IRRIGATION, WITH SPECIAL REFERENCE TO EUROPE

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The significance of the 20-inch isohyet as marking the *approximate average* limit of humid agriculture and of the 10-inch isohyet as separating the semi-arid from the arid or desert regions has been generally recognized. There is, however, a far less general appreciation of the wide extent of the lands deficient in moisture and the very limited areas now under irrigation.

Data recently compiled[1] indicate that almost one-third of the earth's surface receives less than 10 inches of rainfall, while more than another third receives between 10 inches and 20 inches.

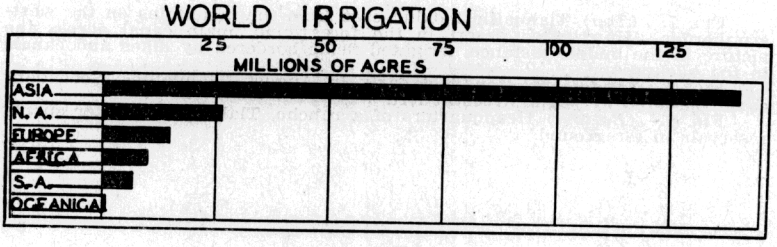


FIG. 1.

Speaking very generally, then, for every acre with sufficient moisture to be capable of large production, there is another acre of limited productivity, and a third so dry as to be practically unproductive. Water supply is obviously the most important factor in determining the potential productivity of the land surface.

To what extent has irrigation been able to remedy this enormous deficit in rainfall? In 1920, the total acreage artificially watered was estimated at approximately 100,000,000, or about 7 per cent of the total cultivated land of the earth. By 1929, although this had been doubled, it amounted in the aggregate to an acreage only about twice the size of the State of California. This would be less than 2 per cent of the land classed as "arid,"

[1] Mead, L., Foreign Markets for Irrigation Machinery and Equipment. U. S. D. C., Trade Promotion Series No. 73, 1929.

i. e., receiving less than 10 inches of rainfall. Even allowing for a larger output per irrigated acre than from ordinary cropping, artificial watering has obviously made but little impression upon the vast dry areas of the earth.

IRRIGATION AMONG THE CONTINENTS

The unequal distribution of irrigated land among the continents is indicated in Figure 1. Asia, with two large densely populated agricultural regions and its vast acreage devoted to

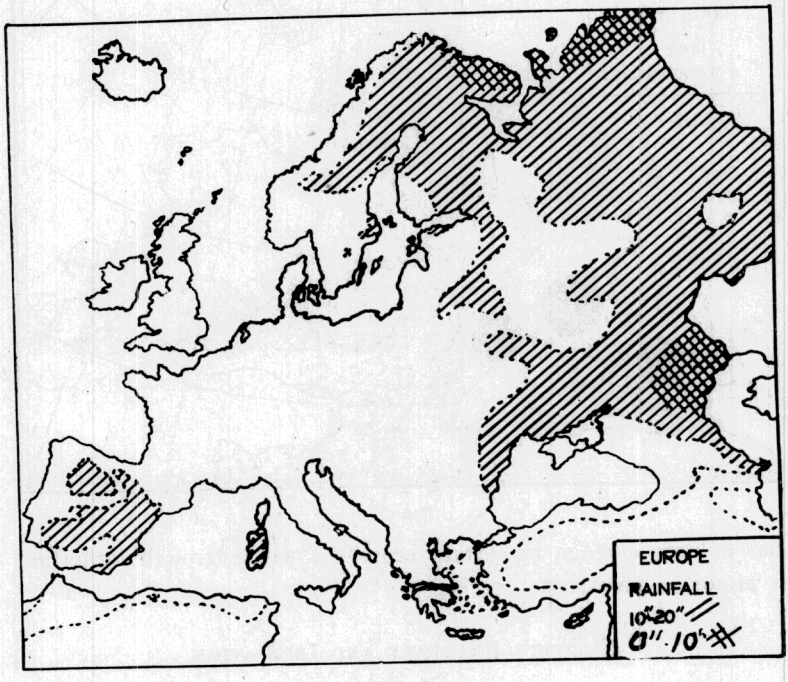


FIG. 2.

the water-loving rice, possesses almost 72 per cent of the world's total. North America, with 13 per cent, chiefly in the United States and Mexico, is a poor second; Europe, with but 7 per cent, is third. Relative to their areas, which would be a fairer basis of comparison, Asia is still far in the lead, with one irrigated acre in every 72 of surface, while on this basis Europe is second, with one acre in every 158 of its area. Rated according to population, Europe ranks lowest among the continents, there being but 31 acres under irrigation for every 100 inhabitants.

Though possessing twice the population density of Asia, Europe has irrigated in proportion to its area, only one-half as much as the former. To a considerable degree this is a tribute to the smaller continent's more favorable distribution of rainfall. Indeed, Europe is the only grand division without an extensive desert area. In addition, that continent is highly industrialized and is able to purchase food supplies from other countries. Asia, on the other hand, is predominantly agricultural and, furthermore,

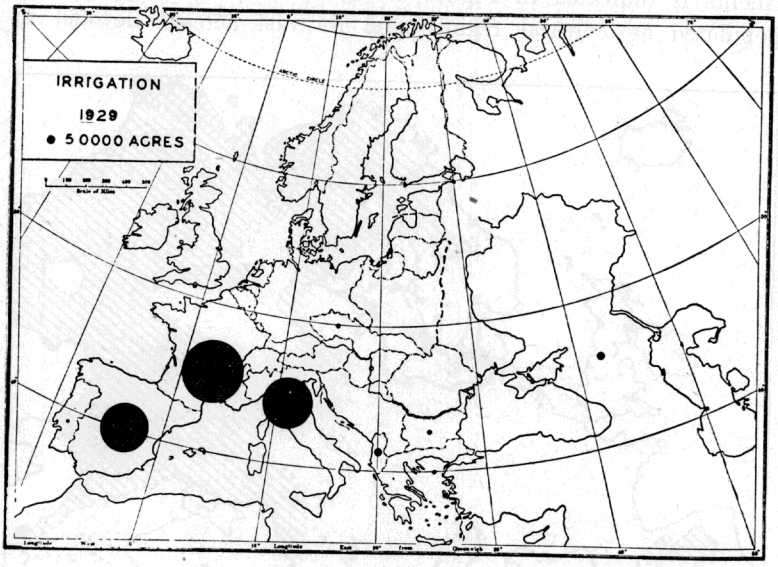


FIG. 3.

has a large acreage in certain crops for whose growth irrigation is almost a necessity.

EUROPE'S RAINFALL AND IRRIGATION

The favorable areal distribution of Europe's precipitation is shown in Figure 2. More than one-half of the continent receives over 20 inches annually, while the area with less than 10 inches is negligible, less than 5 per cent, in fact. The zone receiving from 10 inches to 20 inches lies in the extreme northeast, and east, with a small area in Spain.

Figure 3, showing the extent of irrigated acreage by countries of Europe, illustrates several interesting features, especially when compared with the map of rainfall. The most striking fact is the

concentration of irrigated acreage in the western Mediterranean, France, Italy, and Spain accounting for over 90 per cent of all European lands artificially watered.

A comparison of Figures 2 and 3 reveals the apparently anomalous situation that the major part of the lands receiving less than 20 inches of rain are in the northeast, while the principal irrigated areas are in the opposite corner—the southwest. Apparently, the relation of irrigation to annual precipitation is not so simple as it might at first appear.

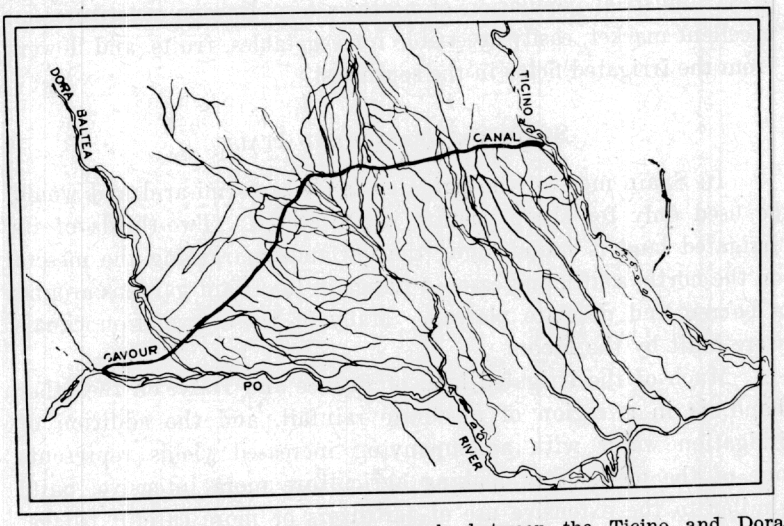


FIG. 4. Network of irrigation canals between the Ticino and Dora Baltea, in the Upper Po Basin.

PRECIPITATION AND AGRICULTURE

To the question of how much rainfall suffices for ordinary agriculture, the annual precipitation data provide but a very incomplete answer. *When* the rainfall comes may be just as important as *how much* is received . Europe is, as we have seen, very fortunate in its areal distribution of moisture, but in the south it is handicapped by a bad seasonal distribution. A marked summer minimum of rainfall combined with high temperatures produces drought, even though the annual amount be over 20 inches. Conversely, northeastern Europe receiving from 10 inches to 20 inches but with a summer maximum and a smaller evaporation coefficient, may have sufficient moisture for ordinary agriculture. Thus,

throughout much of the Mediterranean the summer growth of any but a few drought-resisting plants necessitates artificial watering. Jerusalem has about the same annual rainfall as does London, but the one is in a desert, the other in a garden.

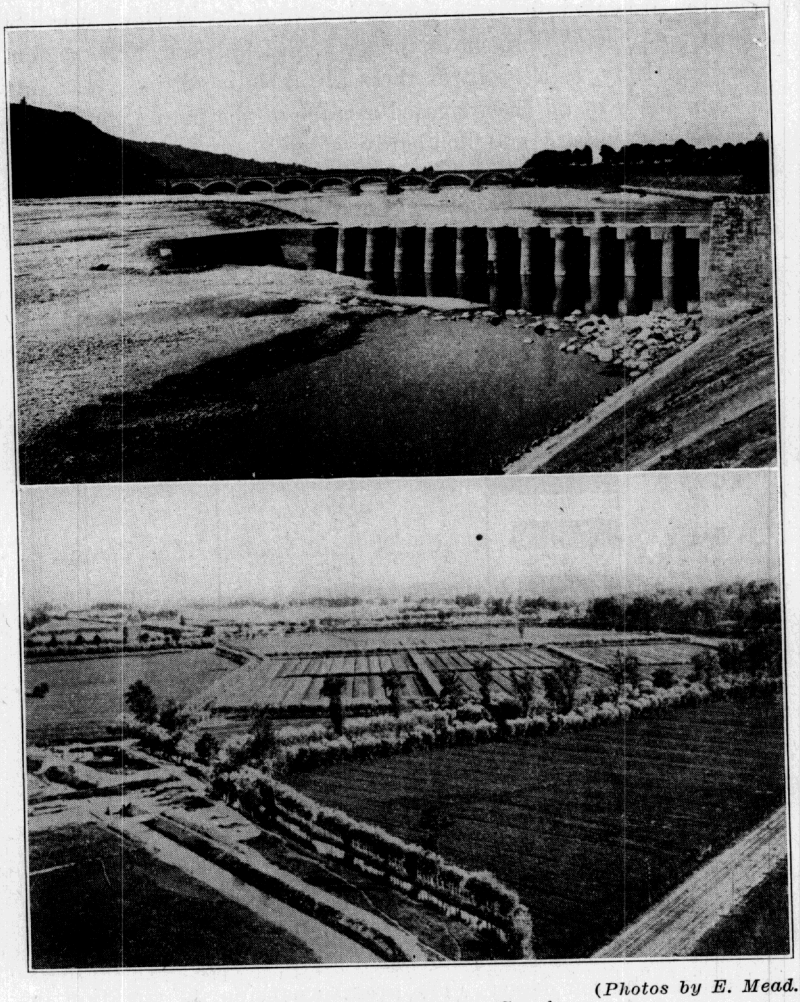
But why the concentration of irrigation in the *western* rather than the *eastern* Mediterranean section of Europe? In the former there is a greater degree of political stability, of cooperative effort, of scientific agricultural knowledge. The physical bases, alluvial plains with snow and glacier-fed streams, are available. Again, the great industrial population of northwestern Europe constitutes an excellent market, easily accessible for vegetables, fruits, and flowers from the irrigated fields in the southwest.

SPAIN VS. FRANCE AND ITALY

In Spain most of the irrigated lands are semi-arid and would be used only for sheep pasture if unwatered. Two-thirds of its irrigated land is found along the lowlands margining the meseta on the north, south, and east—a fringe of luxuriant gardens around a barren and desolate plateau. Many of these irrigation canals were built by the Moors.

Much of the irrigated land of France and Italy, on the other hand, is in a region of moderate rainfall, and the addition of irrigation water with accompanying increased yields represents one of the methods of making agriculture more intensive, quite similar to the extensive use of fertilizers or more careful tillage. The western, or upper, Po basin is the irrigation region *par excellence*. The northern plain of Italy was formerly an extension of the Adriatic, and the same rivers that transformed it from a gulf to a plain are now busy watering the fields and energizing the factories of that populous region. The upper Po and its tributaries are torrential, but in the lower portion the river winds sluggishly across a broad flat alluvial plain. Consequently, in the upper portion, water power and irrigation development have made great progress; in the lower, drainage and flood control are necessary. The superiority of the Alpine, or northern, tributaries in volume and regularity of flow from the snows and ice of the Alps has given the north side of the Po ten acres of irrigated land to every one on the south. About Milan the countryside has the appearance of a great garden with a network of canals. The rainfall of that section is greater than in central Illinois; yet the

abundance of streams makes even irrigation of pastures profitable. Figure 4, a map of irrigation between the Dora Baltea and Ticino west of Milan, gives an excellent idea of the intricate maze of canals in this region. The Cavour canal, carrying water from the



(Photos by E. Mead.)

FIG. 5. (*Above*) Head of the Cavour Canal.
FIG. 6. (*Below*) View in the irrigated region of the Upper Po Basin.

upper Po for over 50 miles to the Ticino, is shown running parallel to the foothills of the Alps. Figure 5 shows the head of the canal, the nearly dry Po channel in the foreground, the diversion dam, and the canal leading off to the left. In its course the canal

is carried under and over many streams and other canals. The upper Po waters are relatively warm; those of the Dora Baltea fed by melting snow are cold. By proper regulation of the amount admitted into the canal from each, considerable temperature control over the irrigated fields is possible. Figure 6, a view over the countryside near Milan, shows the garden-like aspect of the region. Northern Italy, as a result of these favorable conditions, accounts for four-fifths of all the irrigated acreage of the nation, two of its provinces, Piedmont and Lombardy, alone possessing 72 per cent.

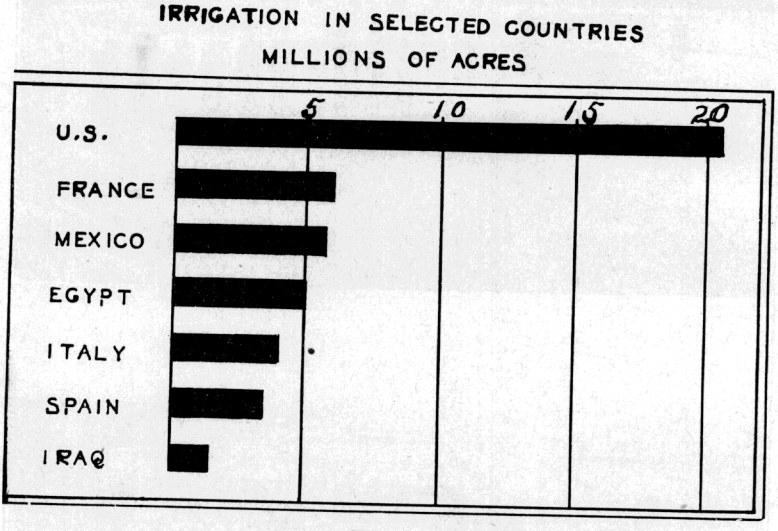


FIG. 7.

It is interesting to note that some of the historically famous irrigated regions are smaller than several of which little is heard. Figure 7 represents diagramatically the irrigation in certain selected areas. France, and even Mexico, is shown to have larger areas artifically watered than has Egypt. Part of the greater publicity given such regions as the valleys of the Tigris-Euphrates and the Nile is due to their more spectacular setting—typical oasis gardens in a barren desert. The great expansion in irrigation in recent times has been in the semi-arid rather than the desert regions, and the use of modern machinery and large capital has served to dwarf some of the world's old irrigation valleys. Thus the United States alone has about four times the irrigated area of Egypt.