

### The Geographical Distribution of Snowfall.

SNOWFALL is scarcely less important than rainfall in the general economy of the earth's surface, and has an even greater latitudinal range over that surface, being entirely excluded only from the inter-tropical lowlands, whereas rain is nearly excluded from the polar regions as well as very high mountains in all latitudes. It is strange that so little attention has been paid to the study of the geographical distribution of snow as such apart from its rainfall equivalent when melted. One welcomes, therefore, a short paper, "Sulla distribuzione geografica della neve," by G. Ferrara (*La Meteorologia pratica*, Anno iv., No. 2, 1923), who gives a general survey of snowfall conditions for the whole globe, together with special statistics, with a map, for Italy.

The average annual number of days on which snow falls, as based on a 10-year period, is very small all over the peninsular and insular parts of Italy, except, of course, in the mountains, being, to quote a few figures, 0.7 at Palermo, 1.4 at Naples, 1.6 at Genoa, 1.7 at Rome, and 3.5 at Florence. In continental Italy, as dominated by the great plain of the Po between the Alps and Apennines, the figures increase to 4.1 at Como, 5.6 at Padua, 8.1 at Milan, 10.5 at Parma, 10.8 at Bologna. But even these latter figures strike one as very small for a region with a winter which, if relatively short, is very sharp at its depth and marked by a fairly regular snow-canopy. They may be contrasted with the generally higher frequencies at stations in the British Isles with a longer winter (M.O. Book of Normals, Sect. IV. b, 1923). Only in the extreme south-west of Ireland and England, which project into warm water, is the annual number of snow-days less than 10; in all other parts it is above that figure, among the higher values being: Stornoway and Wick, 25; Sheffield and Stonyhurst, 26; Sunderland, 28; Aberdeen, 34; Buxton, 38; and Balmoral, 50, the last two stations being 1000 feet above sea-level. On the summit of Ben Nevis<sup>1</sup> (4400 feet) it snows on 170 days in the year, or about as often as it rains in London with only 13 snow-days. The British figures, however, are based on 40 years' records, the Italian only on 10. Also the comparability may be slightly affected by undisclosed differences in the standard of estimation—often the bugbear of those who want to compare the climatological statistics of different countries.

Returning for the moment to northern Italy, the important feature which Ferrara brings out is that there is considerably less snow near the southern foot of the Alps, as typified by Como, sheltered from polar winds and exposed to sunshine, than near the northern foot of the Apennines, as typified by Parma and Bologna, where the conditions are reversed. It may be noted that the high southern Apennines of the Abruzzi, and other provinces, enveloped as they are in the moisture of the Mediterranean Sea, is in winter, the rainy season in the Mediterranean, one of the snowiest mountain systems in Europe, only saved from perennial accumulations by their moderate altitude and by the heat and drought of the Mediterranean summer.

In Europe as a whole, parts of Russia, Poland, Rumania, Hungary, Switzerland, Germany, and the central plateau of France are mentioned as countries having a copious snowfall, while in some of the valleys of Transcaucasia the amount of snow which falls in an average winter is said to amount to 5 to 7 metres (15 to 21 feet), though whether this is actual accumulated depth without drifting or simply the

<sup>1</sup> Readers should be reminded of the permanent snow-beds in corrie round Ben Nevis, and other parts of the Gramians, which of recent years have been proved to exist. They are maintained chiefly by small avalanches blown off overhanging cliffs.

aggregate of successive falls separated by thaws is not stated. One misses in this paper any reference to snowfall in the British Isles, which, under the influence of the ocean climate, is more erratic and transitory than on the mainland of Europe—a fact which tends to conceal its real magnitude. The normal falls during the winter and spring months in the Highlands of Scotland and the northern part of England are undoubtedly heavy. Moreover, in a country like England, where the winter climate is *damp* rather than cold, with a mean winter temperature at sea-level slightly below 40° F., there is a much greater difference between the snowfall of uplands and lowlands than is the case in countries where the mean winter temperature is below the freezing-point. Thus those who live in London and other of the great lowland cities often have little realisation of the severity of the visitations in regions like the Cheviots, the Peak of Derbyshire, and, rather less often, Dartmoor in Devonshire.

Since snow, like sand, is, in large quantities, one of the most formidable of natural agencies, it must be accounted fortunate that the two conditions essential to heavy snowfall, namely, cold and humidity, tend to limit one another. The fact that temperature and vapour tension tend to rise and fall together, except perhaps in regions cut off from supplies of moisture, is a very effective safeguard against excessive snowfall, and reduces the area of the globe where the requisite conditions for heavy snowfall exist. It is known that the snowfall of the polar regions, though constant, is not so intense as the winter fall in warmer latitudes.

In the heart of Asia, too, the winter snowfall is relatively light, partly because of the extreme cold and partly because the physical configuration of the Continent cuts off moisture-bearing winds, both of which factors reduce the vapour tension too low for much snow. Consequently it is in some of the peripheral regions of Asia where the enormous snowfalls occur, for example in Kamchatka, the mountains of Japan, and the plateaus of Afghanistan, Persia, and Asia Minor. Similarly in North America the snowfall is heavy on the Atlantic coast and in the mountains of the Pacific coast, but light in the interior plains. On the other hand, regions like western Europe, with a high degree of winter humidity and storminess, are liable to be too warm for sustained snowfall, and much of the winter precipitation is in the form of rain. Finally, it should be emphasised that occasional light falls of snow at sea-level make a much closer approach to the tropics than is commonly supposed, and statements to the effect that snow is "unknown" in the vicinity of the 30th parallel N. or S. should, as a rule, not be taken literally. Moreover, it does not require, even in such low latitudes, an elevation above sea-level greatly exceeding 2000 feet for the occurrence now and then of very heavy snowfall. This is true of the plateaus of Algeria and Morocco, as also of those in South Africa. In February 1921 a snowstorm of unusual intensity swept Palestine, depositing some 3 ft. of snow in a day on the Judean plateau, upon which stands the city of Jerusalem. Similarly in the uplands of Natal in early spring, about late August or September, when the South African winter drought begins to break and there are cold southerly winds, experiences are sometimes reminiscent of the Pennines and other high moorlands of England, especially in the corresponding months of February and March, when livestock is lost and lonely homesteads blockaded by huge drifts in every accentuated snow-spell. L. C. W. BONACINA.