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THE OPTIMUM PERIOD FOR A RAINFALL NORMAL.

By N. Carruthers.

The answer to the question "How many years should be included in a rainfall normal?" at first seems obvious. Of course, take as many years as are available!

It is advisable, however, to have a fixed normal which does not need revision every year, is derived from a period short enough to render direct computation practicable for a large number of stations, and is at the same time representative of the whole rainfall "population". In other words, it is necessary to choose between the various advantages of normals of different lengths. By "the whole rainfall population" is meant a series of rainfall values including those available for examination, but extending, both backwards and forewards from these, over an infinite period of time.

Any series of annual rainfalls can be considered as a series of positive and negative deviations from the mean of the whole population although the exact value of this mean is not known. If the deviations were distributed purely at random, the arithmetic mean of any fairly large number of rainfalls would give a reasonably close approach to the true mean. (A set of 50 would give an error of only one or two per cent). Also, as far as the accuracy of the records allowed, the larger the number of years included the closer would be the approximation. The average departure (irrespective of sign) of such a normal from the true mean would be $b/\sqrt{N}$ where b is the average departure of individual values, and N is the number of years.

To see whether this is approximately true for actual series, that is to see whether in fact rainfall values are distributed purely at random, a set of 202 estimates of the annual rainfall over England from 1764 to 1843 were examined. These data up to 1927 were published in the

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Meteorological Magazine (Feb. 1928), and Dr. J.Glasspoole gave me those for subsequent years in manuscript. He compiled the series, expressing the values as percentages of the normal for 1881 to 1915. Throughout this article all rainfall values and departures are expressed in this unit.

Table 1.
Departures of N - year normals.

(1) N	(2) "Observed" (1742-1943)	(3) "Expected" $b/\sqrt{N}$	(4) difference
1	10.17	10.17	.00
2	7.45	7.19	+.26
3	5.95	5.87	+.08
4	5.03	5.09	-.06
5	4.43	4.55	-.12
6	4.23	4.15	+.08
8	3.99	3.60	+.39
10	3.71	3.22	+.49
12	3.53	2.94	+.59
15	3.52	2.63	+.89
20	2.89	2.27	+.62
25	2.44	2.03	+.41
30	2.10	1.86	+.24
35	1.84	1.72	+.12
40	1.68	1.61	+.07
45	1.57	1.52	+.05
50	1.52	1.44	+.08
55	1.50	1.37	+.13
60	1.50	1.31	+.19
65	1.52	1.26	+.26
70	1.46	1.21	+.23

Table 1 gives the "observed" average departure from the long-period (202-year) mean of a normal derived from N years (column (2)), and the departure which would be expected in a random series (column(3)), for values of N from 1 to 70. The difference between these is given in column (4). Two main points are brought out in this table. (i) the "observed" departures are greater than the "expected", and (ii) the difference between them shows a

/rapid

rapid increase from N=5 to N=15 followed by a decrease to N=30, then a more gradual decrease from N=35 to N=45 and a gradual increase to N=65.

The advantages sought in the choice of a normal are shortness of basic period and smallness of departure from the true mean (represented approximately by the 202-year mean). Since the average departure increases with a decrease in basic period, some compromise is necessary. The best compromise is obtained by selecting a value of N. for which both the difference between actual and "chance" departures and the change of this difference with increase in N are small. For N greater than 10, the smallest differences lie between N=35 and N=55, the minimum being .05 for N=45. Up to about N=35, there is a significant improvement in the value of the computed normal with increase in N. Above this value, the improvement is small, being less than 0.2% for the addition of 10 years. This is negligible when one considers that the probable error in substituting the 202-year mean for the true mean is ± .61 per cent.

If, instead of the departure of the normal from the 202-year mean, the average sums of N deviations are calculated, these when plotted against $\sqrt{N}$ can be more readily compared with the "chance" equivalent which now, being $b\sqrt{N}$, appears as a straight line. The actual and "chance" values are shown by the full lines in figure 1. Carroll F. Merriam (1941) plotted deviations of American rainfall in this way, and Dr. C.E.P.Brooks suggested to me that such a method could be used to demonstrate the best value of N for a rainfall normal for this country.

It is pertinent to discuss very briefly the reasons for the differences between the actual and "chance" curves.

Fluctuations in rainfall evidently are not purely random. They appear to be due to three different characteristics: (i) persistence, that is a tendency to remain the same (in practice deviations of the same sign tend to be consecutive); (ii) the presence of periodicities (i.e. cycles); (iii) random distribution. It cannot be claimed that any rainfall series possesses any one of these alone.

In an analysis of the rainfall series considered, C.E.P.Brooks and J.Glasspoole (1928) found the following

/period...

periodicities dominant:-

Table 2.

Periodicities in English Rainfall 1727-1927.

Period in years (P_r)	51.7	37.2	11.1	9.5	4.7	2.1	1.7
Amplitude in per cent (A_r)	4.7	2.4	1.6	3.4	3.5	3.9	6.0
r	1	2	3	4	5	6	7

It was found possible to reconstruct values of N-year deviations assuming that the original series comprised a random distribution about the sum of the periodicities in Table 2. These values are given in Table 3 (T, estimated) with the corresponding actual average sums of N deviations, T_o, for comparison. The curve T is shown by a broken line in fig.1 and the straight line R gives the part of T estimated as due to chance. K is the kind of curve which would be expected from pure persistence. Probably the best reconstruction of T_o would be obtained by substituting a curve, K say, similar to K for the straight line R in the composition of T: but it is difficult to know how to combine K' with the effect due to the periodicities since there may be an appreciable correlation between them.

/Table 3.

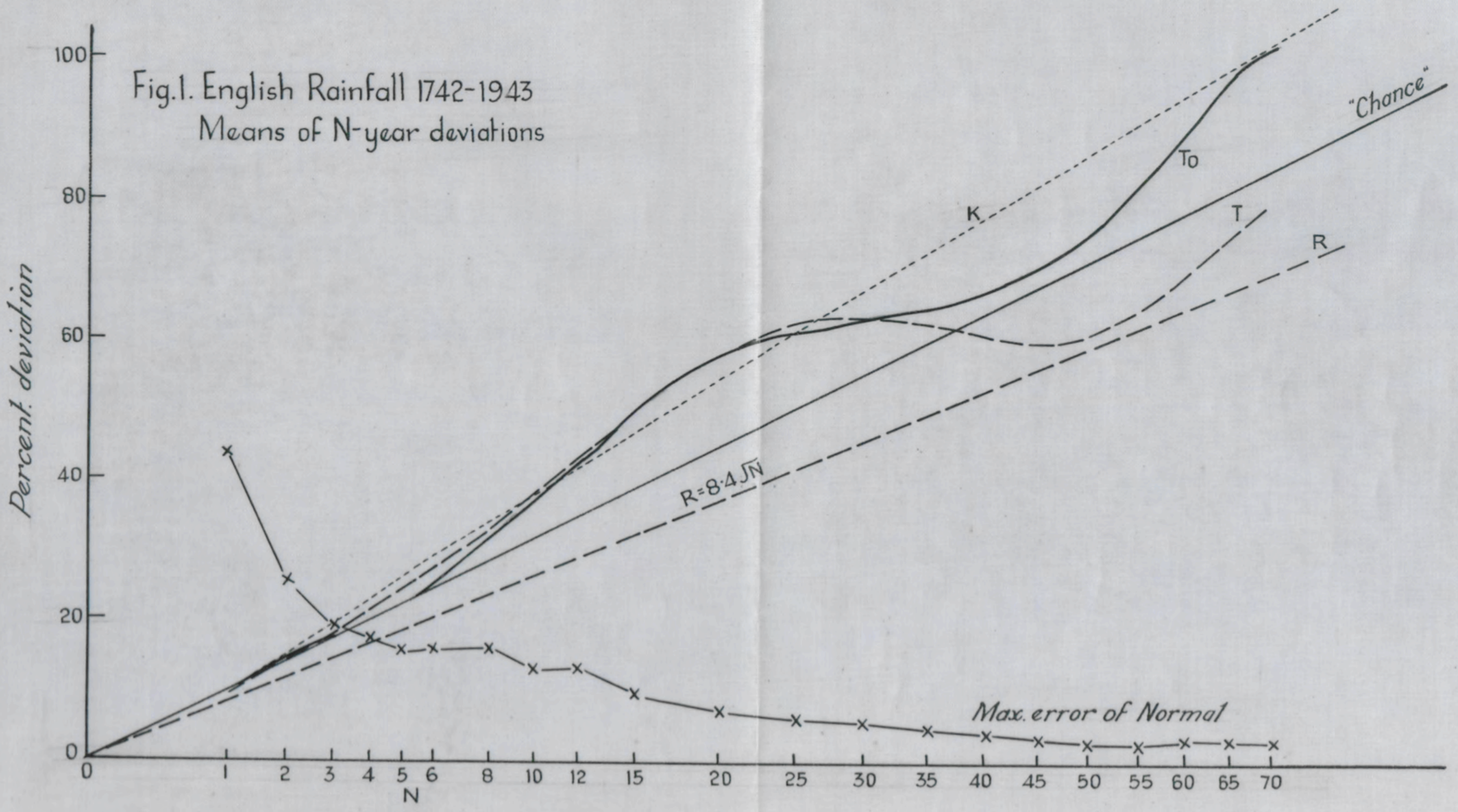

Fig.1. English Rainfall 1742-1943
Means of N-year deviations

Table 3.

English Rainfall 1742-1943.

Average N - year deviations.

(1) N	(2) (estimated)	(3) T_0
1	9.6	10.2
2	14.3	14.9
3	18.1	17.9
4	21.6	20.1
5	24.7	22.2
6	27.8	25.4
8	33.1	31.9
10	38.3	37.1
12	43.6	42.4
15	50.2	49.8
20	57.9	57.8
25	62.3	61.1
30	63.3	62.9
35	62.3	64.2
40	60.6	67.1
45	59.9	70.9
50	61.4	76.0
55	64.7	82.3
60	70.1	89.9
65	75.5	98.6
70	-	102.3

The difference between T_0 and "Chance" or between T and R, in figure 1 may be considered a measure of unsuitability of N years as a basis for computing a normal, the advantages of shortness of period and smallness of error both being taken into account. From T_0 the least unsuitable basic period appears to lie between 40 and 45 years, and from T, between 50 and 55 years. The curve labelled "max error of normal" also has a minimum between 50 and 55 years. This curve gives the departure from 202-year mean (irrespective of sign) of a normal computed from the N years corresponding to the greatest sum of N annual deviations. Since there are fewer N - year deviations for the larger value of N, a better comparison would be obtained from percentile values. The maximum

/departure

departure and the upper five-percentile (the departures being considered without regard to sign) for each of eleven values of N between 20 and 70 are given in table 4.

Table 4.

Departures of normals based upon N years of observations.

N	20	25	30	35	40	45	50	55	60	65	70
Max. departure	7.4	6.1	5.7	4.7	4.2	3.6	3.1	3.0	3.5	3.3	3.4
Five-percentile departure	6.21	5.39	4.69	4.43	3.69	3.18	2.72	2.75	3.34	2.97	2.88
T_o/R	1.56	1.46	1.37	1.30	1.26	1.26	1.28	1.32	1.39	1.48	1.46

Values are given also for T_o/R, which equals the ratio of the departures of the actual rainfall series and the estimated random contribution. The five-percentage departure, like the maximum departure, has a minimum between N=50 and N=55 (if periodicity of 51.7 years), but T_o/R has a minimum for a smaller value of N, between 40 and 45. This may be due to the influence of both 37.2- and 51.7-year periodicities. It is interesting to note that all three quantities given in table 4 <u>increase</u> from N=55 to N=65. This shows that the addition of a few years in excess of 52 may make the normal <u>less</u> accurate. The optimum period for a normal in this country therefore appears to lie between 40 and 50 years.

As shown already from Table 2, however, for periods of more than 30 years the average improvement made by adding a few more years is small: on the average another 15 years added to a normal of 35 years, for example, would make a difference of less than 0.3 per cent. Since, also, the periodicities of about 37 and 52 years cannot be relied upon to remain constant in either period or amplitude for a series comprising the whole rainfall population, a slightly shorter normal seems more practicable, in order to reduce to a minimum the amount of computation required. At N=35 the full curve of fig.1 begins to get steeper after an interval (from N=20 to N=35) of very small increase of T_o with N. Thirty-five years therefore is suggested as the standard length for a rainfall normal.

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The thirty five year period, 1881-1915, at present employed for the "British Rainfall" normal, gives for the series examined here a value for the normal very near that of the 202-year mean (1742-1943), the "probable error" being only .29±.61 per cent; that of the average thirty-five year normal is 1.80±.61 per cent.

When time permits the author of this article intends to make a similar analysis of the rainfall at a single station.

Bibliography.

Brooks, C.E.P. and J. Glasspoole, 1928. British Floods and Droughts, London (E.Benn.Ltd.)

Glasspoole, J. 1928. Two centuries of rain. Met.Mag. Feb. 1928, p.1.

Merriam, C.F. 1941. Long-term Constancy of Rainfall. Washington,Nat.Res.Inst.Univ. Council Trans.Part III, pp.703-707.

ON BEING A STATISTICIAN.

("Statistical Methods in Climatology" by C.E.P.Brooks and N.Carruthers).

Nearly everyone in the Climatology and Marine Branches is a Statistician, even though, like the gentleman who had been writing prose all his life, she (or he) may not know it, for she (or he) deals with Statistics, and should read this handbook. Most often it is a question of averages, which are the lowest form of life in the statistical world, but even this activity requires a modicum of statistical sense. It is unwise, ~~for example,~~ to follow the example of a German scientist, who gave the average age of onset of a certain disease as 45 years, there being two known cases, at the ages of 6 months and 90 years. At times, of course, averaging may become an art, for some of its results are very pretty, but even then it is useful to know what your result really means, if anything. But there are higher

/branches

branches, such as Frequency Distribution, which means finding out how often you can expect the unexpected. This for example is the basis of the classification of rainfalls into Noteworthy, Remarkable and Very Rare (The Vicar who accidentally confused the amount of the offertory with the day's "catch" - in another sense- produced a "Remarkable" example). To take a set of raw figures and, with heroic labour, to produce a curve which smoothes out all the wrinkles, is a fascinating as well as a useful occupation, which tells you what the figures would look like if you had enough of them to look like anything, but one needs to know how to do it. Some of the results of applying a little knowledge, even in print, have been very odd indeed.

Other branches of Statistics are concerned with the results of turning something into something else, a favourite occupation with meteorologists. For example, we turn readings of dry- and wet-bulb thermometers into relative humidity; both thermometer readings are subject to a "probable error" and so is the turning process, so that the probable error of the answer becomes an interesting statistical problem. Then there is the problem of "runs", such as: if it rains on three days out of five, what are the chances of getting a week's fine weather - not so simple as it sounds.

Most books on Statistics are erudite productions, requiring extensive excavation to extract the morsel required. The authors of "Statistical Methods in Climatology" have tried to limit their fare to the morsels which are really likely to be required bythe working climatologist, and to make the handbook intelligible to readers below the rank of Senior Wrangler. All their examples are taken from climatology, and in a few cases they have even ventured to criticise (very gently) the traditional methods of Meteorological Office practice. They would welcome suggestions for improvement, should the handbook survive into a second edition.

Smoke Pall in North Buckinghamshire.

A dense pall of smoke was observed in the North Buckinghamshire - South Northamptonshire area on the evening of the 12th September 1944.

It was observed at Wing between about 1900 and 2100, Winslow between 1930 and 2130 and Barford St.John between 2030 and 2230 hours.

A pilot landing at Wing at about 2000 hours reported that the base of the smoke was at about 4,500 feet, it was thickest at 5,000 feet and extended to about 7,000 feet. Another pilot returning to Westcott reported that the smoke pall was continuous from Northampton to Westcott.

It seems to have been about 30 miles wide and 40 miles long, although not of uniform thickness and with some clear gaps in it. Looking down from 6,000 feet the ground was frequently invisible; observed from the ground, the smoke had a greyish-brown appearance although in the zenith the sky could usually just be discerned. The setting sun was obscured at Winslow .

Surface visibility was not impaired by the smoke, being of the order 6-12 miles. The wind at 5,000 feet was approximately 110 degrees 20 m.p.h., so this smoke pall must presumably have passed over Essex, Hertfordshire and Bedfordshire during the afternoon. A careful scrutiny of hourly observations from stations in this area has failed to reveal any reliable indication of the passage of any such phenomenon. The lower skies were reported as practically clear but there were various reports of up to about 5/10 of cirrus.

The smoke was, in fact, mistaken for Cirrus by several stations in 92 Group later in the evening. At 1900 there were two suspicious reports which may well have been misinterpretations of this smoke pall. North Weald reported 8/10 Cirrostratus and Bassingbourne 3/10 of cloud at 900 feet and an unknown amount at 1,000 feet. At 2000 hours Hendon reported an overcast sky without specifying the cloud type or amount and there were numerous reports of Cirrus and one or two of 5/10 Ac As. In fact, what was almost certainly the smoke 'cloud' caused not a little confusion amongst the observers.

/The

The source of this smoke pall is a matter of some interest, it was quite unlike any of the more common manifestations of industrial and domestic smoke. The winds were a little too far back to bring London smoke into 92 Group area, and the surface visibility, which nearly always suffers an appreciable reduction with London smoke, remained good throughout.

The only comparable phenomenon the present writer has seen was during (I believe) the third week of June 1940, when a huge pall of smoke travelled from North France across Southern England to the Abingdon area and beyond.

More distant sources for this smoke were therefore considered. There were several plobs reporting thick haze over Belgium, N.E. France and the Ruhr area on the morning of the 12th, and two reports of thin stratus, tops 3,000 or 4,000 feet. These latter reports were very puzzling, there was no reason to expect the development of low stratus cloud in this area and the presence of stratocumulus, although just possible was not considered likely. It seems therefore quite probable that this stratus was in fact smoke.

During the period 11th - 12th September, there was a well established warm anticyclone centred over the North Sea. Upper air ascents at Manston, Larkhill and Downham Market on the 12th, all showed a marked inversion at 4,000 to 5,000 feet with typical dry subsided air above the inversion.

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Tracing back the trajectory of a parcel of air in the significant layer which was over Wing at 2000 hours on the 12th, it would have been over the Middle Rhineland at about 2300 - 2400 hours on the 11th September. There was a concentrated incendiary raid on Darmstadt at about this time, so it appears quite likely that this was the was the ultimate source of the smoke pall.

If this conclusion is correct the smoke pall must have travelled some 450 miles from its source without losing its identity.

There was practically no wind shear between 3,000 and 7,000 feet.

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The main concentration of smoke seems to have travelled just below the inversion with a lesser concentration in the smooth air flow in the layer above the inversion Smoke must have been introduced into this layer by violent convection over the target, while the smoke near the surface would have been dispersed by the wind shear in the frictional layer.

* [L.W. Hubbert].

Note.

There is very little doubt that the explanation is the correct one. The phenomenon was visible in the Dunstable area. Near the boundary of the belt of smoke the resemblance to cirrus was very marked, the smoke being in threads which showed up as a pale grey in the sunshine, almost white. The main body of the smoke was of the usual amorphous type, and the sun was reddish when seen through it. It was not nearly so dense as the petrol smoke which came over aloft on June 10, 1940. On that occasion the mid-day sun could be looked at without discomfort, and the disc was white, presumable owing to the nature of petrol smoke.

The clearly defined edge of the smoke of September 12th, probably indicates a single definite source, as Mr. Hubbert suggests. The initial heat of the smoke would carry most of it up to the layer under the inversion. As Mr. Hubbert remarks, the smoke lower down would have been dispersed by friction, though the effect on surface visibility must have been appreciable over quite a wide belt. As far as England is concerned, the absence of smoke from the surface layers was favoured by the dying out of convection in the evening following a sea passage of the air mass during the middle of the day. This effect was pronounced on the NE side of the belt. It may have been less pronounced on the SW side, but London smoke would introduce a complication there.

C.K.M.Douglas.

Industrial Smoke Fog.

On the 25th. Sept. 1944 an example of the extremely local nature of industrial smoke fog, even at relatively long distances from the source of pollution, occured at Burn, Yorkshire. At 1000 hrs. B.S.T. the visibility was 1000 yds, and this was apparently the only station in the British Isles reporting fog. The gradient wind was about 290° 20 m.p.h. giving a surface wind beneath a shallow inversion of West about 5 m.p.h. This placed the station directly in the smoke trail from Leeds about 16 miles away. Relative humidity was 92% and there had been no radiation fog during the previous night, visibility at dawn being about 3000 yds. Airfields 15 miles North of this Station were entirely unaffected and reported visibility about 8-9 miles. Pilots reported that the fog stream was only about 5 miles wide. About 1030 hrs. the visibility fell to 700 yds, and was also very bad vertically. It then improved very slowly to about 2 miles as the wind freshened from WSW ahead of a weak warm front the high and medium cloud from which had prevented insolation earlier and prolonged the existence of the surface inversion.

J.L. Case.

Thunderstorms in Scotland on 27th July, 1944.

The widespread thunderstorms which occurred in Scotland on Thursday, 27th July 1944, presented many interesting and contrasting features. There was intense rain in several localities including the Border country, the city of Edinburgh, parts of Lanarkshire an area around Fort Augustus and Deeside.

In Edinburgh a violent storm broke over the city at about 15.15h. G.M.T.* and continued until 17h. It was preceded by an ominous darkening of the sky which rendered artificial light necessary. Heavy thunder and vivid lightning were accompanied by torrential rain and some hail. The periods of greatest intensity were from 15.30h. to 16.00h. and from 16.30h. to 17.00h. Roofs and chimney stacks were damaged by lightning, and the rain, described as "solid water", flooded roadways and caused damage to property. Mr. J. McMichan, who measured 1.33 inch at St. Roque, writes: "The rain was so heavy that it made vision very poor. As regards flooding it was the usual we get with a sudden thunderstorm - gravel washed down the paths." For some hours after the rain ceased, National Fire Service personnel were kept busy pumping water out of flooded basements. The southern and western surburbs had the worst of the storm. Precipitation varied considerably in amount. A mere trace was shown in the gauge at the Royal Botanic Garden on the north side of the city.

Several other instances of extremely localised downpours were reported. Thus at New Deer, Aberdeenshire, no rain fell while less than 2 miles away there was a thunderstorm with heavy rain. Brechin, in Angus, had .70 inch but at Stracathro Hospital, 3 miles to the north, the observer measured only .05 inch of rain. From Hamilton, Lanarkshire, Mr. S.B. Becket writes: "Thunder and lightning began at 15.30h. and by 16.45h. became frequent advancing from N. Centre of storm was for a time overhead moving slowly southward. Very heavy rain during the storm and some hail. Gauge examined at 16.50h. and at 17.30h. when storm was abating. In the 40 minutes, 1.29 inch fell. Rain slackened and stopped at 18.15h." Three miles away, at the Townhill Waterworks, the rain was not so heavy, amounting to .77 inch but all of this fell

* So far as possible all times quoted are G.M.T. Slight doubt exists in one or two cases.

/between

between 16.50h. and 17.30h. Nearby at Carluke there was .76 inch in 45 minutes from 16.45h. to 17.30h.

Along the Caledonian Canal the thunderstorms occurred earlier in the afternoon. At Fort Augustus Abbey the rain amounted to 1.05 inch of which .63 inch fell between 13.15h. and 14.00h. and .37 inch between 14.00 and 16.15h. At Ardachie, only a mile south of the Abbey, rain was much more intense. Mr. A.T. Bruen measured 2.13 inches - the largest amount reported from any station on that day. Mr. Bruen, says the rain was heaviest between 13.30h. and 14.30h. and he estimated that 1.50 inch fell in that hour. He adds : "There were only one or two claps of thunder, not very near, and no hail or wind. It was very local, a district within 1½ mile had nothing outstanding. There was a good deal of damage done to a road about ¾ of a mile to the west and we had six inches of water in the kitchen owing to the drains being unable to cope with the water from the roof".

The following additional notes are selected from those received in Edinburgh:-

Moffat (Auchen Castle) - Heavy thunder showers throughout the day: 1.33 inch of rain hut no flooding in the upper reaches of the Annan.

Earlston (Cowdenknowes) - Heavy thunder. Rain. 88 inch.

Gartcosh (Gartloch Hospital) - 1.25 inch fell in three local thunderstorms between 11.30h. and 18.30h.

* Tillicoultry (Westbourne) - Thunder and lightning from 14.15h. to 17.20h. Rain only .08 inch.

St. Andrews Waterworks - Heavy thunderstorm. Rain 1.46 inch.

Glamis Castle - Blinky day. Thunderstorm with .78 inch rain.

Tarland - Thunder and lightning between 14.30h. and 15.30h. with cloudburst. Rain 1.25 inch.

H.E.C.

Some Notes on the Thunderstorms of August 23rd 1944.

In the early hours of August 23rd a thunderstorm passed over the Isle of Wight. Mr. John Dover who recorded 2.51 in. for the rainfall day at Totland Bay, states: "To me the storm chiefly lay off to the NE., over Norton and Yarmouth, which are two and three miles distant respectively. For ten minutes the lightning was continuous, the thunder spasmodic. Nearly all the rain came down in less than an hour". Mr. Dover add that only once in a period of 58 years has a greater fall been recorded by him, when 2.56 in. was measured at Totland Bay for September 24th, 1915 and of this amount 2.00 in. fell in a space of two hours.

Rainfall was general over the Isle of Wight on August 23rd. At Ventnor there was a thunderstorm from 0300 h. to 0400h. and .46 in. was recorded for the day while at Ryde, the amount was .62 in.

The storm appears to have passed far inland to the NNW. At Sway (Gordleton), 6 miles to the north of Totland Bay, thunder and lightning were incessant from 0345h. to 0430h. and the entry for the day was 2.67 in. Further inland, at Fordingbridge (Oaklands), there was a heavy thunderstorm "with very vivid lightning and a torrential downpour of rain," .98 in. being recorded for the rainfall day. In Wiltshire 1.03 in. was measured at Shrewton (Maddington) and 1.34 in. at Bishops Cannings. At the latter place the period of the thunderstorm was from 0500h. to 0700h. and most of the rain fell in this period. At Long Newnton, Glos., the measurement was .76 in., at Bishops Castle, Salop, .61 in. and at Leominster, Hereford .56 in.

Thunderstorms also occurred at stations east and west of a line running inland from Totland Bay through Fordingbridge. At Southampton and Bournemouth the precipitation for the 24 hours was .64 in. and .59 in. respectively.

At none of the foregoing stations was there any mention of hail and the wind force does not call for special mention.

It may be remembered that on the morning of August 23

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59 persons lost their lives as the result of a plane crash at Freckleton, in what was described as a freak storm over the Ribble estuary. The district was enveloped in darkness as the storm gathered making the use of artificial light necessary. The lightning was vivid and the rain heavy: during the height of the storm visibility was reduced to a few yards. Some trees were split by lightning, others were snapped off to within a few feet of the ground by the force of the wind. Persons at the mouth of the estuary reported seeing waterspouts. At Southport which is just south of the Ribble estuary, .94 in. of rain fell in 54 minutes.

C.F.M.

Waterspout off Southport observed on ~~May~~ August 13th, 1944.

Mr. C.A. Bell, Acting Borough Meteorologist, Southport, sends us accounts which he has collected of a vertical pillar of dark cloud observed over the sea off Southport at 0930 G.M.T. on August 13th, 1944 lasting 10 to 15 minutes. It extended upwards from the sea to a dark cloud canopy (one account described it as "mushroom shaped"), there are no accounts of rotary motion, and there was no wind or rain on shore, but there can be little doubt that it was a waterspout. Small waterspouts are quite local phenomena, which cause no disturbance outside a very limited radius. The fact that the characteristic spray at the foot was not observed may indicate either that the rotary motion did not extend down to the surface of the sea or that the spout was so far off that the foot was below the horizon.

Waterspout at Shandon (Dumbartonshire) observed on August 19th, 1944.

The afternoon of Saturday August 19th, was warm with brilliant sunshine. The sky was practically clear, there being only some light fleecy clouds coming from the South South West with a light warm breeze.

At about 5.40 p.m. a very heavy bank of black cloud was observed travelling up against the breeze viz. from the North North East direction. The light fleecy clouds which were travelling with the breeze appeared to be drawn in towards the dark clouds and where both formations met they began milling around in clockwise fashion in a manner similar to a whirlpool at an approximate height of 3,000 ft. This milling increased in velocity and after about a minute or so a conical shaped piece of cloud emerged pointing at * about 5° towards the earth.

This phenomena commenced travelling downwards but still remaining attached to the main body of cloud, which appeared to be moving slowly Northwards. A strong rush of air accompanied this downward movement and could be distinctly heard, and it was observed that branches of trees, bracken etc. were thrown into the air by its force.

The sky to the N.N.W. was very black and although it was fair where we stood, it was quite evident that heavy rain was falling in the area. At 5.55 p.m. the bank of cloud began to break and commenced travelling northwards. It appeared to come to a standstill slightly beyond Garelochhead Village, which was approximately 2 miles North of us.

At 6.10 p.m. the bank began again to reform and almost immediately afterwards there was Thunder and Lightning accompanied by torrential rain, the rain lasting up until we left Shandon Golf Club House at 8.p.m.

On arriving back home at Helensburgh which is approximately 4 miles South of the village of Shandon I learned that rain did not commence falling there until after 7 p.m.

/This

This was evidently a waterspout in which the whirling column failed to reach the surface sufficiently definitely to form a vapour column.

(Sgd) Jack Addison.

89, West Princes Street,
Helensburgh.

Waterspout observed at Dungavel, Lanarkshire, on August 19th, 1944.

I have to report the occurrence of a waterspout witnessed at this station last evening, Saturday, 19th August. It is unfortunate that I did not see the whole of the phenomena. When alighting from a bus at my gate my attention was attracted to its appearance in the western sky, at that time it had reached its maximum length and appeared as an extremely long funnel-like structure.

A lady friend, of some intelligence, came along at the time and she was able to describe to me the phenomena in its entirety. Her evidence was, a short while later, corroborated by an R.A.F. officer who is in charge of the A.T.C. Gliding School here at Dungavel.

Briefly, I will describe its appearance and progress:-

"It first appeared as a hump-like structure of moderate length, after some ten minutes it was partly withdrawn into the cloud, shortly afterwards it progressed to its greatest length and remaining so for some fifteen minutes after which it was withdrawn to the clouds in a telescopic-like manner.

It is remarkable that its position was precisely the same as the waterspout which occurred here on the 13th of August 1938. The only marked difference being, that this time, it appeared to be very much longer but not quite so robust, also, it appeared to hang perfectly vertically.

/Cloud

The weather conditions prevailing at the time of occurrence were as follows:—

Cloud : Dense Nimbo-stratus, stretching from the middle western horizon to the south-eastern horizon (the waterspout appeared from a visual point about 300 feet from the western edge of this cloud and in line with, or slightly in rear of Loudoun Hill). Remainder of sky covered with an Altostratus type of cloud.

Visibility : The peaks of Arran (M) could be seen through what I would describe as coastal haze.

Rainfall: A few spots of rain fell during the occurrence, this morning's reading being 'Trace'. Heavy rain appeared to be falling in the area of the River Irvine watershed and possibly in that of the River Avon.

Wind: East, force 3-4.

Thunder : Thunder, two peals occurred (fairly near) during the period.

Time : The time of the occurrence was, approx, 18.40 to 19.00 hours.

I have not heard of any damage being caused such as occurred on the last occasion in the district, Aug.1938.

(~~sgd~~) P.E. Kirton.

Dungavel,
Strathaven,
Lanarkshire.

Waterspout observed off Kilbrannan Sound, Argyll on June 26th, 1944.

The following account has been extracted from the "Glasgow Bulletin" of July 7th, 1944.

Huge Waterspout in Freak Storm.

A towering waterspout was seen sweeping across Kilbrannan Sound, Argyll, during a freak storm on Monday, June 26. Farms near Peninver were almost isolated, while farmers 10 miles away had no rain all day.

* "First there was what looked like a 'plane's vapour trail in the sky, but dark and moving very fast," said a farmer. "It swept down to the sea and formed a waterspout which is an unusual sight in Britain".

"The sea all around seemed to surge and boil as the spout disappeared behind Davaar Island".

The storm began with a downpour of hail, which left fields white, with drifts of up to 18 inches in places. This was followed by a cloudburst, with thunder, lightning, and torrential rain.

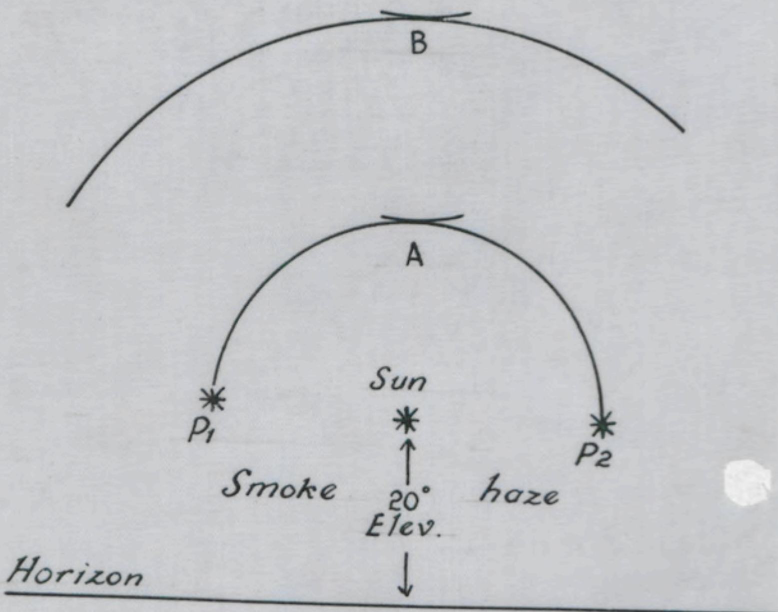
Watercourses overflowed, sweeping away farm roads and inudating fields and outbuildings. Farms in the vicinity of Peninver, a village near Campbeltown, suffered most.

At the Duke of Argyll's farm of Ballymeanach the rushing water cut a swathe wider than a road through a field of young turnips.

Many surrounding farmers had much of their potato and turnip crops ruined, while mewly cut hay was swept out to sea.

Halo Phenomena at Aberdeen

1730 G.M.T. on May 6th 1944



P_1, P_2, A and B plainly visible and all of equal brilliance

22° Halo somewhat weak

46° Halo very weak

Anti-Solar Rays.

A display of anti-solar rays was seen at Totternhoe, near Dunstable, Beds., at 1752 G.M.T. on 8th September, 1944.

This phenomenon, which seems to be surprisingly rare considering that no very unusual circumstances are required for its production, is an effect of perspective. When seen near sunset, rays of sunlight shining through breaks in cloud on the western horizon, pass overhead towards the eastern horizon, where, owing to perpective they appear to converge. Thus looking towards the east one sees rays of light apparently streaming up as if there were some luminary just below the horizon in that area. On this occasion there were cumulus clouds with sharply defined outlines in the west, and these seem to be necessary to produce sufficiently clear cut rays. In the east there was an extensive patch of lower cloud which acted as a screen against which the anti-solar rays were seen. Overhead there was broken cloud which showed no trace of the rays. The lack of any obvious connexion between the low sun in the west and the rays in the east made the spectacle all the more arresting.

12.Sept.44. E.G.Bilham.

Halo Phenomena observed at Aberdeen on May 6th, 1944.

The following notes, with the accompanying diagram were contributed by Mr. S.M.Rattray.

"The 22° halo was rather weak and had the usual parhelia, which were correspondingly brighter than the halo itself. A short upper arc of contact was of an intensity equal to that of the parhelia

The 46° halo was very feeble and incomplete but have nevertheless quite definite, and also had an upper arc of contact equal in length and in brilliance to that of the 22° halo. Both arcs showed the normal colouration. The angles were measured by the Pilot balloom theodolite at 1730 G.M.T. When the sun was approx. 20° above the horizon.

Auroral Notes, January to July 1944.

Comparatively little auroral activity was reported during the period under review, the phenomenon being observed on only 38 nights - fewer than in any corresponding period since 1935. In each of the years 1938 to 1943 aurora was reported on at least 50 nights between January 1st and July 31st. The maximum frequency occurred in 1941 when there were 61 auroral nights in the seven months.

During January 1944 aurora was seen on ten nights. It was noted at Montrose on the 1st but apart from this the earliest reports of its appearance were on the 8th at Sumburgh and the 13th at Lerwick. The most widely observed display of the month was on the evening of the 15th, reports of this being received from several stations in Shetland and the Moray Firth area and from Aberdeen and Kettins. At Lerwick, between 1830h. & 1930h it appeared as faint diffuse luminous surfaces and moderately intense rays behind breaks in the clouds. The intensity ranged from faint to moderate up to about 2145h. Shetland observers saw aurora again on the 18th, 19th, 20th and 27th. Reports of displays on the 26th and 28th were confined to stations in Aberdeenshire and Angus.

Aurora was reported from widely scattered places on 11 nights in February. The displays, even in Shetland where observations were recorded on the 15th, 16th, 20th 23rd and 26th, were generally of faint auroral glows or diffuse luminous surfaces of little intensity. An observer at Comrie (Perthshire) noted aurora on the 1st, 4th, 8th and 9th but says it was dimmed by bright moonlight. It was seen from Nairn on the 15th and 28th and as far south as Rothesay on the 5th and Paisley on the 26th.

The only auroral observations noted in the first half of March were those at Montrose on the evening of the 12th, at Lerwick on the 13th and at Sumburgh on the 15th. On the 18th aurora was reported from Shetland, the Hebrides, the Moray Firth and in East Scotland down to the Tay estuary. A display on the 19th was even more widely observed, being seen in Shetland and as far south as the Clyde and Eskdalemuir. Observations made at Lerwick on the 21st are of interest. A rather faint arc with rays extending up to 30 degrees was seen about 21h. This was followed by a

/homogeneous...

homogeneous arc of moderate intensity with bundles of rays projecting to 15-20 degrees in ENE. There was a suggestion of curtaining in the NNW. and the phenomenon continued in changing form until 2330h. Further auroral manifestations were noted in Shetland on the 23rd, 26th, 28th and 29th. Prestwick had an auroral glow on the night of the 26th. Lossiemouth reported aurora on the 28th and Stornoway on the 28th and 29th.

Aurora was seen on only five occasions in April. This is less than in any other April of recent years. It was noted at Sumburgh on the 1st and at Comrie on the 2nd. It was next observed on the 16th - at Sumburgh and Duntuilm (Skye). Stornoway had an auroral glow at 22h. on the 19th and Leuchars and Sumburgh observed aurora on the 23rd.

One report of aurora was received in May, viz. on the 13th at Fraserburgh. The phenomenon was not observed again until July 28th when it was seen from Lossiemouth.

H.E.C.

Rain falling from clear sky.

In the past an occasional record of drizzle falling from a cloudless sky has been placed on record (e.g. J.S.Dines, Met.Mag., 70, 1935, p.16; S.E.Ashmore, ibid., 116). An occasion of the precipitation of rain under similar circumstances occurred at Wrexham on October 11th, 1944. An intense depression was passing over during the evening, the barometric minimum being 984.1 mbs. at 1955h. Associated with it was a fierce two-phase gale, the first from the south, accompanied by light rain; the wind suddenly dropped, and was no higher than force 4-5 from 1930h to 2010h, when the second gale suddenly burst over the district, this time from the south-west, and with nearly clear sky. At 2130h the sky was quite cloudless and the stars brilliant; the milky way was readily visible. Not a trace of cloud was seen, and yet rain was falling steadily; after a few minutes in the open I was quite wet with this rain, blown as it was in a gale of force 8-9. and 10 in gusts. The rate of rainfall, according to the hyetograph, was about 0.01 in. per hour.

/The

The rain went on for about 15 minutes in this manner, and then low clouds came up and the precipitation continued in its more usual manner.

S.E.Ashmore,
11 Percy Road,
Wrexham, North Wales.

October 12, 1944.

Note: From data in the Meteorologiwal Glossary, rain at the rate of 0.1 in. an hour would probably give drops of a diameter of about 0.2mm. These would fall with a maximum velocity of about 1m./sec. If the cloud were at a height of 3 km. and the mean wind velocity between cloud and ground 50m./sec. the horizontal distance travelled by raindrops in falling 3 km. would be about 150km. It is quite possible under these conditions for rain to fall at a place from which the clouds would not be visible.

Editor.

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The Formation of a New Section for Upper Air Climatology.

The history of upper air investigation dates back to 1749 when temperature measurements were made at Glasgow by means of kites.

A series of upper air soundings by kites were made in 1847 at Kew Observatory; and there also, in 1852, John Welsh made his observations by manned balloons, achieving measurements of temperature, vapour pressure and relative humidity up to a height of 20,000 feet. The first use of captive balloons was by James Glaisher in 1869, of registering balloons by Hermite and Besancon in 1893, and of continuously recording instruments by Rotch at the Blue Hill Observatory (Mass.) in 1894. The use of pilot balloons for measuring upper winds was suggested by Le Verrier in 1874 and has been fairly general since the beginning of this century. Radio sounding methods have been developed only in the last fifteen years, the earliest work being by Moltchanoff and Bureau, but the possibilities of telegraphic methods were recognised a century ago, being mentioned by Sir Charles Wheatstone and others in 1842 in a memorandum in favour of the establishment of Kew Observatory.

Large scale publication of upper air observations commenced with the issue of "Wissenschaftliche Luftfahren" (Braunschweig 1899-1900) sponsored by the Aeronautical Society of Berlin. In 1896 the International Meteorological Organization appointed a commission for scientific aeronautica, and the first international volume of upper air data, edited by the president H. Hergesell, was published in Strassbourg in 1907. After a hiatus due to the war of 1914-18, new resolutions with regard to a more comprehensive collection of data on "international days" were drawn up (in July 1921) by the International Aerological Commission under the presidency of V. Bjerknes, and the first edition of a new series of upper air data was compiled by Sir Napier Shaw for the year 1923 and published in 1927.

The present war has resulted in an increased number of upper air observations, especially at stations overseas. These are made primarily for synoptic purposes; but, so that the records shall be preserved and made readily accessible, a small section has been formed in

M.O.3. The duties of this section include also the answering of enquiries demanding, in the main, summaries of upper air data.

The manuscript data at present stored in M.O.3 consist of pilot balloon summaries and records of individual ascents or monthly summaries of radio sonde and aircraft ascents. Radio wind summaries also are received from a few British Stations. Since summaries of visual observations with pilot balloons are much biassed by reason of the difficulty of following a balloon to even a moderate height in storm cloudy weather, it has been decided that where sufficient measurements of upper winds by radio methods are available, these should be used to the exclusion of the visual methods.

New forms have been drawn up for the summarising of manuscript data. In these the frequency summaries are to be more detailed than hitherto, and, throughout, the data will be referred to isobaric surfaces and not to geometric heights, or iso-potentials, the object being to ensure uniformity and at the same time to retain the element observed. Another inovation is the addition of a frequency summary of absolute humidities (gm/m^3).

The preliminary work of the section includes the preparation of a card index, the main object of which is to provide concise references to published tables, curves, diagrams and charts which will supplement the manuscript returns.

The index is in four parts, the first being an index of "Countries or Regions". This consists of cards of countries, groups of countries or oceans arranged in alphabetical order under the continents. These cards are used for entries of charts covering a whole region, and of observations which cannot be assigned to a single station.

The second, and by far the largest part, is the bibliographical index by stations and ocean squares. The cards contain details of the upper air data available for the separate stations or ocean areas; and they are arranged according to the system of numbered 10 degree squares introduced by Marsden in 1831. This form of classification has the advantage of grouping together stations, the data for which can be combined (e.g. in forming long period means)

/without

without loss of accuracy. (Upper air data, unlike surface data, are not subject to purely local variation).

The third and fourth parts of the index are arranged alphabetically and consist of (iii) additional cards for the stations supplying monthly manuscript returns and (iv) cards labelled "Upper Air Data - Procedure, etc". The former give details of the type of data, the units used, and the amount received in respect of manuscript returns. The latter include procedure notes such as, for example, a record of decisions made with regard to the summarising of temperature data, and reference notes such as a note of average cloud heights in various latitudes or instructions for converting altimeter heights to pressures.

The card index, when finished, should form a complete guide to the collection and preparation of data, for the answering of enquiries.

The historical information given here has been extracted mainly from "A Manual of Meteorology" Volume I, by Sir Napier Shaw and Miss E.S.Austin.

N.C.

The British Society for International Bibliography.

The meetings of the Society for the 1944-45 session will be held in the Council Room at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2, at 2.30 p.m.

The papers to be read on December 5th, 1944 may be of interest to readers of this Magazine:-

The classification and indexing of technical aeronautical information. By W.C.Cooper, Esq.,B.Sc., A.F.R.AE.S., Ministry of Aircraft Production.

Abstracting, indexing and classifications. By Dr. J.A.Wilcken, Ph.D., Editor of Science Abstracts.

OBITUARY.

Colonel Sir Henry Lyons, F.R.S.

We record with regret the death of Sir Henry George Lyons at Great Missenden on August 10th. He was within two months of his eightieth year.

Lyons was born in London and came of a military family. He was educated at Wellington and Woolwich and passed into the Royal Engineers in 1884. His scientific ability soon made itself felt and in 1896 he was selected as director of the Geological Survey of Egypt and two years later he organised and became director of the Egyptian Survey Department. His appointment to this post has a special interest for meteorologists for the Survey Department included a meteorological service in its activities. It was during the eleven years that he directed the Survey that most of Lyons' personal scientific work was done. Under him great progress was made in the cadastral and geological surveys of Egypt and an archaeological survey was made in Nubia of the region about to be inundated by the enlargement of the Aswan dam. His best known published work is The Physiography of the Nile (1906) in which he made a careful study of the Nile and its basin, gathering together an enormous amount of material and setting it out in admirable form. It won wide recognition. The Royal Geographical Society awarded him its Victoria Medal and Oxford and Dublin Universities conferred honorary degrees upon him. He became a Fellow of the Royal Society in 1906.

In 1909 Lyons retired from his Egyptian directorship and came home to take up an appointment as lecturer in geography in Glasgow University, but he soon gravitated to London as honorary secretary of the Royal Geographical Society. It was during this period that he made his first official contact with the Meteorological Office. In February 1913 he became one of the Royal Society's representatives on the Meteorological Committee, filling the vacancy caused by the death of Sir George Darwin. He remained a member of the Committee through all its vicicitudes until 1941, a period of no less than 28 years.

The outbreak of war in 1914 waw Captain Lyons once more in uniform and it is perhaps characteristic of the period that the War Office could find no better immediate use for the services of an officer of his scientific and

/Administrative

attainments than to place him in charge of recruiting at Chatham. Perhaps that was a fortunate circumstance for the Meteorological Office for after the first hectic months had passed the Admiralty realised the need for meteorological information and suddenly demanded daily forecasts and reports for the eastern Mediterranean, of all places! We received no information from the Mediterranean in those days but with the assistance of the Admiralty a few reports were scraped together. A more serious difficulty was that there was no one on the Office staff who had any knowledge of Mediterranean weather beyond what came from general reading. Lyons, the ex-director of Egyptian meteorology was the obvious man to help and application was accordingly made to the military authorities for his services with the result that he was relieved of his routine duties at Chatham and assigned to the Meteorological Office. Even for him the task of framing reports and forecasts from such scanty material was rather like making bricks without straw, but he had a keen eye for meteorological diagnosis and a number of his shots came off. In a comparatively short time the forecast staff picked up some of his technique and the Admiralty got their reports without his daily assistance, leaving Lyons free to attend to other matters. These soon claimed his attention.

Meteorological information was wanted by the Army in France. Here again Lyons was the man to help. He knew all about Army organization and moreover many of the senior officers in France were his contemporaries and personal friends. Thus under his general supervision the Meteorological Section, Royal Engineers, came into being and soon developed into an organization of considerable size, judged by the standards of 1914-1918. In due course Lyons was appointed its Commandant with the rank of Colonel.

A very real difficulty that faced the Office in those days was that there existed no text book to give the newly recruited physicists and mathematicians the appropriate meteorological background to enable them to tackle effectively their new job. A book had to be written <u>ad hoc</u> but no one who had the necessary knowledge had time to write it. Sir Napier Shaw was the obvious man for the task and moreover he was itching to undertake it but the day-to-day administration of the

/Office

Office left no time for literary work. In this dilemma Lyons was made Acting Director of the Office and Sir Napier set free to tackle the burden of authorship. Thus the first edition of Part IV of the Manual of Meteorology came into being in advance of the other three volumes, though it was not actually published until after the cease fire had sounded.

As Acting Director Lyons found plenty of scope for his energies. Additional staff of all grades had to be found in large numbers not only for the forecast services. As the war progressed the need for climatological information by the services became greater and greater and that all meant more staff. Large supplies of instruments old and new, were also needed. Lyons realised that the ~~above~~ service requirements for meteorological equipment would go up by leaps and bounds and that the instrument makers would be unable to meet them at short notice. He accordingly took the responsibility of placing large orders, regardless of the fact that the grant-in-aid that formed the financial basis of the activities of the Office in those days was quite inadequate to meet their cost. Accommodation was another worry. The new premises in Exhibition Road, specially built for the Office as recently as 1910, proved too cramped even after the top floor, which housed the administrative staff of the Science Museum, had been absorbed. Lyons met that difficulty by taking over one of the vacant houses in Cromwell Road to serve as an instrument store.

The combined duties of Acting Director of the Office and Commandant of the Meteorological Section R.E. did not exhaust Lyons' capacity for work during the war years. He served as President of the Royal Meteorological Society from 1915 to 1918 and saw the society through three difficult years with characteristic energy. His three presidential addresses The Winter Climate of the Eastern Mediterranean (1916), The Wind Circulation of North Africa (1917) The Meteorological Resources of the Empire (1918) testify alike to his industry and to his ability for setting out the results of observations as a connected whole. He was awarded the Society's Symons Gold Medal in 1922.

At the close of hostilities Lyons retired from the Acting Directorship though as has been stated already, his connection with the Office (now attached to the Air

/Ministry

Ministry) was maintained by his remaining a member of the Meteorological Committee. He became Director of the Science Museum, a post from which he retired in 1933. His work at the Museum, both in broadening its scientific basis and in popularising its methods of presentation, is well known. It carried him the honour of Knighthood in 1926 and calls for no comment here, but this short account of Lyons' activities would be incomplete without some reference to his work for the Royal Society and his international activities. He was Foreign Secretary of the society from 1928 to 1929 and served as Treasurer for the following ten years, a "really great Treasurer", to quote from an appreciation by its President, Sir Henry Dale, which has appeared in The Times. In addition he was Vice-President of the Society from 1928-1939, we understand that his last years were devoted to writing a history of the Society from the administrative side, which unfortunately he did not live to see published.

During the post-war years Lyons became an increasingly important figure in the international scientific world. While hostilities lasted international cooperation in matters of pure science was necessarily at a standstill but immediately after the armistice, if not before, steps began to be taken to get things going again, largely upon the initiative of Sir Arthur Schuster, so far as this country was concerned. An International Council of Research was set up with Schuster as its General Secretary, and held a formal meeting in Brussels in July 1919. At this gathering of influental scientists thirteen so-called Unions were proposed to deal with the various branches of science. Among them was the International Union of Geodesy and Geophysics of which Lyons became Secretary. He saw the Union through the early stages of its development and attended its meetings at Rome (1921), Madrid (1924) and Prague (1927). In 1928 Schuster retired from the secretaryship of the International Council and was succeeded by Lyons who, as a consequence of taking over these wider duties retired from the secretaryship of the U.G.G.I. at its next meeting at Stockholm (1930). Lyons remained Secretary of the Council, which presently became the International Council of Scientific Unions, until 1937. He was thus in the fore-front of international co-operation effort in the scientific field for some eighteen years.

Lyons genial and rather bulky presence inspired

/confidence

confidence in all he came in contact with. He made an excellant chairman of committee, keeping the discussion suavely but firmly to the point and generally managing to get the business in hand concluded in record time u unless it was of a controversial nature, when he was prepared to allow each his say. As an administrator he had the knack of getting things done - and getting them done quickly and with a minimum of effort and formality. I have a vivid recollection of an interview I had with him shortly after he became Acting Director. I wanted to discuss with him some changes I wanted to make in the internal organization of the Forecast division and placed before him what I regarded as a "first draft" of my proposals. He went through my script with me paragraph by paragraph, clearing doubtful points by terse marginal notes. When we got to the end he almost took my breath away by marking my draft "approved" and handing it back to me with the words "Carry on, I'll arrange with the Office of Works about the additional room". At about 11 am on the following day the Office of Works foreman came to see me to get instructions about furniture for that room!

R.G.K.L.

George Baker.

~~George Baker~~ Devotees of meteorology who were acquainted with that ardent enthusiast the late Richard Bentley, past president of the Royal Meteorological Society, and many other persons, will learn with regret of the death on August 3rd, 1944, in his ninetieth year, of Mr. George Baker, Mr. Bentley's gardener and faithful deputy observer over a period exceeding 50 years. Mr. Baker was known to many of Mr. Bentley's co-workers in this branch of science, and under his careful tuition became an understanding and accurate observer, developing in the course of time an interest equalling that of his instructor in the daily tasks of recording temperature, rainfall, and duration of sunshine.

Mr. Baker's memory will be held in esteem for reasons apart from his services to meteorology by many who came into contact with him. He was of the now disappearing type of loyal old retainer, possessing humility without obsequiousness, but rather with a sturdy independence. He had the gifts of a genial manner and of humour -

/shafts

shafts of real wit often illuminating his speech. A transparent sincerity was the dominant note of his character.

Lucy R. Bentley.
The Mere,
Upton, Slough, Bucks.

September 28th, 1944.

Major D. Mirrielees.

It is with much regret that we have learnt of the death in Normandy in August 1944 of Major D. Mirrielees.

Major Mirrielees had maintained a rainfall record for some years at Garth House, Fortingall, Perthshire; observations have now terminated.
