## A NOTE ON THE SERIES

These maps of Great Britain are produced in two sheets, are on the Transverse Mercator Projection, and carry the new National Grid lines at ten kilometre intervals.

The series was initiated at the suggestion of the Advisory Maps Committee of the Ministry of Works and Planning (later the Ministry of Town and Country Planning) whose members included representatives of the British Association National Atlas Committee.

The planning maps already published or in preparation on this scale have been sponsored by the Ministry of Town and Country Planning and the Department of Health for Scotland and form a related series depicting the primary physical, economic, human and social facts concerning the country as a whole. For convenience of reference, maps prepared independently by the Ministry of Agriculture, the Geological Survey and by research organisations such as the Land Utilisation Survey are included in the list below.

The series will be found valuable not only by those concerned with planning, but by all who wish to see in convenient form essential facts about Britain as a whole. They should be invaluable to schools, business men, and administrators and constitute the nucleus of a National Atlas.



# PLANNING MAPS

Published by the Ordnance Survey on a Scale of 1:625,000 or about 10 miles to one inch

## Explanatory Texts

This series of Texts is issued by the Ministry of Town and Country Planning and the Department of Health for Scotland to assist in the interpretation of certain of the maps in this series

# No. 2. AVERAGE ANNUAL RAINFALL

BASED ON OBSERVATIONS DURING 1881 TO 1915

Published by the Director-General at the Ordnance Survey Office
Chessington, Surrey
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# MAP OF AVERAGE ANNUAL RAINFALL—GREAT BRITAIN

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ISSUED IN TWO SHEETS

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## 1. Introduction

THIS rainfall map, compiled by the Ministry of Town and Country Planning and the Department of Health for Scotland in collaboration with the Meteorological Office of the Air Ministry, is the first meteorological map to be included in the series of Planning Maps prepared on the 1/625,000 scale, and published by the Ordnance Survey. It is based on original maps prepared in the Meteorological Office on a scale of two miles to the inch.

The map shows the general distribution of average annual rainfall over Great Britain, during the years 1881-1915. The amount of rainfall is shown by ten progressive colour tints ranging from pale blue to dark blue. Inset dispersion graphs for selected stations give an indication of the variation of rainfall from month to month throughout the year.

## 2. The Compilation of the Map

### (i) Isohyets

The isohyets, or lines of equal rainfall, are based on observations made at rainfall stations, and reported to the Meteorological Office. The original ½-inch maps were prepared on a county basis, following the publication of the Book of Normals M.O. 236 in 1924, giving monthly and annual averages for the period 1881-1915 for a number of rainfall stations in the British Isles. The small number of stations with an adequate record had always been a difficulty in drawing any type of map showing distribution of rainfall amount, and this problem was again encountered in the drawing of these ½-inch county maps. To overcome the difficulty two methods of approximation were used. The first of these

provides a guide to the run of the isohyets between widely dispersed stations with a complete record, and the other is a method of using the data of stations where the record does not cover the full 35 year period. The two methods are complementary, the one providing a check on the other. In the first method, the plotter is assisted by the known relation between rainfall amount and the configuration of the land. The careful preparation and study of the original maps enabled this relation to be more accurately defined and a technique was built up, of assessing the probable distribution of average rainfall in areas where the number of stations is few[1].

The second approximation takes account of the known facts about the fluctuations of rainfall amount over a period of time. The number and location of rainfall stations reporting to the Meteorological Office varies from year to year, and in any one year about 5,000 stations are in operation. If any station, however, has been in operation for a period of five years or more, the probable annual average for the 1881-1915 period can be computed by comparing its record with those at neighbouring stations. In this way it has been possible to make use of the records of about 20,000 stations in the British Isles[2]. It is technically possible by supplementing the existing records with the methods described above to draw isohyets at intervals of one inch, but for practical reasons on a map of this scale only the 20, 22.5, 25, 27.5, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 120, and 150 inch values are shown.

### (ii) Dispersion Graphs

The graphs are based on the Meteorological Office monthly records for selected stations for each year, of the period 1881-1915. They are drawn according to the method used by P. R. Crowe[3]. The rainfall in inches is plotted for every month over a period of 35 years. There are twelve columns each representing one calendar month, as shown along the horizontal axis of the graph, and each column accordingly contains 35 entries. The entries below the *Lower Quartile* (i.e. the 9th entry from the bottom) represent exceptionally low rainfall, and those above the *Upper Quartile* (i.e. the 27th entry from the bottom) represent exceptionally high rainfall. The central section of the column, covering the portion between the 9th and 27th entries, represents the *Inter Quartile Range* and is coloured blue. The 18th entry is the *Median* which denotes normal rainfall expectation and is marked by a white circle. The *Arithmetic Average* is shown as a white line.

(1) Detail of the procedure is explained in an article on the Rainfall of Norfolk in *British Rainfall* 1928, p. 270.

(2) This method is explained in detail in an article on the Rainfall of the County of London in *British Rainfall* 1933, p. 266.

(3) *Scottish Geographical Magazine* 1933, vol. 49. See also the *Quarterly Journal of the Royal Meteorological Society*, July 1940, Vol. 66.



# 3. The Interpretation of the Map

### (i) Isohyets

The relation of rainfall amount to relief, mentioned above, as of assistance in plotting the isohyets, is clearly shown on the map. The areas of higher rainfall are easily identified as the main uplands of Britain and even the smaller and lower relief features like the Ochils (2,000 feet), Edge Hill (600 feet), and the low hills of Norfolk (300 feet) stand out as areas of higher rainfall than the surrounding plains. Since the relief of the land surface is not the sole factor involved in the mechanism of rainfall, there is not an exact correlation between intensity of rainfall and relief, and the apparent anomalies can generally be explained by the decrease in rainfall from west to east and the difference in shape, position and orientation of the upland areas, in relation to the lower ground, and to the prevailing westerly air stream. The Cotswolds, for example, in the north rise to over 1,000 feet; but partly because these hills are to the east of the Welsh mountains, the rainfall is not markedly greater than in the surrounding lower areas. In addition they lie in a south-west to north-east direction offering less obstruction to the more usual south-westerly winds than for example the Mendips. These hills though of similar altitude lie across the path of the south-west winds and are emphasised as an area of much higher rainfall. Similarly in the Snowdon area there is a decrease not only in the Vale of Conway, but further east over the Denbighshire Moors which rise to 1,600 feet but where average annual rainfall is only about 40-60 inches. In Scotland the Grampians are not nearly as wet as areas of similar altitude in the mountains of the west coast. Similar study and interpretation of the map will yield a considerable amount of basic information about the distribution of average annual rainfall, but in addition information about the variation of rainfall is important and this is provided by the inset dispersion graphs.

### (ii) Dispersion Graphs

These are included on the map, in an attempt to give a compact and reliable analysis of the seasonal and long-period variations in rainfall amount characteristic of different areas of Great Britain. In the first instance, the linear presentation of actual monthly amounts shows at a glance the range of extreme falls and the scatter of the readings, and since the monthly values are arranged in order of magnitude the median or central value and the lower quartiles and upper quartiles can be easily located. The median is indicated because unlike the average it is not affected by abnormally high or low values, and has other advantages as an index of rainfall probability which are fully discussed elsewhere [4]. The arithmetic average is included as a more familiar quantity to facilitate comparison with existing records and to enable the graphs to be related to the isohyets. The Inter-Quartile range is itself useful as an index of variability between stations and also between one month and another at the same station. For example, comparison can be made between the extreme cases of Spalding where the Inter-Quartile range is typically between 1 and 2 inches in any month, and Keswick where values of 3-4 inches are the most common. Wick and Glenquoich, two Scottish stations, also show a comparable difference in the degree of variability. Similarly a comparison of the variability between one month and another can be made. At Buxton the inter-quartile range for April is 1.3 inches, but in September it rises to 2.8 inches, although both months record very similar averages of 3 inches and 3.25 inches. At Aberdeen the range changes very rapidly between two adjacent months with the same average of 3.3 inches; the October range is 1.4 inches and the November range is 2.4 inches.

Finally perhaps the most important quality of the graphs is that they give an indication of the seasonal distribution of rainfall between stations, in different climatic regions[5]. In comparing Stornoway and Spalding, the north-west station shows a clear December maximum and June minimum, forming a regular U-shaped curve, broken only by a low September rainfall. On the other hand, the continental influence on the climate of South-east England is shown in the August maximum at Spalding, although the inverted curve of seasonal change, characteristic of the continental stations, is not fully developed.

(4) P. R. Crowe op. cit.

(5) The fluctuation of Monthly Rainfall was also dealt with in an article in *British Rainfall*, 1922, p. 234; and the Average and Extreme Seasonal Rainfall by J. Glasspoole in the *Transactions of the Institution of Water Engineers*, Vol. 33, 1928.

A number of other quantities and trends can be deduced, which have not been mentioned in this short description of the type and range of phenomena illustrated by the diagrams. The study of rainfall "discontinuities," percentage variability, etc., described more fully in the article already referred to, suggests further uses and implications of these charts, but for present purposes it is sufficient that the dispersion graphs provide a satisfactory method of illustrating the probable extent and frequency of variations from the normal, in rainfall.

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