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MERRILL K. BENNETT

A WORLD MAP OF FOODCROP CLIMATES*

This paper presents a map of world climates which, to students interested in study of the relationship of climate to world geographical distributions of major food crops and regional crop complexes, may perhaps prove more serviceable than do the various maps of world climates such as usually find a place in geographical atlases and textbooks on climatology. Those maps on the one hand aim at description of climates for its own sake, to portray how the face of the earth, especially its land surface, is apportioned among regions which may be said to differ one from the other in some sense involving average circumstances of both temperature and precipitation. On the other hand, conventional climatic maps subscribe to what Miller calls the "general principle that a satisfactory classification of climates must reflect the climatic control of vegetation; that climatic provinces must coincide as closely as possible with major [natural] vegetational regions of the globe" (1, p. 86). The maps here presented do not deal with descriptive differentiation of climates for its own sake but seek to differentiate climates according to their relative hospitality to production (unirrigated) of major food crops, and, this being the aim, major regions of natural vegetation play no part, unless it be accidental, in the differentiations among climates.

Principles of classification have been selected with a view to presenting a picture of world distribution of foodcrop climates that may be readily grasped because of the moderate number of resulting climates and the relatively few criteria of differentiation. The principles of classification will emerge sequentially in the discussion. Not all of the concepts of the differentiating boundaries are as firmly based as may be desired, and the location of bounding isolines are in many instances insecure by reason of conflict of authority, failure to examine the full world range of available meteorological data, or absolute paucity of such data in some parts of the world.

FOODCROP AND NON-FOODCROP CLIMATES

Common observation, together with accumulated knowledge of the quantities of heat (light taken for granted) and water required if a food crop is to mature seeds or cuttings permitting its own reproduction, certify to the existence on the earth of some climates too cold for cultivation of all food crops and of other cli-

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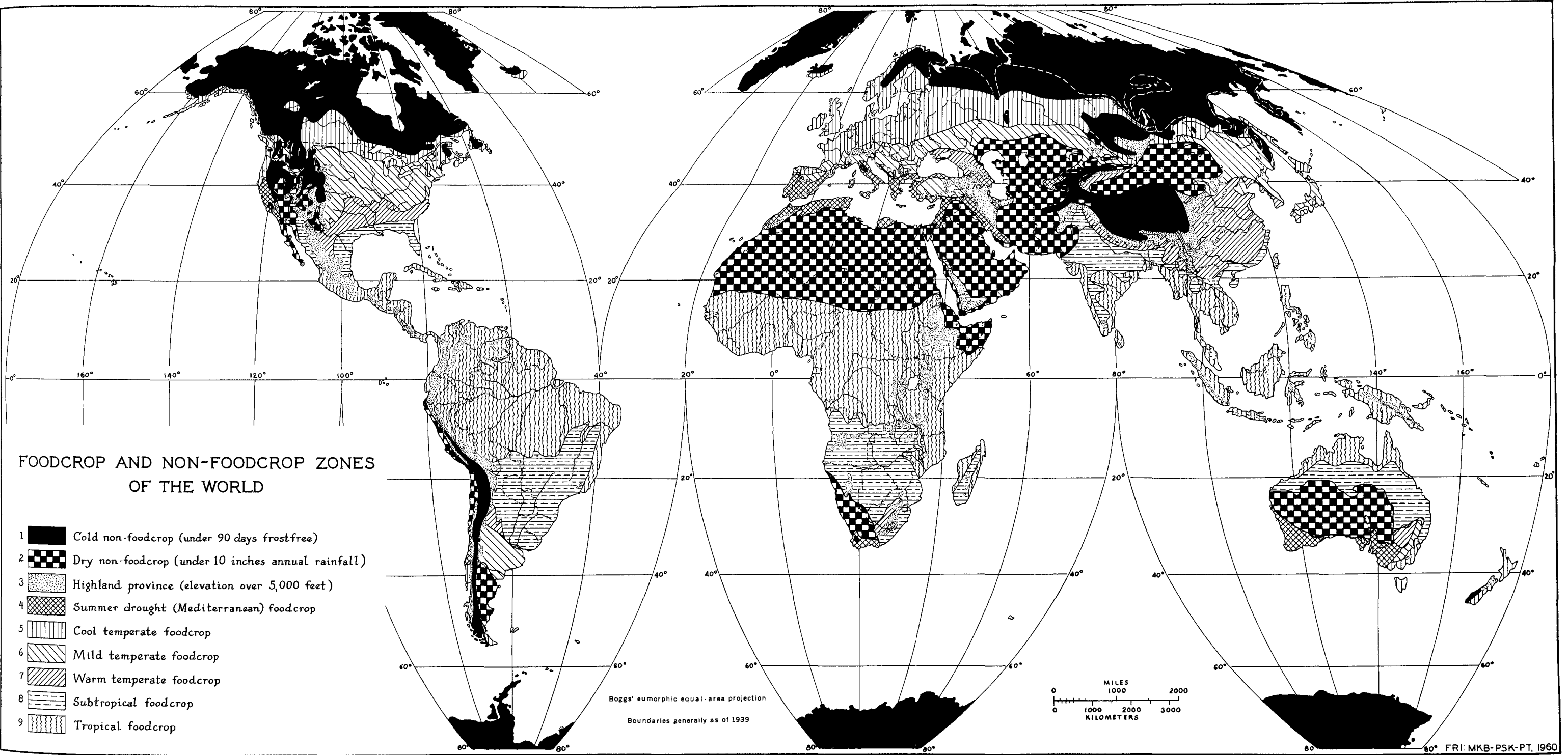
mates that are too dry, failing irrigation in some form. Extremely high rainfall in itself does not preclude cultivation of some known food crop, nor does extreme natural sun heat.

The initial problem in mapping foodcrop climates may therefore be taken as one of marking off areas of the world which are too cold for persisting cultivation of any major food crop. Some sort of an isoline is necessary to denote the boundary between regions which are and which are not too cold to permit substantially regular maturation of the materials of the plant's reproduction. We take as "major food crops" typically those which nowadays yield relatively the largest quantities of dry matter edible by man; they tend also to occupy large acreages though not in proportion to dry matter produced because of differences in yield per acre. A defensible catalog of major food crops includes but is not necessarily limited to such starch crops as wheat, rye, rice, corn, barley, oats, millets and sorghums, white and sweet potatoes, manioc, yams, banana-plantains; such pulse crops as various types of dried beans and peas; oil crops such as coconuts, oil palms, rape, soybeans, peanuts, sunflower, cotton; sugar crops such as sugar cane and sugar beet; and flavor crops such as apples, citrus fruits, grapes, onions, and tomatoes. Cocoa, coffee, and tea may be included even though the last two provide no edible dry matter. Grasses cultivated for forage and important in agriculture, which have a wider climatic range, are not here regarded as major food crops; they do not provide food directly edible by man although indirectly they provide animal foods.

The solid black of Map 1 represents an attempt to specify those parts of the world's land area too cold for cultivation of major food crops. It seemed unfeasible to identify a single isoline circumscribing such a cold zone. Its warmer boundary was accordingly approximated on three criteria. In North America (Alaska excepted), the warm boundary is the isoline of 90 days free of 32° F. frost, as recently drawn on the basis of data from meteorological stations (see 2). Within the Soviet Union the warm boundary is the isoline of 1600° C. of accumulated summer temperatures above 10° C. (50° F.), commonly taken as a low-temperature limit on growth of spring-sown barley, the cereal least demanding of heat (3, p. 6; 4). This isoline extends into warmer territory than a Russian-drawn isoline of 90 days free of "killing" frost (5, Pl. 35); that isoline is indicated by the line of white dashes. The Russian-drawn isoline of 90 days free of killing frost also circumscribes the non-Soviet cold zone in Asia, as well as the cold zones of Antarctica and Alaska. A more recently drawn but nearly identical isoline of 90 days free of killing frost (6, p. 11) encloses the cold zone of Europe. Since the Russian mapping appeared somewhat unrealistic for South America, Iceland, and New Zealand (where some parts have frost-free periods considerably longer than 90 days but the summers are too cool to mature major food crops), the cold zones of those areas are bounded by the equivalent of an average summer temperature of 50° F.¹ Perhaps, needless to say, certain relatively small spots on the earth's surface, chiefly represented by the peaks of mountains or mountain ranges, are

¹ See map in 7, pp. 16-17. This map (A. E. Parkins' refinement of Herbertson's Thermal Regions) delineates territory characterized by "cold winter and cool summer; always cool in the Andes," and the temperature value of "cool" is 32°-50° F.

MAP I



FOODCROP AND NON-FOODCROP ZONES OF THE WORLD

- 1 Cold non-foodcrop (under 90 days frostfree)
- 2 Dry non-foodcrop (under 10 inches annual rainfall)
- 3 Highland province (elevation over 5,000 feet)
- 4 Summer drought (Mediterranean) foodcrop
- 5 Cool temperate foodcrop
- 6 Mild temperate foodcrop
- 7 Warm temperate foodcrop
- 8 Subtropical foodcrop
- 9 Tropical foodcrop

Boggs' eumorphic equal-area projection
 Boundaries generally as of 1939

MILES
 0 1000 2000
 KILOMETERS
 0 1000 2000 3000

too cold for production of food crops; but these have not been so indicated on the map because of their small and isolated areas.

Although it appears impossible as a practical matter to achieve consistency of definition in mapping the many boundaries of the world's land surface in general too cold for cultivation of major food crops, the stated procedure may serve the purpose reasonably well. At least it can be said that the cold zone as mapped contains only about .7 per cent of the world's population while covering about 29 per cent of the land surface of the earth; and since absence of population means absence of crop cultivation, the factual intrusion of major food crops into the cold zone must be decidedly small.

The second problem is to mark off the world's land surface that is too dry for continuing cultivation of food crops in the absence of unusual or unnatural accumulations of water beyond the level of average annual precipitation. As a useful and consistently available moist boundary of this dry non-foodcrop zone we take the isohyet of 10 inches of annual rainfall as drawn in a recent world atlas.² On the principle that low temperature *per se* constitutes a firmer barrier than drought against foodcrop production, or is less amenable to human amelioration for purposes of producing food crops, we encompass with the 10-inch isohyet only that part of the land area which lies outside of the cold zone. Thus one of the indicated non-foodcrop zones in general precludes production of major food crops by reason of deficient heat, while the other precludes it—failing ameliorations—by reason of deficient moisture.

The 10-inch isohyet is of course not an absolute limit upon production of major food crops even when one ignores the natural flood lands and sumps and the artificial irrigation enclosed within it. In parts of the dry zone where rainfall comes in the cool season of the year and evaporation is accordingly relatively slight, a major food crop, fall-sown barley, can be matured without irrigation at a level of 7–10 inches of annual rainfall, though perhaps neither regularly (on account of annual variability of rainfall) nor at high levels of yield. There are also some parts, at relatively high latitudes or elevations, where the rainy season, coming in summer, is so cool as to permit production of spring-sown barley at a rainfall level slightly below 10 inches. On the other hand, there are parts of the world where summer temperatures are so high, and correspond with summer rainfall near 15 inches, that not even barley can be grown. Hence a more precise demarcation of the world's land area too dry for unirrigated food crops would no doubt call for an isohyet of somewhat less than 10 inches where winter rains prevail and at relatively high latitudes and elevations where summer rains prevail but the summers are mild; on the other hand, where summers are hot and summer rains prevail, an isohyet of somewhat more than 10 inches would be more appropriate. But within the appropriate range of annual rainfall levels, one finds the world as a whole mapped only in terms of the 10-inch isohyet.

The zone too dry for unirrigated major food crops as indicated in Map 1 covers

² See 8, p. 4. The isohyet of 10 inches of annual rainfall there given does not accord fully with other mappings, as would be expected because of deficiency of information especially in Africa and Asia. Our mapping differs from Van Royen's only in excluding from the dry zone a moist area (above 10 inches of rainfall) in highland regions of the southwestern Arabian Peninsula.

some 17 per cent of the world's land area and includes about 2.6 per cent of the world's population. Perhaps an approximately equal percentage of the world's foodcrop acreage lies within it. Certainly, however, a large fraction of this acreage is irrigated, as notably in Egypt, along the Indus River of Pakistan, the Syr Darya and Oxus rivers in the southern USSR, in the American southwest, along the coast of Peru, and in scattered oases throughout the Saharan-Arabian-Iranian and the Mongolian dry zones. Close estimation might indeed demonstrate that the unirrigated foodcrop acreage of the world's dry zone as mapped constitutes a good deal less than 1 per cent of world foodcrop acreage.

THE HIGHLAND PROVINCE

Most, though not all, other parts of the world aside from the cold and the dry non-foodcrop zones are characterized by average conditions of temperature and precipitation which permit cultivation of one or another, or various combinations, of the major food crops. The aggregate area of the world outside the cold and the dry zones constitutes only some 54 per cent of the earth's land area, but nearly 97 per cent of the world's population resides within it. Foodcrop acreage and foodcrop production within this part of the world presumably also approximates 97 per cent of the unknown world totals.

It has seemed appropriate as a third step in the process of mapping to indicate (stippled areas on Map 1) certain regions outside the cold and the dry zones where, on account of elevations changing radically over relatively short distances, it is impossible to show at all clearly in a world map so small in scale the various climates that exist within it. Typically these are areas where mountain ridges or other sharp uplifts make for substantial changes in temperature over a short mileage, and also for substantial differences in precipitation between windward and leeward slopes. We have chosen to demarcate these climatically heterogeneous parts of the world as those lying at elevations above 5,000 feet,⁸ in so far as also they exclude parts of the world lying within the cold and the dry non-foodcrop zones. In the main, food crops can be produced throughout the highland province so indicated, although especially in high latitudes the highlands contain some mountain peaks too cold for crop production and at many latitudes some intermontane valleys, lying in rain shadows, too dry for unirrigated crop production. Nevertheless wide areas within the highland province—the high plains of the western United States, the central valley of Mexico, the Bolivian altiplano, the Ethiopian plateau, and the Kenya highlands, for example—produce food crops abundantly. The principal useful purpose served by specific demarcation of the highland province may be to point out, at any given latitude, the zone of transition from a lowland foodcrop climate, usually rather homogeneous and of wide extent, to highland foodcrop climates usually at once different from the neighboring lowlands and diverse among themselves. The highland province is much less homogeneous with respect to climate, and hence with respect to food crops that thrive within it, than any of the areas of the world subsequently to be indicated as foodcrop climates.

⁸ See 7, *passim*, for the contour line of 5,000 feet.

THE EXCEPTIONAL SUMMER-DROUGHT CLIMATE

If the total land surface of the earth measures about 57 million square miles, the portion of it aside from the cold and dry zones (26.3 million square miles) and the highland province (2.7 million) covers approximately 28 million square miles. The great bulk of this vast territory is characterized by regimes of rainfall such that the seasonal distribution is either rather even throughout the year, or shows seasonal peaks near the equinoxes in equatorial regions that are always warm, or has its seasonal peak in summer. Consequently rainfall and warm temperatures favorable for unirrigated agriculture usually coincide. There is, however, a relatively small fraction of the world (about 1.35 million square miles) wherein the rain necessary for unirrigated crops comes in the cool season of the year whereas the warm season is strongly characterized by drought. Food crops of annual habit of growth must, if unirrigated, be sown in these summer-drought regions after the rains have begun in the autumn, making the soil workable and germination of seeds possible. The annual food crops must then largely be of types able to germinate and to continue growth in the increasingly cool weather of late autumn and winter, ripening as temperatures rise but rainfall declines in the spring and early summer. Among the world's important cereals, wheat and rye particularly, but barley and oats also, have the requisite properties if sown in the autumn. But all spring-sown crops, including these grains, and additionally corn, rice, and the millets and sorghums, because they lack the necessary properties, are practically excluded except under irrigation. The unirrigated crop complex of this summer-drought-and-winter-rain, or Mediterranean, climate differs a good deal from complexes in other climates. Elsewhere in the world where annual food crops can grow under natural rain, sowings will take place at onset simultaneously of the rainy season and of the warm season (at higher latitudes) or under conditions of continuing warmth (at low latitudes).

The fourth step in the mapping here undertaken was to attempt to show the location (cross-hatched areas in Map 1) of this exceptional summer-drought climate in so far as it does not impinge upon the cold zone, the dry zone, or the highland province previously mapped. The cross-hatched areas are somewhat wider in extent than the Mediterranean climates as usually mapped by geographers following Köppen's system of classification, whereby that climate must meet temperature conditions of the coldest month ranging from 26.6° to 64.4° F. and the warmest month above 50° F., and rainfall conditions such that the driest month of summer has less than 1.2 inches of rain and the wettest month of winter at least three times as much. Taking first Trewartha's mapping of the Mediterranean climate (9, pp. 26-27), our procedure was (a) to exclude such small portions of it as overlapped our demarcations of the dry zone having less than 10 inches of annual rainfall and of the highland province, and (b) to add to the residual area some adjacent territories equatorward of the Mediterranean type proper in Africa and Australia, and eastward in Asia, which appear to be characterized in general by a cycle of summer drought and winter rain and have an annual rainfall less than in Mediterranean climates proper but more than the 10 inches of the dry non-foodcrop zone. These regions are usually classified climatically as "steppe," mostly tropical or subtropical.

TEMPERATURE PROVINCES IN REGIONS OF WARM-SEASON RAINFALL

Climates favorable to food crops other than in the heterogeneous highlands and in the summer-drought climate all receive their precipitation in seasons of warmth conducive to growth of annual food crops. Their area, as was pointed out above, vastly exceeds that of the highland and summer-drought climates combined. Within this huge area differences in temperatures, especially in the seasons of active crop growth, are important determinants of foodcrop complexes (irrigation ignored): bananas will not mature in Wales even where rainfall is as heavy as in banana-growing parts of Uganda, and white potatoes will not mature in those parts of Nigeria where annual rainfall is the same as in Ireland.

It is therefore a problem first to partition the foodcrop climates (aside from the highland and summer-drought types) in a manner meaningful with respect to potential geographical distribution of either foodcrop complexes or important food crops, so far as temperature *per se* places approximate geographical limits upon their distribution. Discussion could be protracted in the matter of choice of specific temperature circumstances that would best serve to divide this foodcrop area into several "temperature provinces" of significance to foodcrop production.

Briefly, however, those circumstances may be described as follows. (1) The surface isotherm of 68° F. average temperature in the *warmest* month is taken as establishing approximately, between itself and the isoline of 90 frost-free days which constitutes the warm boundary of the cold non-foodcrop zone, a temperature province (cool temperate) wherein production of corn (maize) for grain is excluded by low summer temperature. (2) The surface isotherm of 77° F. average temperature of the *warmest three months* is taken as establishing approximately, between itself and the surface isotherm of 68° F. in the warmest month, a temperature province (mild temperate) wherein production of cotton is excluded by low summer temperature. (3) The surface isotherm of 50° F. in the *coldest* month is taken as establishing approximately, between itself and the surface isotherm of 77° F. in the warmest three months, a temperature province (warm temperate) wherein production of citrus fruits is excluded by low temperature. (4) The surface isotherm of 68° F. in the *coldest* month is taken as establishing approximately, between itself and the surface isotherm of 50° F. in the coldest month, a temperature province (subtropical) wherein production of archetypes of tropical crops such as bananas, cocoa, and coconut are excluded by reason of low temperature. (5) The fifth temperature province (tropical) wherein such tropical crops may thrive is bounded on its cooler peripheries by the isotherm of 68° F. in the coldest month.

It seems not greatly a violation of common usage to designate the resulting five temperature provinces of the foodcrop zone, excluding highlands and summer-drought regions, as indicated above and on the map—*cool temperate, mild temperate, warm temperate, subtropical, and tropical*.

The evidence conveniently available for location of the several isolines here used to separate the temperature provinces requires brief comment, since a compendium of world mappings of the surface isotherms necessary to the purpose, as distinguished from isotherms adjusted to sea level, has not been found. The line of demarcation (not a specific isoline) indicating the cold periphery of the

cool temperate province and the warm boundary of the cold non-foodcrop zone, was described above (p. 286). At the other extreme, the isotherm of 68° F. in the coldest month, which circumscribes and provides the cool boundary of the tropical province, follows Parkins' mapping (10, pp. 151-65, and 7, pp. 16-17), in his surface-temperature regions of the world, of the region called "always hot." Within the poleward extensions of this zone, however, we ignore the isotherm where it lies adjacent to designated highlands above 5,000 feet. The effect of this procedure is somewhat to obscure the existence of subtropical climates within the general poleward peripheries of the tropics; but their location and extent are perhaps sufficiently indicated by the mapped highlands themselves. The isotherm of 50° F. in the coldest month, the cool periphery of the subtropical province, also follows Parkins. That province and the tropical province are not permitted to overlap their neighbors, whether the non-foodcrop dry zone, the summer-drought province, or the highland province.

No single source was found showing satisfactorily the location throughout the world of the isotherm of 68° F. in the warmest month, which is taken as the low-temperature "limit" of corn and as separating the cool temperate province from the mild temperate province. Information had to be patched together from various sources, the more detailed being accorded preference (5, Pl. 33; 6, p. 38; 11, Map 8; 12; 13, pp. 70-71; 14). It can be said that the isotherm as drawn in Map 1 seems to confine quite sharply the world distribution of corn acreage so far as low temperature restricts it, although some acreage representing corn sown for fodder or for sweet corn rather than for grain is found where the summer temperature is slightly lower, in the cool temperate province.

With respect to the separation of the mild temperate and the warm temperate provinces, the basic concept is that the division may reasonably follow a surface-temperature isotherm representing an average temperature of 77° F. in the three warmest months of the year, a level of temperature below which cotton does not mature.⁴ This isotherm has been drawn for the United States (16, p. 10), but we have been unable to find its counterpart elsewhere in the world. For South America, however, readily available meteorological data indicate clearly that the isoline lies a little north of Montevideo and Buenos Aires on the east coast, between Rosario and Santa Fé farther inland and to the northwest, and east of Córdoba lying still farther inland and farther north but at higher altitude. In Australia, isolines of 75° and 80° F. for the individual hottest three months (December, January, and February) permit a rough approximation to the 77° F. summer isotherm (17, Figs. 1, 2, 12). For the Soviet Union and China-Korea we resort to the assumption that cotton cultivation presses as far as possible toward its temperature limit, so that the northern peripheries of the cotton acreage (see 8, pp. 189, 191, and 6, p. 44) indicate approximately the location of the isotherm, although for China isotherms of July temperatures of 75° and 82° F. afford a meteorological check (13, p. 71). While lacking adequate evidence, we take it that in India, southeast Asia, and South Africa all territory lying between the

⁴ The concepts of 68° F. in the warmest month or 66° F. in the three warmest months, as the approximate low-temperature "limit" of corn production, and of 77° F. in the three warmest months as the approximate low-temperature "limit" of cotton production, both commonly accepted by geographers, appear traceable to Finch and Baker (15, pp. 29, 53).

subtropical province and the highland province may be predominantly of warm temperate type, with temperatures in the three hottest months exceeding 77° F.

RAINFALL LEVELS WITHIN FOODCROP PROVINCES

Within any of the nine differentiated regions shown in Map 1, levels of rainfall taken either annually or seasonally differ from one part to another. From the point of view of foodcrop production, the differences in rainfall levels are of negligible significance within the cold non-foodcrop and the dry non-foodcrop zones, these being zones wherein production of food crops is in general impossible under usual conditions, and accordingly no attempt is made in Map 2 to differentiate levels of rainfall within these zones. For a different reason, namely a degree of variability of rainfall levels within short distances, such as to preclude presentation on a small-scale map, no attempt is made to differentiate rainfall levels within the highland province.

Within each of the six remaining temperature provinces, however, levels of rainfall require to be differentiated if indication is to be given of relative hospitality to production of food crops without irrigation. While the tropical province experiences, if properly mapped, monthly mean temperatures always above 68° F., rainfall levels within it vary from 10 to well above 80 inches annually; crop complexes of the low-rainfall parts cannot be expected to prevail in the high-rainfall parts, and conversely.

The final problem of mapping, then, is to indicate within each of the foodcrop provinces, though not in the highlands, differences in rainfall levels which would be expected to affect distributions and complexes of food crops. It appears impossible, however, to follow at all closely the procedures used in marking off non-foodcrop from foodcrop climates and differentiating between the temperature provinces of the foodcrop zone, as by mapping approximate "limits" beyond which unirrigated food crops or particular food crops such as corn, cotton, citrus fruits, or bananas cannot be produced. The rainfall "limits" of many individual food crops seem, as compared with temperature "limits," to be more elastic. Moreover, rainfall occurring in the warm season, outside of the summer-drought province, may well be more important than annual rainfall for production of many major food crops, and one lacks world mappings of isohyets pertaining to warm seasons. Somewhat rough-and-ready procedures seem inescapable.

The first principle followed in Map 2 is to differentiate, within each of six temperature provinces, three levels of rainfall respectively designated as droughty, moist, and rainy. It would be possible on the basis of available world mappings of annual rainfall to differentiate not three but six levels of annual rainfall: 10-20, 20-30, 30-40, 40-60, 60-80, and over 80 inches (see 8, p. 4). Experimental mapping has shown, however, that indication of more than three levels results in a world map—on the small scale feasible here—so complex as to be nearly unreadable. It has seemed advisable, therefore, to attempt within each of the six temperature provinces to make no more than a threefold differentiation, between rainfall levels that result at one extreme in high hazards to foodcrop production because of drought, at the other extreme in hazards of heavy rainfall and flood, with the less hazardous moist portions between them.

A second principle requires, however, that no single range of annual rainfall

be regarded as characterizing a condition of drought hazard throughout all provinces defined by temperature. On account of differential temperatures and evaporation, 10–20 inches of rain coming mainly in summer is much less hazardous in the cool temperate province than in the tropical province. Allowance is made in a rough way by designating as “droughty” the areas with 10–20 inches of annual rainfall lying in the cool temperate, mild temperate, and summer-drought provinces, the last being included because within it the rainfall useful to food crops occurs in the cool season of the year; but in the warm temperate and subtropical provinces we take 10–30 inches as characterizing the droughty areas, and in the tropical province 10–40 inches. The zone of 10–20 inches of rainfall in the mild temperate province, of 10–30 inches in the warm temperate and subtropical provinces, and of 10–40 inches in the tropical province is in general likely to be too dry for unirrigated corn and indeed for a considerable range of unirrigated food crops.

Similarly, no single range of annual rainfall can properly be regarded as characterizing “rainy” or “moist” areas throughout all five of the temperature provinces and the summer-drought province. In the cool temperate, mild temperate, and summer-drought provinces, the rainy extremes are perhaps sufficiently well indicated by regarding annual levels of above 40 inches of rainfall as representing rainy conditions, where excessive moisture creates handicaps for some important food crops. The rainy extreme may be taken as above 60 inches in the warm temperate and subtropical provinces; and above 80 inches in the tropical province. Hence the “moist” areas, relatively little handicapped for foodcrop production, are represented by ranges of annual rainfall of 20–40 inches in the cool temperate, mild temperate, and summer-drought provinces; 30–60 inches in the warm temperate and subtropical provinces; and 40–80 inches in the tropical province.

In Map 2, the six provinces that are subdivided according to rainfall level are denoted in color, and within each province the droughty portions are indicated by underlying black stipple, the moist portions by absence of stipple or hatch, and the rainy portions by cross-hatch. As a whole the map thus shows two non-foodcrop climates, one province, the highland, generally suited to food crops but undifferentiated with respect to temperature and rainfall, three foodcrop climates of the summer-drought province not strictly differentiated as to temperature (though with winters, therein the growing season of food crops, that are mild or cool), and fifteen foodcrop climates differing one from the other with respect to their combination of temperature and annual rainfall.

RELATIVE AREAS OF THE CLIMATES

Readily apparent from Map 2 are the relatively large fractions of the earth's land surface occupied by the cold non-foodcrop zone and the dry non-foodcrop zone. On measurement by planimeter, which yields somewhat imprecise results, the cold zone occupied about 16.4 million square miles and the dry zone about 9.9 million. Taking the earth's land surface, including minor inland and coastal waters, as about 57 million square miles, these two non-foodcrop zones occupy respectively some 29 and 17 per cent of the total.

The highland province and the 18 foodcrop climates, constituting about 54

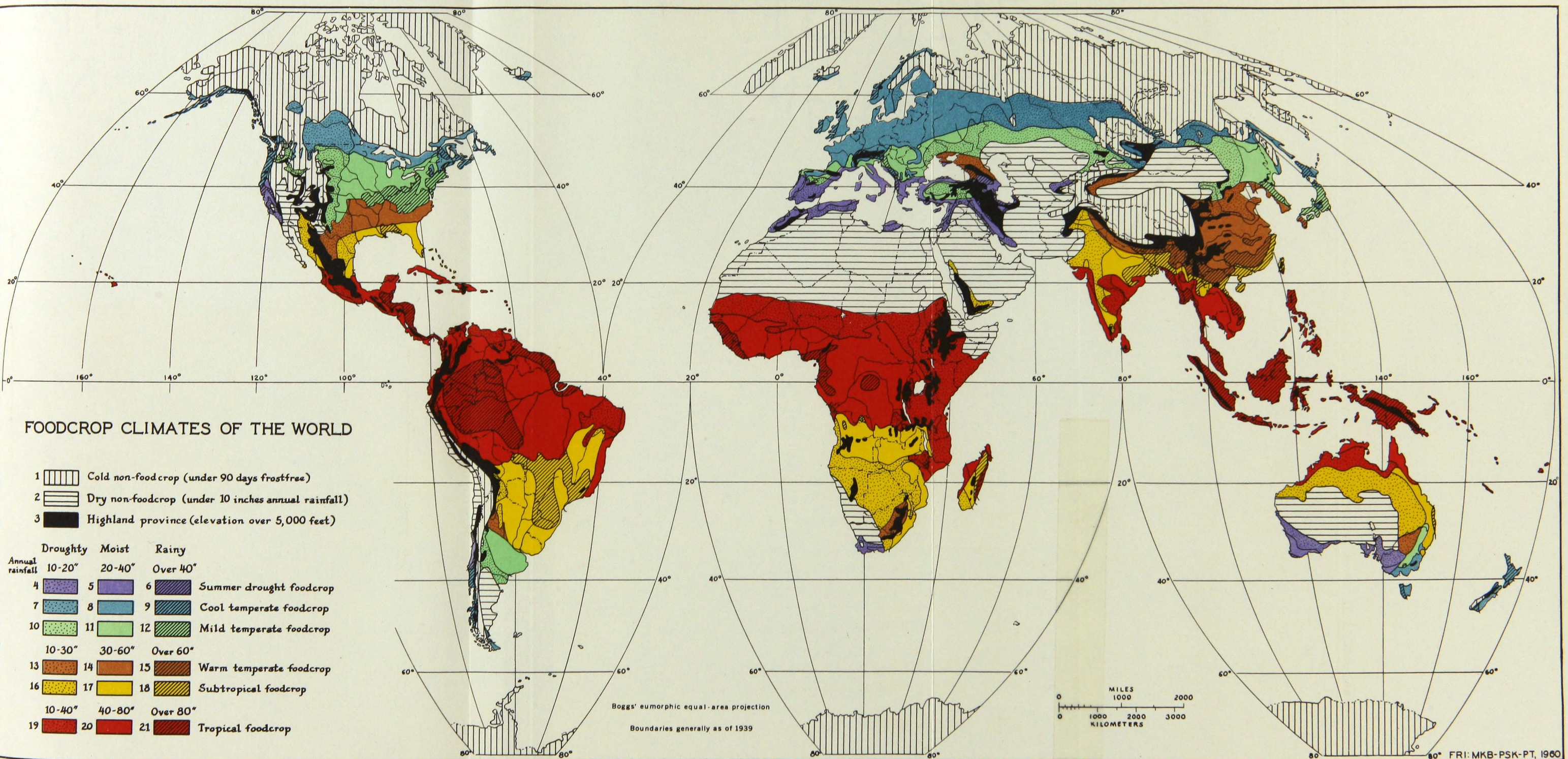
per cent of the land surface and measuring some 30.7 million square miles, are notably unequal in extent, as the following tabulation shows:

Zone or climate	Inches of rain	Million square miles
Cold non-foodcrop zone	—	16.4
Dry non-foodcrop zone	—	9.9
Highland province	—	2.7
Summer-drought		1.4
Droughty	10-20	.65
Moist	20-40	.60
Rainy	over 40	.10
Cool temperate		4.2
Droughty	10-20	1.49
Moist	20-40	2.14
Rainy	over 40	.56
Mild temperate		3.5
Droughty	10-20	1.50
Moist	20-40	1.53
Rainy	over 40	.46
Warm temperate		2.1
Droughty	10-30	.71
Moist	30-60	.99
Rainy	over 60	.44
Subtropical		5.7
Droughty	10-30	2.19
Moist	30-60	2.46
Rainy	over 60	1.02
Tropical		11.1
Droughty	10-40	3.15
Moist	40-80	5.34
Rainy	over 80	2.64

Most extensive in area is the moist tropical climate with some 5.34 million square miles, more than a sixth of the earth's surface climatically favorable to foodcrop production; the smallest is the rainy summer-drought climate of only .10 million square miles. The tropical and subtropical foodcrop climates, at 16.8 million square miles, exceed the temperate ones (here including highland and summer-drought) by more than 20 per cent.

On the whole, so far as can be judged impressionistically by reference to world maps of the distribution of population and of major food crops, notably the basic starch crops, the highland province, the summer-drought climates, and the nine temperate climates are at the present time relatively more fully settled and agriculturally exploited throughout their extent than are the six subtropical and tropical climates. Within each of these six climates, however, there are obviously sharp contrasts from one part to another in the degree of settlement and agricultural exploitation. Vast stretches of the droughty subtropical climate in Australia and Africa, for example, remain almost unexploited, while the same climate in India is heavily populated and cultivated. The moist tropical regions, while by no means comparable with summer-drought or mild temperate regions in density of population, are much more densely settled in continental Asia than in Africa, and in Africa than in South America. In the rainy tropical climate, there is high density

MAP 2



FOODCROP CLIMATES OF THE WORLD

- 1 [vertical lines] Cold non-foodcrop (under 90 days frostfree)
- 2 [horizontal lines] Dry non-foodcrop (under 10 inches annual rainfall)
- 3 [solid black] Highland province (elevation over 5,000 feet)

Annual rainfall	Droughty			Moist			Rainy			
	10-20"	20-40"	Over 40"	10-20"	20-40"	Over 40"	10-20"	20-40"	Over 40"	
4	[stippled]	5 [dotted]	6 [diagonal lines]	7 [horizontal lines]	8 [vertical lines]	9 [diagonal lines]	10 [stippled]	11 [dotted]	12 [diagonal lines]	Summer drought foodcrop
7	[stippled]	8 [dotted]	9 [diagonal lines]	10 [stippled]	11 [dotted]	12 [diagonal lines]	13 [stippled]	14 [dotted]	15 [diagonal lines]	Cool temperate foodcrop
10	[stippled]	11 [dotted]	12 [diagonal lines]	13 [stippled]	14 [dotted]	15 [diagonal lines]	16 [stippled]	17 [dotted]	18 [diagonal lines]	Mild temperate foodcrop
13	[stippled]	14 [dotted]	15 [diagonal lines]	16 [stippled]	17 [dotted]	18 [diagonal lines]	19 [stippled]	20 [dotted]	21 [diagonal lines]	Warm temperate foodcrop
16	[stippled]	17 [dotted]	18 [diagonal lines]	19 [stippled]	20 [dotted]	21 [diagonal lines]				Subtropical foodcrop
19	[stippled]	20 [dotted]	21 [diagonal lines]							Tropical foodcrop

Boggs' eumorphic equal-area projection
 Boundaries generally as of 1939

MILES
 0 1000 2000
 KILOMETERS
 0 1000 2000 3000

of population in the Philippines and Java, very low in interior Brazil and New Guinea. Such notable contrasts invite inquiry into their causes, and into the food-crop potential of the vast regions now barely settled yet apparently as well suited climatically to foodcrop production as other regions that support dense populations.

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