

newly exposed land. Increased rainfall causes the lakes to rise and the trees are killed.

Stumps of dead trees were found by the writer standing in Granite Lake, Williams Lake, Medical Lake, Badger Lake, and many other lakes southwest of Spokane, during the summers of 1926 and 1927, when after 10 years of deficient rainfall the level of the lakes was the lowest known since the white man settled the country. Rings of growth proved some of the trees lived over a century, during such a prolonged drought period that lake levels were below anything known to-day. Since most lakes on the Columbia Plateau, except where the rainfall was too low for trees to have ever grown, contain stumps of trees killed by rising water; it is proof of a widespread drought period lasting over a century. The

phenomenon being widespread can not be accounted for by a local cause that might temporarily have affected the level of one lake alone.

The time of occurrence of the prolonged drought, and whether more than one such period happened has not been determined.

Additional evidence for long drought in historic times comes from eastern Oregon. In the summer of 1926 Goose Lake, Malheur, and Harney Lakes almost disappeared after several exceptionably dry years. In the dried up lake bed well defined wagon ruts were found. It is supposed these were made by the wagon of some pioneer in the decade after 1840, as the floor of the lake had never been exposed since the region was permanently settled.

### AGRO-CLIMATIC CONDITIONS IN RUSSIA<sup>1</sup>

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On account of the uniformity and enormous extent of the belt of the Russian plain and the almost complete absence of mountains the climate is the chief factor in landscape formation. With the flat conditions of Russia this develops in zone form mainly in the direction of latitude and is subject to the influence of solar and Atlantic climatic factors.

The orderly series of latitudinal climatic zones is accompanied by a corresponding arrangement of territories in which soil and vegetation on the one hand and sanitary, economic, and social conditions on the other are the same.

Almost one quarter of European Russia is waste land, whose geographic features, nature of soil, and character of climate—marked lack of warmth in the north and lack of water in the south—are altogether incompatible with any form culture; hence the presence of tundras in the north and the desert belt in the south are readily explained.

The climate of the flat part of Russia either shows the same characteristics detrimental to agriculture and necessitates recourse to primitive forms of farming in the northern Tayga (swampy forest) and in the southern steppes, or then it considerably hampers farming, as in almost all of the remaining parts of the middle forest and steppe regions, which comprise the greatest and best part of the arable surface of Russia.

The climatic extremes of the farming region are explained for the most part by extreme continentality and can be summarized as follows: (a) Marked change in temperature from summer to winter and from day to night; (b) in general, long-continued, severe winter, especially in eastern Siberia, and hot summer in the south; (c) scant amount of snow in Siberia and great extent of perpetually frozen ground, (d) lack of precipi-

tation in southern and southeastern Europe, the region of most fertile soil; (e) dissimilarity of rainfall régime in the whole farming area, and lack of rain in the spring and early summer (even in the region of the Atlantic wedge of maximum precipitation of eastern Europe), which injures forage plants, clover, and alfalfa, so necessary in crop rotation; (f) extraordinarily short growing season of three to five months; and (g) droughts, hot winds, dust clouds, heavy downpours and hail in the south and southwest, and severe night frost over extended areas.

The climatic extremes prevent the permanent colonization of two-thirds of the Russian region and impose upon the cultivated vegetation the stamp of a type of weather very fickle and productive of small yields. Hence expenditures on intensive agriculture do not pay and extensive forms of farming are not supported.

Although it permits farming in the forest belt and in the steppes, the climate of Russia is on the whole not favorable to agricultural development, especially in comparison with western Europe, India, and China.

The climatic conditions make farming but little profitable in the greatest part of Russia; they hardly permit an extension of the farming area and make unattainable the raising of yields to the type found in western Europe, where the harvests are two to three times as great as those in Russia before the World War. Under present conditions on 96 per cent of small rural farms it is not possible to count upon farming as the sole factor in the commercial, economic, and social development of Russia.

For the further advance of Russia and for the easing of the struggle of man against natural conditions there must be a change to diversified farming of intensive type and a development of household industries.

Also, there must be development of mining in order that soil fertility may be renewed and introduction of labor-saving machinery, without which the betterment of the agricultural system is impossible.

<sup>1</sup> Agroklimatische Verhältnisse Russlands. Der Kulturtechniker, Zeitschrift der Deutschen Kulturtechnischen Gesellschaft. XXXI Jahrg. Heft Nr. 6 Breslau. 1928. Translation of conclusions.—W. W. Reed.