Historical Perspective On Climate Change

By Jim Hollingsworth

An analysis of the book Climate and Man; 1941 Yearbook of Agriculture published by the U. S. Department of Agriculture. (1248 pages, with Index).

INTRODUCTION

1941 was a great year, among the warmest in the twentieth century. In fact the temperature fell from about 1941 to about 1975. The perspective of this book is important because the authors were not running around trying to convince people that the earth is in grave danger because of a rising level of carbon dioxide, but these experts in their fields were working on solutions that would allow plants to live where they would not naturally grow. This book of 1941 needs to be compared with any pseudo-scientific articles written today. Today we have a totally different perspective. Rather than trying to help the poor of the world with clean water and good crops we are trying to get them to use less energy, a cultural deathtrap. To truly understand what is happening with climate today we need a historical perspective, and the 1941 Yearbook gives us some of that perspective.

The book is refreshing in that it is just matter of fact, taking life as it comes. It has many articles by many professionals, but the main value of the book is the development of life in the year 1941. Floods, hurricanes, tornadoes, fires etc. All these are taken as a matter of fact and dealt with without a lot of hype. The perspective is that these things have always occurred and will continue to occur without any serious consequences if proper precautions are taken. The main theme throughout the book is not how can we change the world as it is, but simply how can we make the most of our present situation.

CLIMATE AND MAN—A SUMMARY

By: Gove Hambidge (Principal Research Writer, Office of Information, Department of Agriculture.)

Certain kinds of data about climate have been carefully collected for decades—figures on rainfall, for instance; but when the conservationist or the crop specialist tries to connect these figures with the behavior of plants, he finds that they do not work. A plant will thrive in one region with a certain amount of rainfall and fail miserably in another with the same amount. Rainfall does not tell the [whole] story. Further investigation shows why. It is not the amount of rainfall, that counts, but many things besides the amount of rainfall. It depends on the nature of the soil, the amount of wind, the sunshine and cloudiness, the humidity of the air, the temperature—above all, the rate of evaporation and transpiration, which are affected by these other factors. But there are no figures on evaporation and transpiration from the soil and growing plants, and until recently there has not even been any practicable way of making the measurements necessary to get the data. (pp. 4,5)

Notice there is nothing said about carbon dioxide, or anthropogenic (man-caused) global warming. In fact, I doubt in 1941 they had often heard the term.

The author says that "The history of the earth can be traced back some billion and a half years by geologists." He says further "Suppose we imagine this vast period as a single year of time.…During practically the whole of that year, according to geologic evidence, the climate of the earth was much more genial and uniform than it is today." (p. 7) He goes on to point out that the earth had warm periods, and cold periods (ice ages).

He then relates climate to time and history:

Human beings, then, have seen only the more violent moods of the earth. They were not here during the immense stretches of time when it was comparatively quit and peaceful. (Ibid)

He then talks about the nature of the polar ice caps.

The key to the climatic difference between normal and revolutionary times, Russell (Richard Joel Russell, see pp 67-95) holds, is the existence of the polar ice cap. During all times, normal or revolutionary, *climate obeys the same physical laws*, set by the nature of the earth as a rotating ball with inclined axis moving round the sun and surrounded by an atmosphere. But the difference between polar ice and no polar ice is very great over the whole earth. Yet the balance between the two conditions is delicate. "A rise of 2^{0} F. in the temperature of the earth now would be sufficient to clear polar seas of all ice." *We would then be living in a "normal" climate*. (p. 8) (Emphasis added)

Hambidge quotes Russell further:

Russell finds no adequate evidence of recurring climatic cycles; there is no proof that short-time climatic changes, at least, are anything more than matters of chance. Of the many theories that have been advanced to account for long-time changes, especially the occurrence of glacial epochs, he discusses several briefly—changes in the angle of the ecliptic (the inclination of the earth’s axis), precession of the equinoxes (a cycle occurring every 26,000 years), variations in the suns’ radiant energy as indicated by sunspots, changes in the atmosphere that might affect the amount of radiant energy reaching the earth, changes in the amount of carbon dioxide in the atmosphere, volcanic dust. In most cases, he concludes, the cause suggested is not adequate to produce the effect, or there are other serious objections to the theory. (p. 9)

The author has some interesting comments about climate and the affect on the human body.

So far as health is concerned, the monotony of the tropical climate is more harmful than the heat and humidity. Where climatic variations are slight from day to day and season to season, the body loses its ability to adapt itself to changes and thus becomes more sensitive to whatever changes do occur. Hence the danger, for example, of “chills” in the Tropics; bodily resistance to cold has been lost. Moreover, if there is enough variation in the climate, it is possible to withstand extreme conditions for a while, even though they might be dangerous if long-continued. (p. 25)

Here is another interesting health note.

Those who have high energy production because of an overactive thyroid are likely to become neurasthenic [lassitude, irritable] in the Tropics. There is less oxygen per cubic foot in hot than in cold air, and this may reduce the effectiveness of all bodily functions unless the body becomes adjusted to it. (p. 26)

CLIMATE CHANGE THROUGH THE AGES

By: Richard Joel Russell (Professor of Physical Geography, Louisiana State University, Collaborator, Soil Conservation Service)

Russell first talks about what is a normal climate as far as geologic history is concerned.

Normal geologic periods were times of quiet between [geologic] revolutions during which normal climates prevailed. Rocks deposited at such times indicate a minimum of relief—uneveness in height—and few signs of crustal unrest. The paleontologic record is one of widespread ranges in both plant and animal distribution. The early Cenozoic was such a time. Plants closely allied to some of our warm-climate types were flourishing in places such as Greenland, Spitzbergen, and other lands in the high latitudes where their growth is impossible today. Even more strikingly uniform were the temperatures in all latitudes during most of the Paleozoic and Mesozoic eras. (p. 75)

The Author quotes C.E.P. Brooks concerning the growth of the ice caps.

Brooks [Brooks, C.E.P., 1926 Climate Through the Ages; A study of the Climatic Factors and Their Variations] has shown that a surprisingly small variation in temperature causes a change from open to ice-capped polar seas. As long as winter temperatures remain above 28° F., the approximate freezing point of ocean water, the polar seas remain open. At slightly lower temperatures, the ice frozen during the winter melts again in the following summer, and the seas remain effectively open. But if the winter temperature falls about 5° F. lower than the freezing point of the ocean water, an ice cap will form. Its growth will be slow at first but summer melting will not quite offset the effect of winter freezing. After its radius has reached about 600 miles, the growth of the ice cap becomes rapid because the ice itself has a cooling effect on surrounding areas and the rate of summer melting is thus reduced. Growth continues until the ice extends so far from the polar areas that its margins encounter temperatures sufficiently high to stop further extension. Glacial climates have their optimum development at such times. Rising temperatures cause retreat of the ice and the modification of climate patterns. The cooling effect of the ice cap is so great that retreat is slow until the ice has diminished in area to its critical point—a radius of about 600 miles—after which the ice disappears very rapidly. [This is primarily because snow/ice is white and reflects, rather than absorbs solar energy.] For a complete explanation of the theory behind these conclusions the reader is again referred to Brooks Climate Through the Ages.

Polar ice now lowers the temperatures in Canada and the United States many degrees. It profoundly affects ocean temperatures, especially at great depths. There is a sort of vicious circle in ice-cap and temperature relationships.

Brooks calculates that lowering of polar temperatures 5° F. under the freezing point ultimately results in a drop of 50° F. in polar winter temperatures. The initial drop causes the growth of the polar ice cap; the cooling effect of the ice itself is responsible for the remainder of the drop. A rise of 2° F. in the temperature of the earth now would be sufficient to clear polar seas of all ice. We are thus in a world where the balance is extremely delicate between normal and glacial climates. (p. 76)

Here is some historical perspective.

The oceans of normal times were much warmer than those of today. In the absence of polar ice, from which cold water, heavy because of it temperature, now creeps to abysmal depths and accumulates, it is probable that bottom temperatures were considerably higher.

The distribution of both plant and animal fossils bears out these generalizations. (p. 77)

The author mentions that toward the end of the Paleozoic glacial deposits occur in tropical India. (p. 80) He goes on to note that we are still in an ice age.

That we have not fully emerged from an ice age is evident from the fact that complete melting of the Greenland and Antarctic ice caps would result in raising sea level another 100 to 160 feet. (p. 81)

So what about atolls?

Many atolls occur in places where surrounding oceans are deep, showing that they are perched upon islands of quite another origin, because corals live only in shallow water and could not have established themselves on the ocean floor. Similar reefs form rings around existing islands. It is generally believed that atolls were originally fringing reefs and that either the subsidence of islands or a rise in sea level accounts for their present condition. Against the first of these suggestions is the fact of widespread distribution. It seems improbable that islands in all parts of tropical oceans would sink together. More probably the seas have risen. From this consideration came the recognition of the fact that each major glacial advance caused a lowering of general sea levels and each major glacial retreat caused a subsequent rise. (p. 82)

As further evidence of glaciations he mentions the area between the Wasatch Range of Utah and the Sierra Nevada of California and the enclosed basins found there.

Lakes exist in some of these basins today—among them Great Salt Lake, Winnemucca, Pyramid, Walker, Tahoe, and others. Most of these lakes are low today, [1941] and many of them are dry-floored, being known as playas; conspicuous examples are Carson Sink, Black Rock Desert Playa, and the Surprise Valley lakes. Similar lakes exist in the dry regions of all other parts of the world. They have been called “Nature’s rain gages,” because heavier precipitation deepens their waters and diminished precipitation lowers them or even dries them up completely. (ibid)

In 1984 Salt Lake was rising and consideration was given to a number of alternatives, among them pumping some of the water elsewhere. Ultimately it was not found necessary. https://water.utah.gov/GSL/GSLflood.htm

While we make a big thing about how the climate has changed and the temperature has risen we need to keep in mind that we have only had good instruments to measure weather for about 150 years.

Instrumental climatology, the precise, modern science based upon actual measured observations, dates only from the middle of the nineteenth century. The thermometer and barometer were invented two centuries earlier, but systematic observations were not taken. The earliest rainfall record, in the modern sense, started at Padua, northern Italy, in 1725. Suns pots have been recorded since 1749. At the beginning of the nineteenth century there were only 5 places in the United States and 12 in Europe where worth-while observations were being taken. The Challenger Expedition, 1872-76, brought back the first significant observations taken at sea. Even today [1941] the climatologist finds data too meager for satisfactory conclusions in nearly all parts of the world. (p. 84)

Of course today we have more land based weather stations, weather balloons, and satellites, (1969) but many weather stations have been moved from one location to another, usually from a grassy field to an airport, so the record is not consistent. Moving to an airport means setting on concrete which usually reflects a higher temperature, especially at night. This makes it look like the climate is increasing in temperature, when actually it is not, or not at the same rate.

By the end of the bronze age, about 1,000 B.C. the climate had changed.

European climates were warm enough at that time to permit the growing of crops high in the mountains, in places now glaciated. A new period of flooding, starting about 850 B.C., drove the people to drier and warmer localities. Similar histories have been traced for dwellers around lakes in northern Africa and the enclosed lakes of western and central Asia. (p. 87)

So what did the climate look like in the not so distant past?

From the climatic standpoint, warm and moist conditions lasted from about 5,000 to 3,000 B.C., and the time is called the Atlantic period. Temperatures were high enough so that all small mountain glaciers of the Alps and the present United States disappeared completely. (p. 89)

The author points out that climatic conditions at that time were not the same the world over, but varied from place to place. Some places were quite wet for a couple thousand years then had severe drought conditions. Our recent droughts in parts of the Southwest, then, are not unusual in terms of the geologic/climatologic record. Some places widely separated were quite wet, then they turned dry.

About 400 B.C. a precipitation maximum is indicated in North America, Africa, western Asia, and Europe. All of these places record very dry conditions about A.D. 700. There is thus considerable evidence in favor of world-wide climate swings. On the other hand, the records indicate some notable exceptions, particularly between European and Chinese precipitation. (p. 90)

He goes on to say more on the subject.

Advocates of climatic stability who use first-century *vs*.twentieth-century comparisons have no stronger case than would a person who might visit Duluth each January and advocate a theory that average annual temperatures there are below freezing. (ibid)

From about A.D. 180 to 350 Europe experienced a wet period. The fifth century was dry in Europe and western Asia and apparently also in North America. Many of the lakes in the western United States appear to have dried out completely. Europe was both warm and dry in the seventh century. Glaciers retreated to such an extent that a heavy traffic used Alpine passes now closed by ice. Tree rings in the western United States indicate minimum precipitation at this time. Nile floods were low until about A.D. 1000. (ibid)

If anything can be said about climate the only thing that seems to be constant is that climate is always changing. Here in Idaho we say if you don't like the weather just wait and it will change. We are on the edge of competing air currents which means we can have very arctic air, or tropical.

The beginning of the ninth century brought heavier precipitation to Europe. The levels of lakes rose, and people living around their borders were pushed upslope. Documental evidence from south-western Asia and American tree rings give similar testimony. Warm, dry conditions returned during the tenth and eleventh centuries. This was a time of great exploratory activity among northwestern Europeans. The Arctic ice cap may have disappeared entirely. In any event the logs of Greenland voyagers show routes of travel where they would now be impossible because of ice floes. Greenland was settled in 984 and abandoned about 1410. During the eleventh and twelfth centuries it was in rather close touch with Iceland and Europe, even to the point of having its own bishop. The decline of the colony was due to unsatisfactory conditions both in Greenland and in northwestern Europe. The first half of the thirteenth century was a period of great storminess, as shown by documents describing conditions on the North Sea. The early fourteenth century was unusually cold and snowy in Iceland and Denmark. America, too, experienced cold and wet weather during this general period. The Aztecs settled Mexico in 1325, when lakes stood at levels higher than today's levels. Drought and lower levels followed, but in 1550 lakes again reached high stages.

The early seventeenth century in Europe was particularly wet. Alpine glaciers extended far down valleys, and northern Italy suffered from disastrous floods. Glaciers retreated between 1640 and 1770 and then advanced until the middle of the nineteenth century. Since then they have retreated back to sixteenth-century positions. This appears to be a world-wide condition and suggests that the last century has had higher summer temperatures than the eighteenth century just preceding. (pp. 90, 91)

The author notes the difficulty of developing climate trends when we have only had good instrumentation for a few short years.

Though firm advocates of climate cycles will sharply disagree, such facts as we possess today neither definitely demonstrate nor disprove the existence of any real cycle. Such climate variability as has been observed may be explained as resulting wholly from random fluctuations. (p. 92)

(I wonder what he would say if he were writing today. Could he see the variations that we seem to see on a world-wide scale as simply "random fluctuations"?)

The author develops some theories based on the tilt of the axis of the Earth toward the ecliptic, the plane on which it revolves around the sun. The angle of the Earth in relation to the plane of the ecliptic was 23°27'3" in 1941. It is estimated that it will reach a minimum of 22°30' in 9,600 years. (Present angle 2017, 23°26'13.3", and it varies from 22.1 to 24.5 in a 41,000 year cycle.) This inclination of the axis of the Earth is the principal cause of our seasons. (If the Earth were at an angle of 90° to the plane of revolution, night and day would be the same all over the Earth, and there would be no seasons.) It is estimated by some scientists that this change in the angle of the axis is enough to cause changes in climate, though others feel it is not enough difference to matter. (One could stop here and consider that our native Earth has considerable Intelligent Design.)

There is another factor, a cycle that happens every 26,000 years. That is the fact that the orbit of the Earth is not completely round, so at some points at various times of the year the Earth is either closer or farther from the Sun.

Another factor that could affect climate is sunspots, variations in the radiant energy from the sun, but in 1941 they did not know much about the relationship between the two. Today (2017) there is a much stronger case for variations in solar energy affecting changes in climate.

Another thing that may affect climate is the atmosphere and the relation to the Sun's energy reaching the Earth.

The ability of the sun's radiant energy to travel from the outer limits of the atmosphere to the earth's surface may change with changes in the atmosphere itself; on a clear day the coefficient is higher than on a day with a heavy cloud layer. Such variations might produce results similar to those caused by variations in the emission of radiant energy by the sun itself. (p. 93)

The author goes on to suggest why this might be a factor in a changing climate.

If the atmosphere had a perpetual cloud layer, a great deal of solar radiation would be reflected back to space, and consequently the amount of energy available to the earth's surface in the form of heat would be diminished. A cloud blanket, however, would also cut off a good deal of terrestrial radiation, tending to conserve such heat as might exist beneath it. Temperature ranges between day and night, one season and another, and higher and lower latitudes would be reduced. (p. 94)

So, which is more important, the reflection of the energy from the Sun that comes to the Earth, or the insulating quality of the cloud cover? The difficulty, of course, is that the Earth is never totally covered by clouds, and so it would be very difficult to estimate the relationship between the two. Mountain ranges, especially, affect the amount of Earth that is covered with clouds.

The author also talks about carbon dioxide.

Much has been written about varying amounts of carbon dioxide in the atmosphere as a possible cause of glacial periods. The theory received a fatal blow when it was realized that carbon dioxide is very selective as to the wave lengths of radiant energy it will absorb, filtering out only such waves as even very minute quantities of water vapor dispose of anyway. No probable increase in atmospheric carbon dioxide could materially affect either the amount of insolation reaching the surface or the amount of terrestrial radiation lost to space. (ibid)

But what about volcanoes? More dust in the air will affect the solar energy.

Large amounts of volanic (sic) dust in the atmosphere have also been considered as a possible cause of glacial climates. Lowered temperatures have followed great dust-producing volcanic explosions during the period of instrumental observation. Volcanoes have been particularly active during times of glacial climate. It seems most reasonable, however, to relate both the volcanic activity and the climate to crustal unrest [earthquakes and continental drift] and to regard the former more in the light of modifying influence than as the underlying cause of the latter. (ibid)

Volcanoes spew out large quantities of carbon dioxide and acid, which could also affect cloud formation as well as affect weather in other ways.

What about energy from the interior of the Earth itself?

There is a slow radiation into the atmosphere of heat that slowly escapes from the earth's interior. It has been suggested that variations in the rate of escape could produce changes in climates. The rate of escape, however, is too slow to have an appreciable effect upon such things as daily or seasonal temperature ranges today. These are controlled by solar rather than by terrestrial energy. (ibid)

When I worked in a mine, a mile underground, it was very hot and no one could work there without ventilation. But, from where did that heat come? Obviously it comes from the center of the Earth from cooling, or from nuclear reactions.

The conclusions of the author leave one with the feeling that it would be very difficult to predict what the climate will do in the future.

Man has observed that climate conditions fluctuate rather widely from time to time at a given place, and in seeking to understand such natural phenomena he has been tempted to explain such fluctuations on the basis of recurring cycles. As yet, [1941] however, no definite proof has been advanced to contradict the opinion that all such relatively short-term climate changes are nothing more than matters of chance. The world pattern of climates today is the product of climatic variations, not the expression of recurring mean, or normal, conditions. The extent of desert climate will not be the same next year as this. The humid margin of the desert is the product of an ever-changing distribution of extreme aridity. The time may come when such changes will be well enough understood to be of definite forecast and economic value, but it is likely that such information will be the fruit of long-continued and patient research. (p.95)

CLIMATE AND SETTLEMENT IN THE GREAT PLAINS

By: C. Warren Thornthwaite ,Chief, Climate and Physiographic Division; Office of Research, Soil and Conservation Service.

The author talks about changes in climate for the Great Plains.

The year 1905 was one of the rainiest in the history of the Great Plains, and semiarid climate disappeared from the region altogether, except in a small island in southeastern Colorado. Moist-subhumid climate, normal to Iowa and western Illinois, occupied most of Montana and extended in two great lobes westward across Nebraska and Oklahoma. Humid climate, characteristic of Ohio, pushed into the Plains in two places. (p. 183)

In1905 it was very wet in most of the Great Plains. Now note what happens in just a few years.

The years 1910 and 1934 were 2 of the driest on record. In 1910 desert climate covered most of the southern Plains; there were a few islands of desert climate in the northern Plains, and semiarid climate was displaced by arid eastward as far as Wisconsin. In 1934 nearly half of the area of the Great Plains experienced desert climate. (ibid)

So what about droughts?

In 1931 a disastrous drought was experienced in the northern and central Great Plans, with desert climate prevailing in most of eastern Montana and in parts of eastern Colorado and western Kansas. Thereafter, in every year until the end of the decade, some part of the Plains was affected by serious drought; and in 1934 and 1936 the region from end to end was scourged with drought. (ibid)

Droughts and heat waves seem to go together.

The **1936 North American heat wave** was the most severe heat wave in the modern history of North America. It took place in the middle of the Great Depression and Dust Bowl of the 1930s, and caused catastrophic human suffering and an enormous economic toll. The death toll exceeded 5,000, and huge numbers of crops were destroyed by the heat and lack of moisture. Many state and city record high temperatures set during the 1936 heat wave stood until the Summer 2012 North American heat wave.[1][2] The 1936 heat wave followed one of the coldest winters on record. (https://en.wikipedia.org/wiki/1936_North_American_heat_wave)

Thornthwaite went on to mention the affect these droughts had on the population.

The depression, coming simultaneously with the onset of the drought, carried prices of agricultural products down to the lowest levels on record. The Great Plains farmers, burdened with expensive power machinery and land that had been overcapitalized, were bankruped almost immediately, and Federal relief in many forms poured into the region. Despite the fact that the administration of relief tended to discourage movement of population, there was a tremendous emigration from the Plains region between 1930 and 1940.

In many respects the period from 1920 to 1940 resembled the earlier period between 1880 and 1900. In both a series of rainy years was followed by a disastrous drought. Both wet periods occurred when there was great pressure for more farm land and encouraged rapid immigration that led to extension of the cultivated area and to overgrazing. Each drought period set in motion an emigration that grew into a rout. In both cases the series of rainy years had been mistaken for normal climate, with disastrous results. (pp, 185, 186)

THE COLONIATION OF NORTHERN LANDS

By: Vilhjalmur Stefansson (Anthropologist)

Not everyone has the same view of water.

It is fundamental in southern thinking that water is useful and desirable as a liquid, but that it is undesirable, hostile, and even deadly when a solid. In the [extreme] north, the attitude is the reverse. There water is considered to be most friendly and useful when it is cold and hard. In the south, people think of water in its relation to travel as something in which you swim, or on which you move by oar, sail, or steam power. With southerners it is a miracle to walk on water. To northerners the most commonplace use of water is to walk on it; thereafter they think of it as a highway, or highway material, for sledges, tractors, skis, snowshoes, skates, and airplanes. (p.208)

It is a question of daylight.

Another common failure to grasp northern principles is to suppose that in the north, summer frosts destructive to wheat necessarily increase. The contrary is true. At Lacombe, near the southern boundary of Canada, during 15 years the average frost-free period was only 69 days; but at Beaverlodge, 200 miles farther north, it was 80 days, and at Fort Vermilion, 230 miles farther north than Beaverlodge, it was 88 days. This increasing length of the frost-free period has, of course, nothing to do with Japan Current, Chinook wind, or any other fanciful explanation; it is due to the simple and constantly observed fact that in the wheat country which runs north through the center of the continent, much of it originally prairie, July frost results from a gradual accumulation of chill during a long absence of the sun, the actual deadly nip usually coming just before or just after sunrise. Northward from Ladcombe to Fort Vermilion the summer nights get shorter rapidly, which accounts for the northward increase in length of the frost-free period; north of Vermilion the darkness does not last long enough in midsummer to produce a sufficiently low temperature for a destructive frost. (pp. 213, 214)

CLIMATE AND FUTURE SETTLEMENT

Jan O.M. Broek (Associate Professor of Geography, University of California)

Has the arctic been open to travel at times? Just one example.

In this respect the recent policy of the Union of Soviet Socialist Republics [Russia] is of great interest. The main goal is to create a safe navigation route through the arctic waters, practically a private corridor of some 6,000 miles, linking the western and eastern extremities of the country. In the last few years a score of ships have each season (July until October) made the through passage. (p. 234)

COMFORT AND DISEASE IN RELATION TO CLIMATE

Joseph Hirsh (Assistant Health Education Specialist)

There is more illness in cold seasons than in warm seasons.

Many (if not most) diseases, such as the common cold, pneumonia, infantile paralysis, [polio] and others, exhibit a seasonal pattern. During some months of the year the number of cases is relatively small while in other months the number is large. The greatest number of cases of the common cold, for example, occur during the winter months of January, February, and March, and the least during July and August. Conversely, cases of infantile paralysis reach a maximum during late summer and are generally absent during the winter.

Altitude is not precisely a variable of climate. However, a number of climatic factors are associated with it—increased sunlight and wind and lower temperature, humidity, and air pressure. Certain well-recognized physiological effects are related to altitude, both in mountainous regions and in airplane flights. For example, high altitude increases the number of red blood cells, accelerates respiration, and increases the metabolic rate. In connection with other factors previously noted, moderately high altitudes are conducive to good health generally and in suspected and active cases of tuberculosis specifically, unless otherwise indicated in individual cases. On the other hand, a rapid change to a high altitude is exceedingly bad for people with some diseases of the heart and blood vessels. (p. 243)

EFFECTS OF CLIMATIC FACTORS ON GROWING PLANTS

A.C. Hildbeth (Principal Physiologist, Cheyenne Horticultural Field Station, Bureau of Plant Industry), J.R. Magness (Principal Pomologist [one who studies the growing of fruits] Bureau of Plant Industry), and John W. Mitchell (Associate Physiologist, Bureau of Plant Industry)

The mineral elements from the soil that are usable by the plant must be dissolved in the soil solution before they can be taken into the root. They are carried to all parts of the growing plant and are built into essential plant materials while in a dissolved state. The carbon dioxide from the air may enter the leaf as a gas, but is dissolved in water in the leaf before it is combined with a part of the water to form simple sugars—the base material from which the plant body is mainly built. Actively growing plant parts are generally 75 to 90 percent water. Structural parts of plants, such as woody stems no longer actively growing, may have much less water than growing tissues.

The actual amount of water in the plant at any one time, however, is only an infinitesimal part of what passes through it during its development. The process of photosynthesis, by which carbon dioxide and water are combined—in the presence of chlorophyll and with energy derived from light—to form sugars, require that carbon dioxide from the air enter the plant. This occurs mainly in the leaves. The leaf surface is not solid but contains great numbers of stomata, or pores, through which the carbon dioxide enters. The same structure that permits the one gas to enter the leaf, however permits another gas—water vapor—to be lost from it. Since carbon dioxide is present in the air only in trace quantities (3 to 4 parts in 10,000 parts of air [1941]) (400 parts per million, .04%) and water vapor is near saturation in the air spaces within the leaf (at 80° F.saturated air would contain about 186 parts of water vapor in 10,000 parts of air), the total amount of water vapor lost is many times the carbon dioxide intake. Actually, because of wind and other factors, the loss of water in proportion to carbon dioxide intake may be even greater than the relative concentrations of the two gases. Also, not all of the carbon dioxide that enters the leaf is synthesized into carbohydrates. (p. 300)

The authors do not mention the part that oxygen plays in these chemical reactions. Here are the basics:

Photosynthesis can be represented using a chemical equation.

The overall balanced equation is…

$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$

Sunlight energy

Where: CO_2 = carbon dioxide

H_2O = water

Light energy is required

$C_6H_{12}O_6$ = glucose [a carbohydrate, sugar]

O_2 = oxygen

https://msu.edu/user/morleyti/sun/Biology/photochem.html

It is also important to point out that when any carbohydrate burns or decomposes it produces carbon dioxide and water vapor.

INFLUENCE OF CLIMATE AND WEATHER ON GROWTH OF CORN

Merle T. Jenkins (Principal Agronomist [one who studies soils and crops], Division of Cereal Crops and Diseases, Bureau of Plant Industry)

Corn does best when the weather is warmer, especially at night. Not all species have the same temperature requirements, but most require warm weather.

Corn is a warm-weather plant that requires high temperatures both day and night during the growing season. Finch and Baker state that practically no corn is grown where the mean summer temperature is less than 66° F., or where the average night temperature during the 3 summer months falls below 55°. The production of corn along the northern border of the United States and at the higher elevations in the West is consequently unimportant in spite of constant efforts to develop strains better suited to these regions. The region of greatest production in the United States has a mean summer temperature of 70° to 80° [day], mean night temperature exceeding 58°, and a frostless season of over 140 days. The results of a study of the average temperatures and yields during the 16-year period 1914–29 for the 24 States from New York westward and southward which produce large crops of corn without irrigation, show that the States with the largest average yields had average summer temperatures for the months of June, July, and August of 68° to 72° F. (p. 310)

It would therefore appear that if the climate should actually warm at least five degrees it would be a real benefit to the raising of corn. Rising levels of carbon dioxide would also benefit the growth of all plants.

While strains of corn differ somewhat in their temperature requirements for germination and seedling development, few are able to germinate satisfactorily below 50° F. Warm weather after planting hastens germination and early growth. (ibid)

We have found here in Northern Idaho that if we have a week of sunshine after planting the corn will come up, but if it turns cold the plants do not grow. Further, if we get a lot of rain after planting the seeds tend to rot in the ground. So, here is another case where a rise in temperature in the late spring would be a help to corn production.

Corn flowers [tassles] and ripens much sooner when grown at 80° than at 70° F., and temperatures as low as 60° greatly retard flowering and maturing. (ibid)

Our corn does not really begin to grow well until we have several days approaching 100° F.

Although corn grows best in warm weather, extremely high temperatures, especially when accompanied by deficient moisture, may be injurious. Plants are most susceptible to injury by high temperatures at the tasseling stage, when a combination of high temperature and low humidity, resulting in extreme desiccation, may kill the leaves and tassels and prevent pollination. (ibid)

As noted warm weather is necessary for growing corn, but it is also important to keep the crop well watered. Dryland farming of corn then depends on the rain that nature happens to bring.

CLIMATE AND VEGETBLE CROPS

Victor R. Boswell (Principal Horticulturist) and Henry A Jones (Principal Olericulturist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry) (Olericulturist – One who cultivates vegetables for the home or market)

Irrigation has probably done more than anything else to extend the frontiers of vegetable production. What were sun-baked deserts at the turn of the [twentieth] century are now our most productive vegetable districts. (p. 380)

The authors also mention the refrigerated trucks that haul produce from farm to market as being a large factor in obtaining good quality produce.

CONCLUSION

The book has dealt with the various factors that affect climate. What effect does the climate have on the various crops that are grown in the United States, and elsewhere? Rather than looking at the various negative aspects of a particular climate the book seeks to mitigate those conditions, either in manipulation of different natural resources, or in the modification of the various plants to be able to survive when it is either too hot, too cold, too wet or too dry. Rather than doing as they did we waste a lot of time trying to place the blame on someone or some group of people or industries. Carbon dioxide is not the chief cause of increases in global temperatures, but the Sun is the primary source of heat, and carbon dioxide is coming from the oceans and elsewhere. We also learn that though the atmosphere contains a very small percentage of carbon dioxide it is also the source of all living matter, both plant and animal. Simply put, plants take in carbon dioxide and give off oxygen. It is a simple life cycle that has gone on for thousands of years. It is up to us to make the most of it.

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[Bio: Jim Hollingsworth has taught and administered school for a number of years, has a strong interest in issues of science, and is a layman working against global warming alarmism. He got most interested after attending a climate change seminar put on by the Heartland Institute and has followed the speakers for many years.

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