9(28)	53.4		15.6(9)	13	0
Kettering, Northants	23.3	11.1	28.5(20)	5.5(19)	2.8(5)	43.2	65	16.5(13)	8	0
Louth, Lincolnshire	22.7	11.1	29.0(20)	6.7(29)		40.4		24.6(26)	9	0
Keyworth, Nott'shire	22.3	11.6	27.0(6)	6.9(28)	1.0(28)	36.4		14.6(14)	9	1
Nottingham, Nott'shire	23.3	12.0	28.6(6)	8.5(28)	6.1(23)	43.7	69	15.9(14)	8	1
Derby, Derbyshire	21.9	12.1	27.0(6)	7.3(28)	6.2(28)	36.3	54	7.8(10)	11	1
Middleton, Derbyshire	19.1	10.5	24.6(6)	6.0(28)		38.6	46	9.2(14)	12	0
Keele University, Staffs	20.1	10.9	25.0(6)	8.2(23)	8.2(28)	49.7	59	12.7(14)	15	0
Liverpool, Merseyside	20.3	12.5	25.4(6)	5.3(28)		99.7	116	19.9(30)	16	1
Lathom, Merseyside	19.0	12.3	23.7(19)	6.1(28)		98.6		20.1(13)	116	0
High Bradfield, S.Yorks	18.0	10.1	24.7(6)	5.1(28)		40.2		10.3(10)	13	-
Cottingham, Humbs'ide	22.3	11.7	27.8(20)	7.9(29)	4.6(29)	34.2	49	11.7(26)	9	1
Carlton-in-Cleveland	20.4	11.5	26.4(6)	5.7(28)	1.2(28)	50.0		13.5(9)	12	1
Durham University	20.1	10.7	26.5(6)	5.5(2)	3.0(2)	61.5	89	17.0(9)	14	-
Sunderland, Tyne/Wear	19.9	12.3	23.7(6)	8.0(28)		61.8	96	23.6(9)	10	1
CANADA: Halifax NS	22.2	13.9	26.5(17)	7.1(28)		58.7	60	21.2(20)	11	3
U.S.: Bergenfield, NJ	28.0	17.9	35.0(6)	10.6(9)	8.9(9)	130.1		59.4(-)	10	6
JAMAICA: Kingston	33.7	25.8	35.0(1)	24.2(21)		116.4	143	49.8(21)	6	16
AUSTR'LIA: Leopold	13.7	5.7	16.4(18)	2.3(18)		59.7	108	13.0(23)	20	0

CUMBRIA RAINFALL:

Carlisle, 95.9mm (112%); Honister, 458.0mm; Coniston, 268.9mm; The Nook, Thirlmere, 295.1mm (154%); Hawkshead, 198.2mm (133%).

SUBJECT INDEX, VOLUME 14

compiled by K. O. Mortimore

- Aegean Sea, Eddy whirlwind in the, 391
 Africa during extremely dry and wet years, Spatial and temporal rainfall variability over south-eastern central, 3
 Agricultural college's use of an automatic weather station, An, 55
 Aircraft trailing vortices upon a cereal-field near an airport, A study of the effect of, 9
 Air pollution alert in Madrid, 276
 Anglesey, January-February spring in Liverpool and, 138
 Atmosphere, Vortex motion in the, 123
 Atmospheric plasma-vortex phenomenon and its circular ground traces known as the circles effect, 157
 Automatic weather station, An agricultural college's use of an, 55
 Autumn leaf-fall, A premature, 391
 Avon county, 5 August 1989, Circles made by a whirlwind in, 414
 Avon County, 1988, Weather and butterflies in, 18
 Ball lightning, Orange coloured, 393
 Beckhampton Downs viewed as a defective quintuplet, The circles effect: New types in 1988 (1) A quadruplet circle-set on, 126
 Birds during 1989, Impact of high temperature and low rainfall on Britain's breeding, 373
 Birds during mild mid-winter 1988-89, Unseasonal nesting by, 90
 Book Listings: Weather in focus, 63; The Antarctic treaty regime: Law environment and resources, 137; The climate of Scotland: some facts and figures 393; The geostationary applications satellite, 394; Solar energy applications to buildings and solar radiation data, 394; Meteorology and flight, 394
 Book Reviews: Weather forecasting in New Zealand, 29; The impact of climatic variability on U.K. Industry, 30; Weather: We like it or not - 70 years of weather at Ryde, 31; An introduction to boundary layer meteorology, 62; Tropospheric ozone: Regional and global scale interactions, 99; Chambers science and technology dictionary, 100; Surrey in the hurricane, 135; Applications of meteorology to atmospheric pollution problems, 136; Clouds in a glass of beer: Simple experiments in atmospheric physics, 284; The weather journals of a Rutland squire, 285; Weather, climate and animal performance, 309; Synoptic meteorology in China, 311; Living Ice: Understanding glaciers and glaciation, 345; Glacier fluctuations and climatic change, 346; Surrey in the hurricane, 347; Circular evidence, 347; Controversy of the circles, 354; Weather sensitivity and services in Scotland, 426
 Britain and Ireland in 1987, Damaging hail in Great, 419
 Britain from the weather in 1988, Deaths in, 307
 Britain's breeding birds during 1989, Impact of high temperatures and low rainfall on, 373
 British Isles and their relationship to some zonal circulation indices, Westerly weather types over the, 297
 British Isles: Rosdalla, County Westmeath, Eire, April 1054, The earliest documented tornado in the, 86
 British tornadoes and waterspouts of the 1970's. Part 1: 1970, 47
 Butterflies in Avon county, 1988, Weather and, 18
 Butterflies in midwinter, 285
 Butterfly, A mid-winter, 64
 Canary Islands for 35 years, The worst storm in the eastern, 278
 Cereal-field near an airport, A study of the effect of aircraft trailing vortices upon a, 9
 Circles formation in a Wiltshire cereal-crop - An eye-witness account and analysis of circles-effect event at Westbury, 265
 Circle in Kent which overlapped a roadway, A spiral, 431
 Circle-making vortex that descended through 11,000-volt overhead cables in southern England, 83
 Circle phenomenon from 1678, An account and illustration of the crop, 387
 Circles and circle-eating sheep, Sheep, 431
 Circles effect, Atmospheric plasma-vortex phenomenon and its circular ground traces known as the, 157
 Circles effect: New types in 1988 (1) A quadruplet circle-set on Beckhampton Downs viewed as a defective quintuplet, 126
 Circles effect research unit, 253
 Circles in an oatfield in Hertfordshire, August 1678, Discussion of the mowing devil story regarding, 383
 Circles made by a whirlwind in Avon county, 5 August 1989, 414

- Circles near the Devonshire coast, beyond a 400ft ridge, 1979-1988, 392
 Circles, Sheep, 54; 287; 430; 431
 Clouds, Liverpool's hole in the, 286
 Cold air funnels, Tornado at Didcot, Oxfordshire, on 23 November 1984 and its relationship to, 109
 Compact disc, Digital map of the world on, 433
 Continental tropical air over England in early February, 138
 Crop-circle phenomenon from 1678, An account and illustration of the, 387
 Cyprus, Temporal fluctuations of annual rainfall in Nicosia, 37
 Deaths in Britain from the winter in 1988, 307
 Dee Why tornado of 23 April 1989, 316
 Delimitation of seasons, Example: The station of Larissa (Greece), 338
 Deluge: The storms of 3 and 13 June 1989, A remarkable June, 304
 Devonshire coast, beyond a 400ft ridge, 1979-1988, Circles near the, 392
 Didcot, Oxfordshire, on 23 November 1984 and its relationship to cold air funnels, Tornado at, 109
 Digital map of the world on compact disc, 433
 Dover, Dry winter in extreme S.E. England at, 139
 Dover, The 'best' December of the century at, 64
 Dryness of April-August 1989 compared, The, 393
 Dry winter in extreme S.E. England at Dover, 139
 Dublin, Severe smog problems in, 64
 Eddy whirlwinds in the Aegean Sea, 391
 Eire, April 1054, The earliest documented tornado in the British Isles: Rosdalla, County Westmeath, 86
 Embryo vortices, 430
 England at Dover, Dry winter in extreme S.E., 139
 England in early February, Continental tropical air over, 138
 England in early February, Tropical air over, 286
 England, November 1988, Sunshine in north-east, 261
 England overnight 18th-19th March 1987, The heavy localised snowfall over central southern, 76
 England: The case of June and July 1988, Factors influencing rainfall in north-east, 114
 Europe, Temperature extremes in southern, 32
 Fatima, The 'miracle of the sun' at, 333, 430
 France, A wire-traversing vortex case from, 83
 Gales in Malta in November and December 1988, Freak heavy rainfall and, 73
 Greece, Delimitation of seasons, Example: The station of Larissa, 338
 Greece, Extremely low relative humidities on Mount Olympus, 271
 Green boost for Ventureprise, 433
 Hail in Great Britain and Ireland in 1987, Damaging, 419
 Hartford-shire, 1678, Mowing-devil or strange news out of, 381
 Heat of the Irish summer of 1989, The, 390
 Hertfordshire, August 1678, Discussion of the mowing devil story regarding circles in an oatfield in, 383
 Hertfordshire, Witchcraft in, 389
 Humidities on Mount Olympus, Greece, Extremely low relative, 271
 Ideas for the magazine, 32
 Instruments, Care of recording, 393
 Ireland in 1987, Damaging hail in Great Britain and, 419
 Irish summer of 1989, The heat of the, 390
 Isle of Wight, A record May in the, 316
 Jakarta, Weather of 1988 in, 286
 Kent, May 1989, Nil rain in Thanet, 316
 Kent which overlapped a roadway, A spiral circle in, 431
 Larissa (Greece), Delimitation of seasons, Example: The station of, 338
 Leaf-fall, A premature autumn, 391
 Lightning, Orange-coloured ball, 393
 Lightning shock, Mrs Meaden's, 431
 Literature reviews and listings: 29; 62; 99; 135; 284; 309; 345; 393; 426
 Liverpool and Anglesey, January-February spring in, 138
 Liverpool's hole in the clouds, 286
 London tornado of 8 December 1954, Further eye-witness account of the west, 418
 London tornado of 8 December 1954, Memories of the west, 416
 London volmet south, The fall and rise of, 389
 Madrid, Air pollution alert in, 276
 Magazine, Ideas for the, 32
 Malta, A stormy day in, 101
 Malta in November and December 1988, Freak heavy rainfall and gales in, 73
 Malta, Storms of 8-9 December 1988 in, 102
 Meaden's lightning shock, Mrs, 431

- Mesoscale rotation observed on 2 April 1989, Unusual, 390
- Miracle of the sun at Fatima, 333; 430
- Mount Olympus, Greece, Extremely low relative humidities on, 271
- Mowing-devil or strange news out of Hartfordshire, 1678, 381
- Mowing devil story regarding circles in an oatfield in Hertfordshire, August 1678, Discussion of the, 383
- Myths and mysteries in the making, 360
- Nesting by birds during mild mid-winter 1988-89, Unseasonal, 90
- New Journal: Global and planetary change, 137
- New Products: Delta-T devices adds 4-wire measurement to Delta Logger, 105; Live animated weather satellite pictures from a low-cost system, 140; Weather data's windscope 400DP, 140; Portable weather station for rapid deployment, 432; Digital map of the world on compact disc, 433
- Nicosia, Cyprus, Temporal fluctuations of annual rainfall in, 37
- Ol Longonot, The steam vents of, 379
- Orange-coloured ball lightning, 393
- Oxford during 1987, Weather at, 91
- Oxfordshire, on 23 November 1984 and its relationship to 'cold air funnels', Tornado at Didcot, 109
- Pepys, 1660-1669: Part 3, Weather of, 42
- Plasma-vortex phenomenon and its circular ground traces known as the circles effect, Atmospheric, 157 (see also entries under circles and circles effect)
- Pollution alert in Madrid, Air, 276
- Product News: Ventureprise co-operative Ltd., 366; Ventureprise wind rose programme, 366; Green boost for Ventureprise, 433
- Rainfall and gales in Malta in November and December 1988, Freak heavy, 73
- Rainfall in Nicosia, Cyprus, Temporal fluctuations of annual, 37
- Rainfall in north-east England: The case of June and July 1988, Factors influencing, 114
- Rainfall in south Wales, Increasing, 375
- Rainfall on Britain's breeding birds during 1989, Impact of high temperatures and low, 373
- Rainfall 1955-1988, South Wales, 139
- Rainfall variability over south-eastern central Africa during extremely dry and wet years, Spatial and temporal, 3
- Rain in Thanet, Kent, May 1989, Nil, 316
- Recording instruments, Care of, 393
- Record May in the Isle of Wight, 316
- Relative humidities on Mount Olympus, Greece, Extremely low, 271
- Roadway, A spiral circle in Kent which overlapped a, 431
- Rosdalla, County Westmeath, Eire, April 1054, The earliest documented tornado in the British Isles, 86
- Rotation observed on 2 April 1989, Unusual mesoscale, 390
- Scottish lakes (Loch Ness and Loch Ashie), Two whirlwinds on, 344
- Sheep circles, 287; 430
- Sheep circles and circle-eating sheep, 431
- Sheep in circular flocks, is there a meteorological, or some other connection, 54
- Shetland, Late sleet in, 317
- Sleet in Shetland, Late, 317
- Smog problems in Dublin, Severe, 64
- Snowfall over central southern England overnight 18th-19th March 1987, The heavy localised, 76
- South Wales rainfall 1955-1988, 139
- Spatial and temporal rainfall variability over southeastern central Africa during extremely dry and wet years, 3
- Spiral-circle in Kent which overlapped a roadway, 431
- Spring in Liverpool and Anglesey, January-February, 138
- Steam vents of Ol Longonot, The, 379
- Storm chaser, Ode for a miserable, 315
- Storm in the eastern Canary Islands for 35 years, The worst, 278
- Storms of 8-9 December 1988 in Malta, 102
- Storms of 3 and 13 June 1989, A remarkable June deluge, 304
- Stormy day in Malta, 101
- Summer of 1989, The heat of the Irish, 390
- Sun at Fatima, The miracle of the, 333
- Sunshine in north-east England, November 1988, 261
- Temperature extremes in southern Europe, 32
- Temperatures and low rainfall on Britain's breeding birds during 1989, Impact of high, 373
- Temporal fluctuations of annual rainfall in Nicosia, Cyprus, 37
- Temporal rainfall variability over southeastern central Africa during extremely dry and wet years, Spatial and, 3
- Thanet, Kent, May 1989, Nil rain in, 316
- Thunderstorm and lightning phenomena: Mrs Meaden's lightning shock, 431
- Orange-coloured ball lightning, 393
- Storms of 3 and 13 June 1989, The

- remarkable June deluge, 304; TORRO thunderstorm reports: March-April 1988, 27; May-June, 65; July, 102; August, 287; September, 323; October-December, 363; January-February 1989, 399; March-April, 401
- Tornadic whirlwind and associated vortex phenomena: Aircraft trailing vortices upon a cereal-field near an airport, 9
- Atmospheric plasma-vortex phenomenon and its circular ground traces known as the circles effect, 157
- Circle formation in a Wiltshire cereal-crop, An eye-witness account and analysis of circles-effect event at Westbury, 265
- Circles in Kent which overlapped a roadway, A spiral, 431
- Circle-making vortex that descended through 11,000-volt overhead cables in southern England, 83
- Circles effect: New types in 1988, 126
- Circles effect research unit, 253
- Circles in an oatfield in Hertfordshire, August 1678, 383
- Circles made by a whirlwind in Avon county, 5 August 1989, 414
- Circles near the Devonshire coast, beyond a 400ft ridge, 1979-1988, 392
- Crop-circle phenomenon from 1678, 387
- Eddy whirlwinds in the Aegean Sea, 391
- Embryo vortices, 430
- Mesoscale rotation observed on 2 April 1989, Unusual, 390
- Mowing-devil or strange news out of Hartfordshire, 1678, 381
- Sheep circles, 54; 287; 430
- Sheep circles and circle-eating sheep, 431
- Tornado at Didcot, Oxfordshire, on 23 November 1984 and its relationship to 'cold air funnels', 109
- Tornadoes and waterspouts of the 1970's, Part 1: 1970, British, 47
- Tornado in the British Isles: Rosdalla, County Westmeath, Eire, April 1054, The earliest documented, 86
- Tornado of 23 April 1989, The Dee Why, 316
- Tornado of 8 December 1954, Further eye-witness accounts of the west London, 418
- Tornado of 8 December 1954, Memories of the west London, 416
- TORRO tornado division reports: January-May 1988, 24; June-July, 127; August-September, 317; October-December, 361; January-February 1989, 399
- TORRO Tornado Intensity Scale, 53
- Vortex case from France, A wire-traversing, 83
- Vortex motion in the lower atmosphere, 123
- Whirlwinds on Scottish lakes (Loch Ness and Loch Ashie), Two, 344
- Tropical air over England in early February, 286
- Tropical air over England in early February, Continental, 138
- Unseasonal nesting by birds during mild mid-winter 1988-89, 90
- Ventureprise Co-operative Ltd., 366; 433
- Volmet south, The fall and rise of London, 389
- Vortex case from France, A wire-traversing, 83
- Vortex motion in the lower atmosphere, 123
- Vortex that descended through 11,000-volt overhead cables in southern England, Circle-making, 83
- Vortices, Embryo, 430
- Vortices upon a cereal-field near an airport, A study of the effect of aircraft trailing, 9
- Wales, Increasing rainfall in south, 375
- Wales rainfall 1955-1988, South, 139
- Warmth in context, Winter, 279
- Waterspouts of the 1970's, Part 1: 1970, British tornadoes and, 47
- Weather and butterflies in Avon county, 1988, 18
- Weather at Oxford during 1987, 91
- Weather in 1988, Deaths in Britain from the, 307
- Weather of 1988 in Jakarta, 286
- Weather of Pepys, 1660-1669: Part 3, 42
- Weather station, An agricultural college's use of an automatic, 55
- Weather summary: September 1988, 34; October, 70; November, 105; December, 142; January 1989, 144; February, 290; March, 292; April, 326; May, 328; June, 370; July, 406; August, 436
- Weather types over the British Isles and their relationship to some zonal circulation indices, Westerly, 297
- Westbury, Circle formation in a Wiltshire cereal-crop, An eye-witness account and analysis of a circles-effect event at, 265
- Westerly weather types over the British Isles and their relationship to some zonal circulation indices, 297
- Whirlwind in Avon county, 5 August 1989, Circles made by a, 414
- Whirlwinds in the Aegean Sea, Eddy, 391
- Whirlwinds on Scottish lakes (Loch Ness and Loch Ashie), Two, 344

Wiltshire cereal-crop, An eye-witness account and analysis of circles-effect event at Westbury, Circle formation in a, 265
 Winter butterfly, A mid, 64
 Winter in extreme S.E. England at Dover, Dry, 139
 Winter's tale, 409
 Winter 1988-89, Unseasonal nesting by birds during mild mid, 90
 Winter warmth in context, 279
 Witchcraft in Hertfordshire, 389
 World weather disasters: June 1988, 21;

July, 58; Aug., 95; Sept., 132; Oct., 280; Nov., 311; Dec., 355; Jan. 1989, 358; Feb., 396; March, 427
 World weather review: July 1988, 33; Aug., 69; Sept., 141; Oct., 289; Nov., 325; Dec., 368; Jan. 1989, 369; Feb., 403; March, 405; April, 434; May, 435

Zonal circulation indices, Westerly weather types over the British Isles and their relationship to some, 297

AUTHOR INDEX

Andrews, C.A., 287
 Ashton, S.E., 73
 Austin, A., 391

Balafoutis, C.J., 271
 Bargman, D., 392
 Bathurst, G.B., 123
 Burt, S.D., 135
 Burt, T.P., 91

Campbell, S., 333
 Clay, A., 30; 136; 309
 Clifford, P.B.L., 101

Eden, P., 416
 Elsom, D.M., 109
 Evans, D.M., 393

Flocas, A.A., 3; 37; 297

Giles, B.D., 297
 Glue, D.E., 90; 373
 Green, R.H., 393

Hahn, R.A., 393
 Herron, A.C., 285
 Holmes, D., 286
 Hosking, K.J., 316

Irvine, S.G., 317

James, A.C., 27; 65; 323
 Ledson, K.G., 138; 286

Mack, D.C., 304
 Mack, J., 315
 Maheras, P., 271; 338
 Makrogiannis, T.J., 297
 Matarira, C.H., 3
 Mayes, J.C., 375
 Meaden, G.T., 9; 24; 47; 54; 83; 126; 127; 157; 265; 317; 347; 354; 361; 431

Meskill, D., 64; 390
 Mortimore, K.O., 102; 287; 363; 399; 401

Oldschool, S.R., 138

Perry, A.H., 29; 32; 73; 279; 311
 Pike, W.S., 62; 76; 360; 394

Pitsoulis, N., 338
 Prichard, R.J., 430
 Randles, J., 383
 Rendall, P.D., 414
 Reynolds, D.J., 390
 Rogers, P., 316

Rolfe, G., 31
 Rowe, M.W., 24; 33; 47; 69; 86; 127; 141; 289; 317; 325; 344; 361; 268; 369; 403; 405; 418; 434; 435

Selge, R.W., 32; 389
 Schove, D.J., 42
 Skinner, R.M., 387
 Southern, G.A., 409
 Spink, P.C., 286; 379; 430
 Stanier, D.J., 102

Thomas, A.J., 21; 58; 95; 132; 280; 307; 311; 355; 358; 396; 427
 Thomas, F.G., 64; 139; 316; 430; 431
 Tout, D.G., 276; 278
 Trenchard, J.C.H., 139
 Tufnell, L., 63; 99; 137; 284; 345; 393

Venters, P., 91

Wakefield, B.M., 391
 Webb, J.D.C., 419
 Weeks, A.H., 18; 64
 Wheeler, D.A., 114; 261

EDITORIAL ADVISORY BOARD

NICHOLAS L. BETTS,
 Department of Geography, The Queen's University of Belfast, Belfast BT7 1NN, Northern Ireland.
 DR. TIMOTHY P. BURT,
 School of Geography, University of Oxford, Mansfield Road, Oxford OX1 3TB, England.
 ROBERT A. CROWDER,
 Lincoln College, University College of Agriculture, Canterbury, New Zealand.
 PROF. JEAN DESSENS,
 Centre de Recherches Atmospheriques, Université Paul Sabatier, Campistrous, 65300 Lannemezan, France.
 DR. DEREK M. ELSOM,
 TORRO Research Centre, Geography Unit, Oxford Polytechnic, Oxford OX3 0BP, England.
 PROF. GREGORY S. FORBES,
 Associate Professor of Meteorology, Pennsylvania State University, University Park, Pennsylvania 16802, U.S.A.
 DR. MICHAEL G. HAMILTON,
 Department of Geography, University of Birmingham, Birmingham B15 2TT, England.
 DR. S. JOHN HARRISON,
 Department of Environmental Science, University of Stirling, Stirling FK9 4LA, Scotland.
 PROF. HUBERT H. LAMB,
 Emeritus Professor, Climatic Research Unit, University of East Anglia, Norwich, Norfolk, England.
 DR. MICHAEL J. NEWARK,
 Canadian Climate Centre, Atmospheric Environment Service, Environment Canada, 4905 Dufferin Street, Downsview, Ontario M5H 5TR, Canada.
 DR. ALLEN H. PERRY,
 Department of Geography, University College, Swansea SA2 8PP, Wales.
 PROF. RICHARD E. PETERSON,
 Professor and Chairman Atmospheric Science, Texas Tech University, Lubbock, Texas 79409, U.S.A.
 PROF. HUGO POPPE,
 Professor of Meteorology and Climatology, Department of Geography, Leuven University, Leuven, Belgium.
 PROF. JOHN T. SNOW,
 Professor of Meteorology, Department of Geosciences, Purdue University, West Lafayette, Indiana 47907, U.S.A.
 DR. DENNIS A. WHEELER,
 Geography Department, Sunderland Polytechnic, Chester Road, Sunderland SR1 3SD, England.

TORRO DIRECTORS ASSOCIATED WITH THE JOURNAL OF METEOROLOGY and specialising in data collection, research and consultancy

DEREK ELSOM,
 TORRO Research Centre and TORRO Photographic Library, Geography Unit, Oxford Polytechnic, Oxford OX3 0BP. Tel: 0865-819761 Fax: 0865-819073 Home Tel: 08677-2716.
 TERENCE MEADEN,
 TORRO Tornado Division, TORRO Publications Division, CERES Circles Effect Research Division, CERES Photographic Library and CERES Publication Division, 54 Frome Road, Bradford-on-Avon, Wiltshire BA15 1LD. Tel: 0225-862482 Fax: 02216-5601.
 KEITH MORTIMORE,
 TORRO Thunderstorm Division and Thunderstorm Census Organisation, 77 Dicketts Road, Corsham, Wiltshire SN13 9JS. Tel: 0249-713516.
 MICHAEL W. ROWE,
 TORRO Tornado Data Collection and Research Divisions, 21 Bankview, Buckland Park, Lymington, Hampshire SO41 8YG. Tel: 0590-678121.
 MARK STENHOFF,
 TORRO Ball Lightning Division, P.O. Box 540, London SE6 2TN. Tel: 01-690-6317.
 ALBERT J. THOMAS,
 TORRO Disasters Data Division, 94 St. Andrew's Road, Bordesley Green, Birmingham B9 4LN. Tel: 021-772-3936.
 JONATHAN D. C. WEBB,
 TORRO Hailstorm Division, 73 Wytham Street, Oxford OX1 4TN.

BOOK REVIEW EDITOR to whom all books and notices for review should be directed

DR. LANCE TUFNELL,
 Department of Geographical Sciences, Huddersfield Polytechnic, Queensgate, Huddersfield, West Yorkshire HD1 3DH, England.

CONTENTS	PAGE
A winter's tale. G. A. SOUTHERN	409
Circles made by a whirlwind in Avon County, 5 August 1989. P. D. RENDALL	414
Memoirs of the West London tornado of 8 December 1954. PHILIP EDEN	416
Further eye-witness accounts of the West London tornado of 8 December 1954. MICHAEL ROWE	418
Damaging hail in Great Britain and Ireland in 1987. J. D. C. WEBB .	419
<i>Book Review: Weather sensitivity and services in Scotland.</i> Ed. by S. J. HARRISON and K. SMITH.	426
World weather disasters: March 1989. A. J. THOMAS	427
The Fatima 'miracle'. R. J. PRICHARD	430
Embryo vortices? F. G. THOMAS	430
Sheep circles. PAUL C. SPINK	430
Sheep circles and circle-eating sheep. G. T. MEADEN	431
A spiral-circle in Kent which overlapped a roadway. F. G. THOMAS .	431
Mrs. Meaden's lightning shock.	431
<i>New Products:</i> (1) Portable weather station for rapid deployment. (2) Digital map of the world on compact disc	432
<i>Product News:</i> Green boost for Ventureprise	433
World weather review: April 1989.	434
World weather review: May 1989.	435
British weather summary: August 1989.	436
Temperature and rainfall tables: August 1989.	438
Index, volume 14, issues 135-144, 1989.	440

FRONT COVER:

Sunset over Jerusalem, 27th October 1989.
(photograph by the editor)

EDITORIAL OFFICE:

Journal of Meteorology, 54 Frome Road, Bradford-on-Avon, Wiltshire,
BA15 1LD, U.K. (telephone: 02216 2482; fax 02216 5601).