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Snow-Cover in the British Isles.

by Gordon Manley, M.A., M.Sc.

The experience of three severe winters coupled with the war-time diffusion of much of our city population over the countryside has directed attention to the frequency with which snow may be expected to cover the ground in various parts of Britain. Those of us who in pre-war years had to pursue their avocations in upland northern districts were well aware that this was a feature of the British climate which tended to be overlooked, a fact the more understandable when it is recalled how large a proportion of our population dwells in lowland towns of considerable size. In a paper by the present writer (G.J.Roy. Met. S., 65, 1939) this aspect of British climatology was considered, using as a basis the figures published by the Meteorological Office since 1912. With the aid of some of the conclusions in this paper, and making a more extensive survey of the data especially from lowland stations, it has been possible for the first time to illustrate the frequency of snow-cover by means of a map. Few countries have as yet published maps of the distribution and frequency of snow-cover; in Western Europe indeed, the difficulties are considerable, as will be evident when the construction of the map under review is described. One of the most useful discussions of the duration of snow-cover is that of Hebner for Germany. (Die Dauer der Schneedecke in Deutschland, 1928).

Snow-cover has been observed and recorded in the British Isles at official station since 1912; at first, rather few stations appear to have completed their records, and an examination of the figures also suggests that for a year or two some observers were not quite clear as to the criterion to be adopted. A day with "Snow-lying" is recorded, if at the 9h. observation the countryside surrounding the station, at the same level and typical of the station itself, is more than half covered with snow. Observations based on this criterion are now as a rule fairly consistent

between adjacent stations, but in earlier years, this was not always so. For example, one station in a Scottish mountain valley, although at a low level, recorded some remarkably high figures about the time of the last war, quite out of keeping with any other station in the vicinity; after investigation the writer concluded that a temporary observer, probably filling a gap under difficulties, had recorded "Snow-cover around the station" whenever snow covered the adjacent mountains fifteen hundred or more feet above. After the war, however, the establishment of a number of permanent air-fields (such as Cranwell, Lympne) and the renewal of more detailed observations at many climatological stations provided, from 1921 onward, a very consistent series of records, especially from country districts; and a further valuable series was forthcoming from many county agricultural stations after 1925. Country districts for obvious reasons are preferable to towns, as far as records of snow-cover are concerned; more will be said about the effect of London in this respect.

It must not be forgotten that observation of snow-cover, even when the criterion is carefully laid down from headquarters and applies to a single fixed hour, is not always easy. In Cambridgeshire for example, the writers of 1940 and 1942 provided a considerable number of days when a thin powdering of snow covered considerably more than half of a large grass playing field adjacent to the writer's house. But ploughland in the neighbourhood at the same time did not give an impression of prevailing snow-cover at all, except at times when one approached a field in which the furrows ran east and west. As nearly three-quarters of Cambridgeshire is ploughland, observers locally are often liable to differ in their

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opinion whether the countryside is or is not thinly covered. In more hilly districts the observer's opinion may well be swayed in favour of snow-cover in places where most of the slopes in view have a northerly aspect and remain largely covered with snow when southerly slopes, or even ground at the level of the observer would be virtually free from snow. There are also a few exposed stations at which snow, on the majority of occasions on which it falls, is liable to drift considerably; around such stations there may be considerable drifts in the roads and in the lee of walls, yet the ground is often sufficiently clear at the observing hour for the observer to record "no snow-cover." But when a large number of stations are compared, discrepancies arising from the various causes are to some extent smoothed out; for the map under review, upwards of 150 stations were used. It was, however, throughout necessary to bear in mind the characteristics of the station and the probable reactions of the observers. For example, in considering the frequency of snow-cover on the Southern Pennines more weight was attached to the record from Oakes, near Huddersfield, than to that from Buxton, inasmuch as the Buxton station is well in the middle of the town and the earlier figures from it did not always appear to be consistent with other upland records; they tended to be on the low side and there is no reason to suppose that Buxton lies in an exceptional "snow-shadow" for example.

Some notable difficulties arose from a familiar cause; the thoroughly irregular distribution of stations. Decisions with regard to the frequency of snow-cover in North Wales for example rest largely on the observations from Rhayader and Welshpool, with a very brief and imperfect record from Penygwryd in Snowdonia. To this may be added the assumption based for example on the writer's observation of the frequent diminution westward in the amount of snow-cover, with a corresponding rise in the snow-line in a month such as March; this is a well known feature of most of our British hill-ranges. That diminution in amount is accompanied by diminution in the number of days of snow-cover is borne out by observations from such Pennine stations as Oakes and Darwen; or West Linton and Eskdalemuir in S. Scotland, and Craibstone, Logie Coldstone, Glencarron

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and Achnasheen further north. Even in the English Midlands one of the largest gaps covers almost the whole of the uplands (Mendips, Cotswolds, Northamptonshire, Leicestershire); throughout this area, eight years record from Cirencester (443 ft.) and eight from Leafield (612 ft.) with a patchy record from Rugby (390 ft.) afford very scanty material from which to deduce how frequently a snow-cover may be expected on the large area above 700 feet.

The frequency of snow-cover is a climatological element subject not only to great variations from place to place, but also from year to year. The necessary compilation of available data was made early in the present war, and covered the years 1912-1938. It was soon observed that over most of the country there were two exceptional years, 1917 and 1919, with a third (1937) rather less conspicuous in the statistics. By way of illustration, West Linton with an average of 39.2 days yearly, recorded 88, 74 and 69 mornings with snow-cover in these three outstanding years. Eskdalemuir (average 24.7 days) recorded 90, 41 and 43. Cambridge, with an average of 7.6 days, recorded 32, 28 and 15; Darwen in Lancashire, with an average of 12 days, gave 40, 34 and 27 respectively. In many places 1916 was also rather snowy; hence it will readily be seen that the average for any given station would be likely to be considerably affected by the inclusion or omission of the years previous to 1920. Making a rough estimate one might say that the average for the 27 years 1912 to 1938 at many stations was about 10% higher than that for the eighteen years 1921-1938; hence an effort was made whenever possible to bring the averages for shorter periods up to those likely to be applicable over the longer term of years.

It may now be asked, what would the effect be if the data for the three severe winters of 1940-1942 were incorporated in these averages. So far as snow-cover is concerned the winters of 1941 and 1942 have been comparable in many places with 1917 and 1919, and again, if these two outstanding years are included the effect will in general be to raise the averages for the whole

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period by a figure commonly of the order of 10%. But it is not to be forgotten that the exceptionally snow-free winter of 1942-1943 already goes some way towards redressing the balance. For the present, it would seem reasonable to retain these averages for snow-cover, 1912-1938, and to allow them to be associated with the published thirty-year averages of temperature for 1906-1935 or the forthcoming series for 1911-1940; and not to make further adjustments until the end of the next decade. By 1950 there will not only be a better network of stations, for example on the High Cotswolds, but more evidence will be forthcoming with regard to a possible incipient trend in the direction of severer winters corresponding with those prevailing between 1870-1897. Further, it is worthy of recall that the late winter and early summer months (March-April) of 1940 were relatively mild, and that in 1940-1941, and again in 1941-1942, there was little snow before January; hence the totals for these years, 1941 and 1942 are in many districts not quite so high as those of 1917 or 1919.

Features of the Map: Great Britain.

Considering the coastal lowlands first: everywhere in a narrow strip round the coast from Norfolk to Solway and up the west of Scotland as far as Wester Ross, less than five mornings yearly with snow-cover are to be expected. The strip broadens to include the whole of the lowlands of Devon and Cornwall below about 500 feet (cf. Tavistock, 4.4 at 457 ft., and Redruth, 3.1 at 397 ft.) The neighbourhood of the Severn estuary (Cardiff, about 4) and a considerable patch of Hampshire are also included (S. Farnborough about 5); this appears to result from the fact that both areas lie in a slight "snow-shadow" with regard to winds from between north and east. Immediately adjacent to the sea the south and west coast of England gives about four days in Kent, two along the Sussex coast and round Southampton Water, between one and two in S. Devon, less than one in Cornwall and West Pembrokeshire; nearly two at Holyhead, less than four at Douglas and five at Southport. Various places on the western Scottish islands and coasts give from two to five days, rising to six further inland at Greenock and Rothesay.

All the evidence goes to show that the inner London area records less than five days; the suburban stations generally give just under five, South Kensington about three; but Hampstead (450 ft.) records an average of 12.9 days.

The strip with less than five days yearly becomes very narrow along the east coast of Norfolk (Yarmouth nearly 5, Bungay above 7, Copdock above 8). Northward, Cromer has nearly six days, Skegness 6.8, Hull 7.1, but Spurn Head only 2.5; Scarborough 5.4, Tynemouth over 7.) The average is generally from 6 to 8 on the eastern Scottish coast south of Angus, rising to 10 in Edinburgh, and 12.6 at Aberdeen; it is generally about 10 very close to the Moray Firth, at Wick and in the lower Orkneys and Shetlands. In all this region however, the rise in frequency with altitude is very rapid; near Aberdeen, Craibstone (325 ft.) records upwards of 25 days, and further inland Logie Coldstone, (608 ft.) about 39 days. This very rapid rise in frequency of snow-cover with altitude on our north-eastern coasts has already been discussed at some length in the paper cited above. It also applies very markedly near the coast of Kent (cf. J.H. Dyson, Q.J.Roy.Met.S., 68, 1942, p.261); and probably the "5" and "10" isopleths as drawn on this map should be carried considerably nearer the Kentish coast, in spite of the low records from Margate and Dover on the coast itself.

Great Britain: Ireland.

The greater part of the Southern English lowlands e.g. in the Thames and Severn valleys, the Fenland, and also a large area in Shropshire, Cheshire and South Lancashire and smaller patches near the Humber and Carlisle experience from seven to ten mornings yearly with snow-cover. (Oxford 7.7; Cambridge 7.6; York about 11, Shrewsbury about 8, Walspool 9.2, Leyland near Preston 8.5.) To the south-west Marlborough even at 424 ft. averages only about 8; Cullompton (Devon) 3.8 illustrates the decrease towards Exeter.

With altitude and distance inland the increase is marked, especially towards the east coast. The higher North Downs generally exceed 10, with parts of the South Downs (Tunbridge Wells, 355 ft., nearly 8). In East Anglia Norwich has over 12 days, Halstead (inland Essex) nearly 12; further inland, small areas on the highest of the Chilterns probably record upwards of 20 days. The whole of the higher ground of the Midlands and the Trent Valley may expect from 10 to 15 at least (Birmingham, 535 ft., about 10; Mayfield, 374 ft. about 16; Cranwell at 230 ft., over 14). Part of the lowland of Northumberland, Durham and N. Yorkshire, with the Midland valley of Scotland falls into the 10-15 region (Catterick 13.5; Glasgow district, 10 at lower levels).

Northward and eastward; the rise on the flanks of the Pennines is marked and if space and other circumstances had allowed the map could undoubtedly have been improved by the inclusion of the "15" isopleth. There is probably a considerable area in High Leicestershire as well as most of Nottinghamshire with 15-20 days: (Mansfield nearly 19 at 357 ft.) and small areas may just exceed 20. Much of industrial Yorkshire and Durham also falls into this category (Huddersfield 17, Meltham 16, Durham 17:) but on the lee side of the Pennines the average frequencies at similar levels are lower (Giggleswick about 16, Stonyhurst about 9, Darwen 12). All the evidence indicates that the shores of Morecambe Bay are relatively free from snow-cover, no doubt on account of the fact that the region frequently lies in a "snow-shadow" so that the quantity in any given fall is commonly a good deal smaller than further east: further there are fewer snowfalls (cf. article by the present writer, Meteorological Magazine, April, 1940.)

Snow-cover at higher levels.

One of the chief defects of British climatology arises from the shortage of high-level records; there are very few stations at levels above 1000 ft. Deductions with regard to the frequency of snow-cover on high ground must largely be based on the observed rate of increase in places where stations of different altitudes are close together;

(Cf. York 11, Harrogate (478 ft.) 21 days; Cally 5, Dumfries 11, Eskdalemuir 25 days.) It has been already shown in the paper cited above that these increases can in large measure be related to the mean temperature in such a way as to make it possible to calculate the probable frequency of snow-cover at higher levels.

On this basis, the greater part of the central and eastern Pennines above 1000 ft. may expect over 30 days with snow-lying; this becomes 50 or more in several upland areas, above about 1600 ft., notably round the Peak and in several larger upland areas further north; the largest lies on the Durham-Cumberland-estmorland border. The Upper Teesdale record kept by the writer, at 1840 ft., indicates an average frequency of snow-cover of about 80 days. The East Yorkshire uplands, although generally lower, have also a high expectation of snow-cover; from 20-30 days on the higher Wolds, and upwards of 30 on all the higher moors towards Cleveland. (Castleton, 450 ft. about 25). Elsewhere on a small scale map it is impossible to show the detail on all summits; but it will be observed that a strip "between 30-50 days" almost connects the Pennines and the Lake District across Shap Fell. (Bellingham, 849 ft., about 31 days).

X Scotland
Considerable areas in the S. Uplands of Scotland (Leadhills, 1310 ft., 61 days on a short record) and a very large area in the central Highlands have over 50 days (Balmoral 60.2, Braemar 68.2; Dalwhinnie probably over 60). In this district a sizeable region, notably in the Eastern Highlands is shown as "more than 100 days". Small areas further north and south, generally too small to show on a map of this scale, may also exceed 100 days, for example on the highest summits of the S. Uplands, the Lake District, Crossfell and North Wales. On Ben Nevis (4406 ft.), the number of days with snow-cover is of the order of 230 days.

At high levels however, it is not safe to say that the frequency of snow-cover increases with a close relationship to the fall of mean temperature. Drifting removes much of the snow-cover from the summits and in

the winter of 1940 for example it was observed that the upper slopes of Helvellyn above 2000 feet were largely bare while the valleys were still heavily and continuously covered. Attempts have been made to estimate the duration of large snow-drifts at high levels, i.e. above 2000 ft., and it would appear that in any given year "large drifts" are likely to survive for between one-third and one-half as long again as "snow-cover". This is important especially with regard to upland roads; so many of these are badly sited and may remain blocked by drifts even when the surrounding countryside is almost entirely clear.

Little has been said hitherto with regard to snow-cover in Wales. As elsewhere, upland stations are few and deductions rest to a considerable degree on the data from Rhayader (757 ft., about 16 days), Cantref (1080 ft., probably 16 days) and the Herefordshire station of Bromyard (393 ft., 9 days) with occasional brief records from elsewhere, e.g., an older record from Wistanstow in Shropshire. The evidence goes to show that much of the Welsh upland, although relatively high is considerably freer from snow than the Pennines, especially towards the south-west. The Brecon Beacons too appear to afford an interesting example of "snow-shadow" with regard to the valleys lying to the south and west. Towards Pembroke the diminution is reminiscent of Cornwall (Haverfordwest 5.0, Swansea 2.4, Aberystwyth 1.0, St. Ann's Head 0.5).

Dartmoor presents an interesting problem; in occasional years a Channel snowstorm, as one may call it, resulting from a winter secondary passing up-channel, gives for orographic reasons a very heavy and lasting accumulation of this upland. But many years pass without any exceptional fall of this kind, and the reputation of Dartmoor for snow-falls seems to be somewhat exaggerated if the average experience of the period 1912-1938 is any guide. Although Princetown is the highest of the official stations in Great Britain (1430 ft.) the average yearly number of mornings with snow-cover is only about seventeen. It is probable that there is a small area towards the northern end of the moor with upwards of 30 days.

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In recent years the Association for the Study of Snow and Ice has endeavoured to collect more precise data with regard to the frequency and duration of snow-cover at high altitudes, but this work has had to be discontinued during the war. A note on some of the results will be found in the Quarterly Journal of the Royal Meteorological Society for January 1941.

st. here Ireland.

Here again there are only too few stations; it is however evident that a very large part of the lowlands can expect less than five days yearly with snow-cover (Birr Castle, about 4 days; Armagh 7.3; Newtonforbes about 7.; Markree upwards of 4; Dublin (Phoenix Park) less than four. One station only records from above 500 ft. (Seskin, 535 ft., in S.E. Ireland, with 5.2 days.) The southern and south-western coasts resemble that of Cornwall in having everywhere less than 1 day; and it would appear that only small areas on the highest of the mountain ranges are likely to carry snow for upwards of 30 days. Even the areas with more than 10 days are restricted to small patches above 400 ft. in the north-east, and perhaps 1000 feet further to the south.

Conclusion

map under discussion
It must be remembered that the accompanying map is a first attempt to illustrate the distribution of a climatic element for which the data are as yet very imperfect. It would scarcely be wise at this state to endeavour to make a more detailed map; and the representation of the monthly frequencies of snow-cover is also difficult as yet, indeed perhaps inadvisable until a longer term of years is available. One of the most noteworthy features, however, at the more northern high-level stations is the frequency of snow-cover in March and April by comparison with the south: it will be noted that in the north the chance of snow-cover in March is nearly as great as in January.

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	Jan.	Feb.	Mar.	Apr.	May	Sept.	Oct.	Nov.	Dec.	Year	Range of Variation
BRAEMAR 1120ft. 1913/38..	16.3	13.0	11.8	4.8	0.7	0.1	2.0	5.5	13.0	68.2	32, 142
WEST LINTON 770 ft. 1912/38..	9.5	8.7	7.6	1.8	0.1	0	0.8	3.6	7.2	39.3	13, 88
USHAW 54 ft. 1912/38..	4.9	4.6	4.7	0.8	0.1	0	0.1	1.4	4.0	20.6	3, 69
CAMBRIDGE 41ft. 1912/38..	2.3	2.1	1.1	0.2	0.0	0.0	0.0	0.3	1.7	7.7	0, 32
SOUTHPORT 30ft. 1912/38..	1.6	1.0	0.8	0.1	0.0	0.0	0.1	0.7	0.6	4.9	0, 19
KEW 18ft. 1913/38..	1.0	0.9	0.5	0.1	0	0	0	0.2	0.8	3.5	0, 11

It is also not impossible that as our knowledge grows, more light may be thrown upon the relationship between snow-cover and soil temperature. For example, the rather low frequency of snow-cover in the Fens compared with the same level in the inner parts of Essex and Suffolk (Cambridge 7.6, Halstead 11.6), may possibly owe something to the soil temperature as well as to a decreased supply of snow. There is much room for further work in regard to this hitherto neglected element of the British climate.

Some readers may also question the relationship between "mornings with snow-lying at 9h." and "days of snow-cover." There is no reason to believe that the number of mornings with snow-lying and the number of whole days with snow-cover are approximately equal whenever the mean

temperature of the month in question is below 38°: but this is not yet conclusive. Nevertheless, for the majority of our uplands the accompanying map can be regarded as a reasonably close representation of the duration of snow-cover in an average year, apart from occasional scattered drifts.

The range of variation between extreme years is large: some typical examples are given for six stations in the table above. Taking the stations with long records into account it would appear that, at inland places averaging 10 days yearly, the probable range of variation is from 0 to between 30 and 40 days. Stations at which the average is 20 may record up to 70 days with snow-cover in an extreme year; as a whole we may say that in an occasional year snow-cover will be experienced up to between three and four times the average expectation. At the higher-level Eastern Scottish stations the range of variation appears to be less, from rather under half to just over double the normal; at Western Scottish stations the variability is greater. Elsewhere, mild coastal stations with an average between three and five days may occasionally record from 15 to 20. In the other direction it may be said of the majority of stations with averages of less than 12 days that an occasional year will occur without snow-cover being recorded.

neglected element of the British climate.

Some readers may also question the relationship between "countings with snow-lying at 98°" and "days of snow-cover." There is no reason to believe that the number of countings with snow-lying and the number of whole days with snow-cover are approximately equal whenever the mean

The American Meteorological Society.

Interesting and far-reaching developments in the meteorological services of America are foreshadowed in the Bulletin of the American Meteorological Society for January 1943. For the first time a section in Spanish has been introduced and the significance of this and the opportunities for a much closer co-ordination of the meteorological service of North, Central and South America are discussed in an inspiring article by A.G. Galmarini Director of the Argentine Meteorological Service and President of the Regional Commission of S.America for the International Meteorological Organization.

Galmarini points out that the American Meteorological Society has become the mother institution for the development of continental meteorological co-operation and calls upon all American meteorologists to join the Society, to form local branches and to use the Bulletin as an instrument for the spread of ideas for mutual help in technical and administrative work. An Argentine Branch of the American Meteorological Society has already been formed.

Galmarini points out that international air transport is an important factor in following this co-operation which is in itself a manifestation of the international spirit and the "good neighbour" programme.

He ends by hoping that America will show on a new field the power which comes from identity of aspiration, ideals and purposes of action and progress. This hope will be shared by meteorologists all over the world and it may well be that in the future this same spirit will inspire the Societies of the Old World.

The mild weather of 1942-3 is also shown by the earth temperature records in London and by the relatively large evaporation values for London during this period.

The mild weather of December 1942-August 1943.

The run of nine consecutive months from December 1942 to August 1943 each with a mean temperature in excess of the average calls for comment. Utilising the mean of the hourly values at Greenwich and the average 1881 to 1915 the series of departures in °F. are set out below:-

1942.	1943.								
Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	
+3.8	+3.1	+2.7	+2.5	+6.2	+3.1	+.4	+1.2	+1.8	

April 1943 was the mildest April in the series since that of 1794. At Kew the period April 15th-18th was the warmest spell of four days in April since comparable records became available there in 1854.

In the series of values for Greenwich, given by Brunt in his Royal Society paper on Periodicities in European weather which go back to 1764, there are 17 runs of 9 or more consecutive months with more than the average temperature i.e. one in eleven years. The longest run was of 16 months from July 1797 to October 1798. The only runs of more than 9 months since 1880 were:-

April 1934 to April 1935	(13 months)
Dec. 1920 to Oct. 1921	(11 months)
May 1911 to May 1912	(13 months)

The mild weather of 1942-3 is also shown by the earth temperature records in London and by the relatively large evaporation values for Camden Square during this period.

The widespread distribution of the mild weather of 1942-3 is shown by the figures below, where the general temperature over England and Wales and over Scotland is set out as departures from the 1901-30 averages.

	1942	1943							
	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
England and Wales	+3.7	+1.2	+3.2	+2.2	+5.3	+1.6	+1.2	+.5	+1.1
Scotland	+3.4	0.0	+3.8	+3.2	+4.0	+.7	+1.3	+.1	-.7

Over England and Wales the run of mild months persisted throughout the period, but in Scotland there was a break in August 1943.

J. GLASSPOOLE.

The Hot Wind of August 17th 1943.

I was spending the night at Trefnant, 6½ miles SSE of Rhyl. After a fine, sunny and warm, but hazy day, with a moderate S wind (on the coast there was a land breeze all day) clouds gathered at 1940h and a few drops of rain fell. The wind dropped at sunset and it remained overcast, and unpleasantly hot. However it suddenly blew again after about 20h, a steady breeze of about force 6 with remarkable warmth: an uncertified thermometer, which is certainly not far wrong, registered 74° when exposed at 2125h. The high minimum temperature of 60° obtained the next morning supports this: it must have occurred after the wind ceased at 03h. on the 18th.

S. E. ASHMORE.

The Rainfall of July 31st and early August 1943.

The spell of fine warm weather towards the end of July was broken by thunderstorms which occurred at many places on July 31st. Other storms occurred during the first few days of August.

Among the recorded amounts of precipitation worth mentioning are the following:-

July 31st. At Crosby, Liverpool, a total of 1.16 in. was recorded and of this amount .76 in. fell in 20 minutes. At West Kirby, during a period of 21 minutes, from 1715h. to 1736h. G.M.T. 1.02 in. fell. The total fall for the 24 hours was 1.30 in.

August 1st. Thunderstorms were widespread in Scotland and at a station in Glasgow 1.50 in. was recorded during a storm of comparatively short duration. At Fort William most of a fall of 2.01 in. occurred in 2 hours.

August 2nd. Heavy rain was observed at many places and at Stratford near Manchester, where the storm commenced in the late afternoon, .92 in. fell in 30 minutes.

August 5th. At Weetwood Filter Beds, near Leeds, most of the fall of 1.21 in. fell in a period of 1 hour, during the early afternoon.

OBITUARY.

Francis John Welsh Whipple, Sc.D., F.Inst.P. Dr. F.J.W. Whipple, whose death occurred on September 25th at the age of 67, played a very large part in the history of the Meteorological Office over a period of 27 years. He was educated at Merchant Taylors' and Cambridge, where he graduated as Second Wrangler, after which he returned to Merchant Taylors as a mathematics master. He had a family connection with meteorology however (his father, G.M. Whipple, was Superintendent of Kew Observatory from 1876 to 1893) and in 1912 he left teaching for the Meteorological Office. He was successively in charge of the Instruments and Climatology, until in 1925 he became Superintendent of Kew Observatory on the retirement of Dr. Charles Chree.

While still at Merchant Taylors' he had contributed several important papers to mathematical periodicals, and at the Office his mathematical training and ability gave him in a high degree the faculty of envisaging the mathematical aspects of each section of his work in turn. The Silvertown explosion drew his attention to the problems of zones of silence and abnormal audibility, and their bearing on the thermal structure of the atmosphere up to high levels, and this work constitutes perhaps the most important single group of his very numerous scientific papers. This study developed into the investigation of the air and earth waves accompanying the Great Siberian Meteor, and to accompanying meteor phenomena in general. His interest in the mathematical aspects of the structure of the atmosphere also led to several papers on the variation of wind with height, his best known contribution in this direction being on the laws of approach to the geostrophic wind.

sk. here → While in charge of the Climatology Branch (or Statistical Division as it was then known) he took part in developing the technique of accurate observations of visibility, and he also dealt with the problem of obtaining exact measurements of rainfall, particularly at the lower limits. He was for some years Editor of the Meteorological Magazine: a necessary qualification for this post appears to be facility in commenting on the various phenomena of atmospheric optics which are reported to the Magazine in an

unending stream, and in this difficult mathematical-physical subject he was in his element. He also contributed a long article on "Meteorological Optics" to the Dictionary of Applied Physics.

As Assistant Director in charge of New Observatory Dr. Whipple's attention was devoted mainly to two great subjects of research, seismology and atmospheric electricity and he did much to advance the modern development of the latter subject.

He was especially attracted to the relation of the diurnal variation of potential gradient to atmospheric pollution on the one hand and to thunder-storm activity on the other, and he contributed some very neat hypotheses to explain the various peaks and dips on the diurnal curve. His insatiable energies also found an outlet in a running commentary on the application of the developing science of statistics to meteorology, and especially the true use and meaning of that much abused tool, the coefficient of correlation. His mathematical knowledge was always at the service of his younger colleagues, to verify the soundness of their work and put it into correct form for publication.

Dr. Whipple was an active and popular Fellow of the Royal Meteorological Society, served on the Council for many years and acted as President in 1937-38. From 1930 to 1934 he served on the Board of the Institute of Physics. He was Chairman of the Seismological Committee of the British Association and represented Britain at the International Geophysical and Geodetic Union in Washington in 1939. His activity continued unimpaired after his retirement from the Office, and his sudden death came as a great shock to his numerous friends.

Dr. Charles Frederick Marvin. We regret to announce the death on June 5th 1943 of Dr. C.F. Marvin at the age of 84 years. He was associated with the United States Weather Bureau from 1891-1934 and was Chief of the Bureau from 1913 till his retirement in August 1934.

Possibly his best known contribution to Meteorological literature is his paper on "The law of the geoidal slope and fallacies in dynamic meteorology" published in the Monthly Weather Review for October 1920. He published a number of papers on the care and management of various instruments and was responsible for the "Instructions to Observers" issued by the Bureau.

A recording rain-gauge of his design, the "Marvin Float Rain Gauge" is widely used at official stations in the States.

He invented the Marvin Meteorograph which was widely used for obtaining records of pressure, humidity, temperature and wind in the upper air from kites or balloons. It was in its day undoubtedly the best instrument of its kind.

He was also responsible for the official handbook of the United States Weather Bureau on Meteorological Instruments.

He was a very keen supporter of International Meteorology and without his support it would have been impossible to secure the practically unanimous adoption of the resolution for the international use of the millibar at the meeting of the Commission for Synoptic Weather Information, in London in 1928, which was confirmed at the International Conference of Directors in Copenhagen in 1929.

At the official luncheon during the meeting in London in 1928 he was one of the guests of honour called upon to reply to the speech of the Under Secretary of State for Air, Sir Philip Sassoon. He was a man of sturdy build and he made a correspondingly sturdy speech. He was also a strong supporter of the movement for Calendar Reform.

[NOTE While he was Chief of the Weather Bureau he was also Deputy to the Secretary of the United States Department of Agriculture and I remember being in his Office in Washington in 1927 when in that capacity, he had to make a decision which would have a widespread effect on the markets for cotton or wheat throughout the world. E.C.).

A. BERSON. The death of Professor Arthur Josef Stanislaw Berson is also announced in the same issue of the "Physikalische Zeitschrift."

Professor Berson, who was of Polish nationality, was one of the pioneers in the scientific exploration of the upper atmosphere. Working with Aesmann from 1887 in co-operation first with the German Society for the Promotion of Aeronautics, then with the Prussian Meteorological Office and finally in 1905 in the independent aerological observatory at Lindenberg, where he was "Standige Mitarbeiter". He carried out extensive exploration of the free air by balloons. An account of the early work dealing with ascents from 1888-1899 was published at Berlin in 1899-1900, in the three volumes "Wissenschaftliche Luftfahrten" of which Berson was one of the joint authors. Berson took a very practical interest in the work and himself made several balloon flights both from Germany and other countries culminating in a record flight from Berlin on 31 July 1901 when in company with Schilling he recorded a height of 34,500 ft. at which level he lost consciousness though the balloon probably rose several hundred feet higher.

Later, in 1908, he led the aerological expedition to East Africa sent out by the Lindenberg Observatory to study the structure of the upper air in equatorial regions, and published the results in a volume entitled "Bericht über die aerologische Expedition des N. Aeronautischen Observatoriums nach Ostafrika im Jahre 1908".

Berson was one of the first members and before the last war a regular attendant at the meetings of the International Commission for the Scientific Exploration of the Upper Air, appointed in 1893. He was also one of the founders and permanent members of "Aeroarctic", an organization for the exploration of the Arctic regions by air. He died on 3rd December 1942.

C.A.T. JENSEN. The death is reported in "Physikalische Zeitschrift" for January 1943 of Dr. Jensen, Professor of Cosmic Physics at Hamburg University. He is best known for his works on the problems of atmospheric polarization and of solar radiation.

HA. MATTHEWS. We regret to note the death of Ft. Lt. H.A. Matthews in March 1943 from heart trouble while with the Met. Branch of the R.A.F. Dr. Matthews was a frequent visitor to the M.O. Library at South Kensington while looking out data for his climatological researches when lecturer in Geography at Birkbeck College and later at Bedford College for Women. In 1930 he published a paper entitled "Climate and climatic regions of Chile with special reference to Köppen's classification of climate."

MISS AGNES GARDINER. It is with regret that we have learnt of the death, which occurred on July 17th, of Miss Agnes T. Gardiner of Weybridge (Heath Field), where she had lived for over 60 years.

Miss Gardiner maintained an unbroken series of rainfall observations at Heath Field for 41 years, from 1897 to 1937. In 1937 a letter of appreciation was sent to Miss Gardiner on the completion of 40 years observations, together with a presentation copy of "British Rainfall" 1936.

JOSEPH KING. We have learnt with regret of the death on August 26th of Mr. J. King, which occurred at his home at Brownholm, Tilford, Surrey. Mr. King, who was in his 84th year, set up a rainfall station in 1924 at his residence at Hill Farm, Bemelsdale, Haslemere. This record terminated in 1930 and in 1932 rainfall observations commenced at Brownholm, Tilford, where they have been maintained without a break.

Mr. King published many pamphlets on political and foreign affairs, education and artistic subjects.
