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The Climate of Arizona

Read before the American Climatological
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TUCSON, ARIZONA

Member American Climatological Society

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CLIMATE OF ARIZONA



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THERE is probably no country on the globe, that shows so many striking and picturesque topographical contrasts as does Arizona. Frightful chasms, dark and gloomy canons, massive mountains, rolling plains, rich and fertile valleys, arid wastes and beautiful mountain vales form a panorama of nature at once in her wildest and most gentle mood. Here time has wrought mighty changes, and the face of the land yet bears the traces of the fearful convulsions which rent it from end to end. From Utah to Sonora, and from the great Colorado to New Mexico, the same physical features are met with. Mountain and valley, table-land and plain, barren peak and rocky gorge, and above all a sky without a cloud and a sun unequaled for brilliancy. Such a land is Arizona; a land blessed with many a gift, and showing a wild and attractive beauty that well becomes a clime that has given birth to a race wilder than its canons and mountains, and with natures as fiery as its summer suns."*

In order to understand the nature of the climatic conditions found in Arizona, and to study the climate intelligently, it will be necessary to first glance at the geographical location, its area and topography.

Arizona is situated between 31° and 37° North Latitude and between 109° and 114°.40' West Longitude. It is bounded on the north by Utah and Nevada, on the east by New Mexico, on the south by the Mexican State of Sonora, and on the west by California and Nevada. Its area, according to the

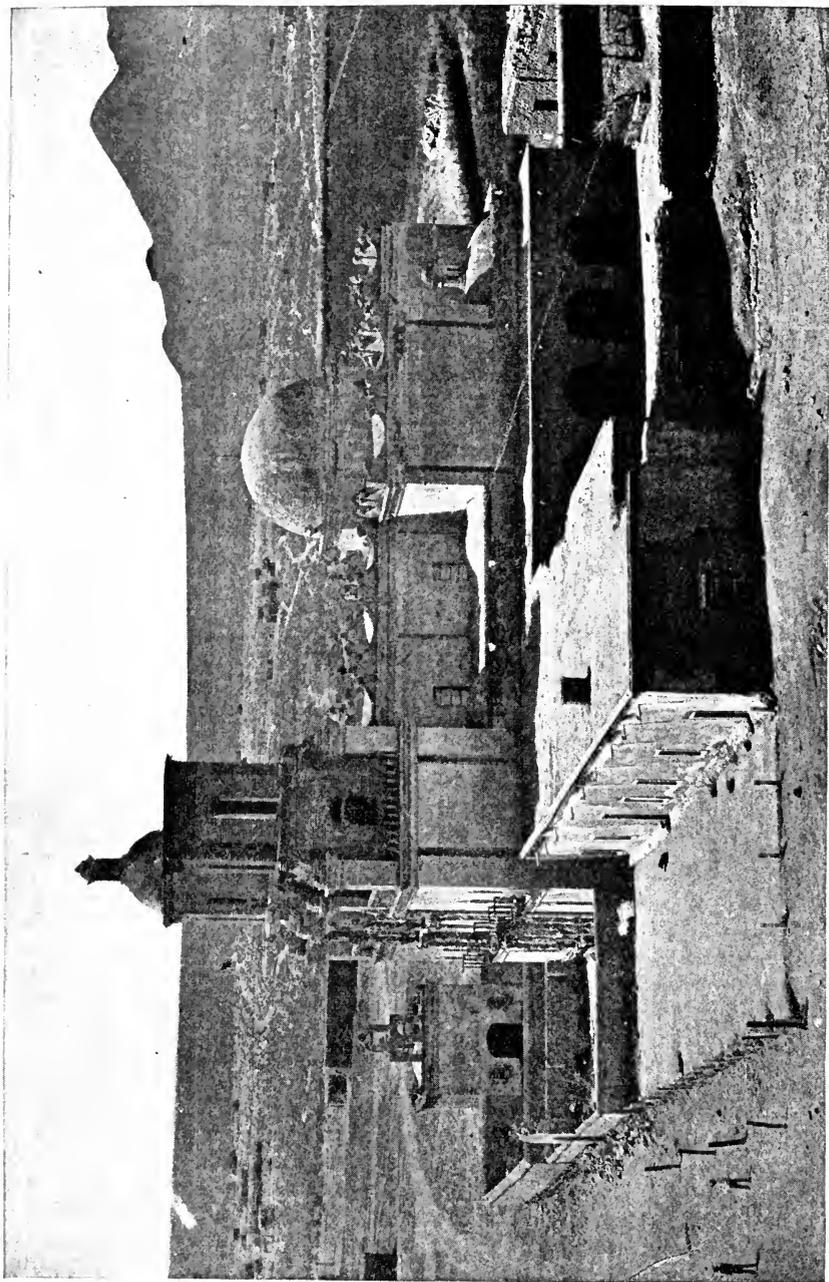
latest surveys, is 113,916 square miles. Its length from north to south is over 400 miles, and from east to west more than 350 miles. It is larger than the combined areas of New England, New York and New Jersey. Its altitude varies from below the level of the sea to thirteen thousand feet above sea-level.

The conditions which confront the student when he begins to study the climate of Arizona are so unlike those which obtain in the Mississippi Valley and the Atlantic and Gulf States, that he is compelled to look for some general cause for the radical difference.

On the Atlantic Coast, from the Gulf of St. Lawrence to Alabama, the Appalachian mountain system extends, having throughout its course a general northeast to southwest trend. Generally speaking, this range, which corresponds to the Cordilleran mountain system of the Pacific Coast, has a moderate altitude, rarely more than 5,000 feet; the ranges and spurs all have a uniform and parallel direction, and the ascent is gradual. From the sea-coast on the east, and from the plains on the west, there appear, in the order named, a gently undulating rolling country, then hills of moderate altitude, and these coalescing form, with a gradual general elevation of the entire mass, the mountains proper. There are no enormous canons like these of the Colorado and Columbia, and the elevations extend over large areas of country.

The Atlantic Coast is influenced by no equatorial ocean current. Hence it is that New York, which is about the same latitude as Naples and Madrid, has a

*"The Resources of Arizona," 1884. Patrick Hamilton.



THE SAN XAVIER DEL BAC.

(San Xavier del Bac Mission.

Established by the Franciscan Order, 1654. First church erected, 1657. Present structure completed, 1794. Situated nine miles south of Tucson.)

climate much like that of Northern Scotland or Scandinavia, which localities are at about the same latitude as Northern Labrador. An altitude of 5,000 feet does not deplete the wind currents of their moisture, so that the valleys which are located between the mountain ranges are everywhere well watered, both from the Atlantic Ocean and from the Great Lakes. There is, therefore, no region of the Atlantic seaboard which is deficient in moisture, and there is on the contrary a marked humidity. All this vast territory, including not only the Atlantic Coast, but also the Mississippi Valley where the conditions are virtually the same, is subject to great alterations in temperature. Great heat in summer and excessive cold in winter are the marked characteristics, with sudden changes in temperature and markedly humid atmosphere, in which the *sensible* extremes are felt with a discomfort which is unknown in the arid regions.

On the Pacific Coast the conditions are entirely different. Here, too, a gigantic mountain system ranges between the Mississippi Valley and the ocean. Like the corresponding system on the Atlantic Coast, its general trend is towards a central axis, the direction, however, being from northwest to southeast. Generally speaking, this range has a high altitude, frequently more than 5,000 feet, and as high as 15,000 feet in every State and Territory. The ranges and spurs do not have a uniform and parallel direction, but are cut up in every direction, making in reality a series of mountain ranges of independent trend. Finally, the ascent is always abrupt and from the soft nature of the elements composing the mountains, the streams have cut their way far below the level of the surface; hence the gigantic canons.

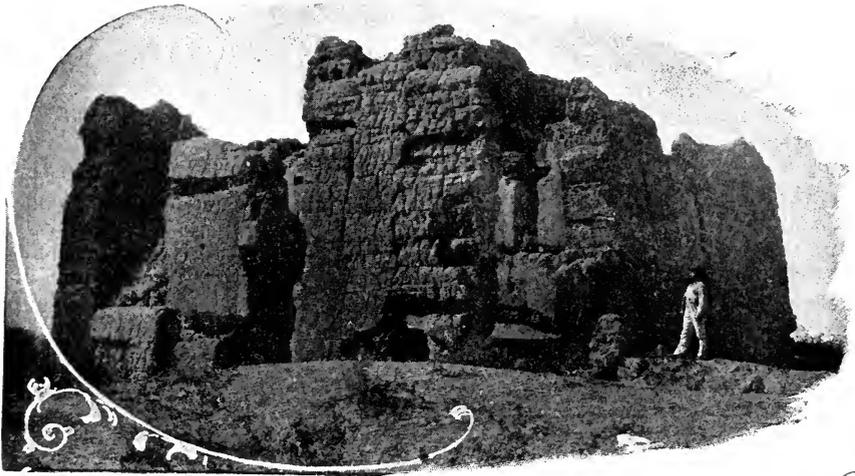
The Japan Ocean Current also has an important influence on the climatic conditions of the Pacific Coast. This stream, arising in the equatorial regions, flows north along the eastern shore of Asia until it strikes the shores of Northern Siberia and Alaska, where, after being tempered by the cold waters from the Arctic regions which come down through Behring Strait, it flows southward along the western shore of North

America as far as the equatorial regions. The stream has a most decided effect on the temperature of the entire Pacific Coast, and also influences the trade winds and the rainfall. The large body of water which comprises the Japan Current being always at the same temperature, it follows that the atmosphere of the entire coast region remains, with little variation, the same throughout the entire year. So that while the people of the north and east are enduring the most intense cold or the most oppressive heat, the people of the Pacific Coast are enjoying a temperature which is most equable and moderate. While the effect of the Japan Current is felt over the entire western coast of North America in a general way, principally from a moderation and equability of temperature, still, from this peculiar topography of the country, the modifications of temperature, humidity and rainfall are very marked. Thus, for example, Washington, Oregon and Northern California, west of the mountains, are excessively humid and equable; whilst east of the mountains the rainfall and humidity are deficient and the temperature almost entirely dependent upon altitude and latitude.

In addition to the Japan Current, another large stream of warm water makes its influence felt along the Pacific Coast. This is the North Equatorial Drift Current. Arising in the north equatorial region this stream flows westward along the Tropic of Cancer until it strikes the Japan Current as it flows northward along the eastern shore of Asia. By this current it is turned north as far as the island of Nippon, Japan, by which it is deflected east. It then flows almost due east, between the fortieth and fiftieth parallels of latitude to the western shore of North America, where, meeting the Japan Current on its return from the Arctic regions it is deflected south. It now follows the Japan Current southward as far as the thirtieth degree of latitude, when, meeting the Equatorial Counter Current from the southwest, it is deflected westward, from whence, flowing over the Hawaiian Islands, it arrives at its original starting point. The water of this stream, after flowing for upwards of four thousand miles

through the equatorial region, emerges therefrom to flow through the temperate region. From the length of time which is required for this stream to pass through the tropics it is apparent that

in height. The territory between these stupendous barriers comprises besides Utah, Nevada and Arizona, the eastern portions of Washington and Oregon, and the western portions of Idaho, Wyoming,



Prehistoric Ruins The Casa Grande

the water must be warm. In passing through the temperate region it never reaches higher than the forty-fifth degree of latitude and even then the waters and atmosphere surrounding it are tempered by the Japan Current. It follows, therefore, that this stream is always exceedingly warm and the winds which arise and blow over it are always bland. The effect of this is felt all over the Pacific Coast and even beyond the Rockies; where, as far inland as the Dakotas, the fierce blasts of mid-winter are occasionally replaced by a balmy spring-like wind—the “Chinook”—which causes the great drifts of snow to vanish within a few hours.

At the southern borders of British Columbia and Alberta, the great Cordilleran mountain system divides into two immense chains: the Rocky and Sierra Nevada. The former extends through Montana, Idaho, Wyoming, Colorado and New Mexico, while the latter passing near the coast, traverses Washington, Oregon, and California and ends by forming the peninsula of Lower California. These vast mountain ranges form, almost without a break, two gigantic walls five thousand feet and over

Colorado and New Mexico. The entire region within these limits is an arid waste, except where the altitude rises to above five thousand feet; for the moisture-laden winds from the Pacific find the Sierra Nevadas an insuperable obstacle to their progress, and what little moisture reaches the eastern slope of the Rockies is entirely condensed before the winds can cross the summits. The moisture for this immense region is either derived from such bodies of water as the Great Salt Lake and the Gulf of Lower California, or gains entrance through an occasional mountain pass, and this meagre amount of moisture is so rare that it will only condense on the higher altitudes.

Arizona lies at the southern extremity of this great basin. It is situated far inland and has a southwestern exposure. In viewing the topography of the country as a whole, we find the highest point of elevation at the northeastern portion of the territory, in the San Francisco Mountains, the highest peak of which, Mount Humboldt, raises its snow-clad summit to a height of thirteen thousand feet. From thence, there is a general depression in a southwesterly direction

as far as the basin of the Colorado desert, which is below sea-level. Probably no country in the world presents such great diversity of altitudes within such limited areas. One may stand on the brink of the Grand Cañon of the Colorado and within a few hours make a sheer descent of a mile and a half to the banks of the stream.

The contour of the country is peculiar. It has been likened to a wash-board. With the southeastern extremity so tilted as to represent the highest altitude of Mount Humboldt and the southwestern extremity, so as to represent the depression below sea-level in the Colorado desert, the corrugations running from northwest to southeast, but with many breaks in the continuity of the ranges, one obtains a rough conception of the topography. Although the ranges have a general trend from northwest to southeast, the drainage, owing to the confused and broken contour, is entirely to the southwest; and the rivers which drain this vast area, in order to gain access to the sea, have cut great cañons and gorges through the soft elements which compose the mountains.

Everywhere throughout the territory, plains and mountains alternate; the latter rising abruptly from at or near sea-level, to a height of several thousand feet. One may stand on the mesa at Tucson, at an elevation of twenty-four hundred feet and see a distance of one hundred miles. Within that vast scope no less than six separate mountain chains are in plain view, seemingly but a few leagues

distant, which range in altitude from four thousand to eleven thousand feet. These mountains, above an altitude of four thousand feet are covered with great forests of pine and fir; while the intervening mesas are nothing but arid wastes.

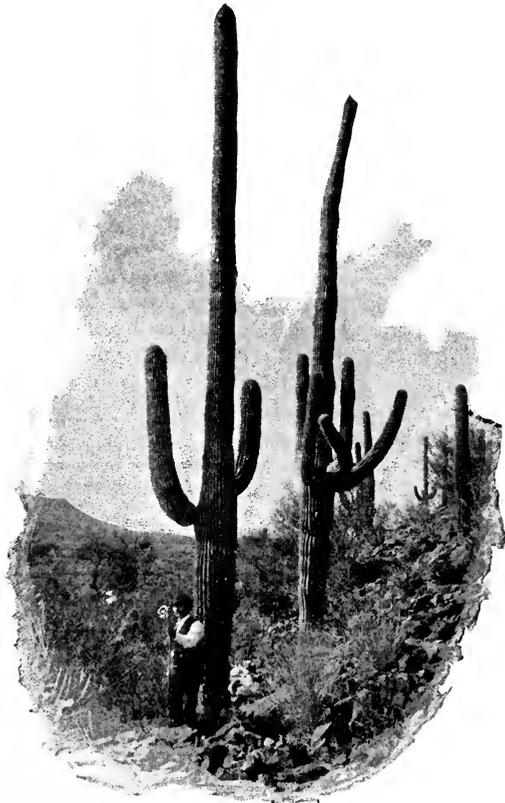
This peculiar topography has a decided bearing on the climate of Arizona. So frequent are the mountain ranges that their summits represent, so far as the wind currents are concerned, the general level of the country. Hence it

TABLE I.
SHOWING THE RELATION BETWEEN RAINFALL
AND ALTITUDE.

STATIONS.	ALTITUDE.	RAINFALL.
Camp Colorado	0 feet	2.05 inches
Yuma	141 "	3.05 "
Gila Bend	735 "	6.15 "
Phoenix	1068 "	7.08 "
Tucson	2400 "	11.00 "
Fort Huachuca.....	4785 "	15.33 "
U. S. Station, Chiricahua Mountains.....	7400 "	22.33 "

is that the moisture-laden winds pass over the intervening valleys and condense on the tops and sides of the mountains; the rainfall being directly proportionate to the altitude.

A study of the temperature records for Arizona show that the entire territory is influenced by the conditions which effect the other portions of the Pacific Coast, although only to a slight degree. Thus, the temperature of Tucson is milder than the temperature of Atlanta, although the latter city is more than 1,000 feet lower than the former; and the temperature of Yuma is milder than that of New Orleans, notwithstanding the fact that the latter is



A SAHUARA OR GIANT CACTUS.

more than 200 miles nearer the equator than the former.* Aside from these general conditions, which make all regions of the Pacific Coast warmer than corresponding latitudes on the Atlantic and Gulf Coasts, the temperature of Arizona is largely dependent on altitude.

I repeat, the temperature of Arizona is slightly warmer than corresponding altitudes and latitudes on the Atlantic Coast or in the Mississippi Valley. Further than this, the temperature seems only to be modified by altitude and humidity. We have no records of temperature at a higher point than Prescott; but we know that the temperature is lower as we ascend. At Flagstaff, we encounter several feet of snow with zero weather, and the summit of Mount

climate, which they cannot find in the United States, at a high altitude.

It will be noticed by Table III that of all the stations in southern Arizona, Phoenix shows the greatest variation of temperature, being the hottest in summer and the coldest in winter. Phoenix is at an altitude of 1068 feet, just midway between Yuma and Tucson. Under ordinary conditions we would expect to see the temperature there also midway in extremes between these two points. Although we have not at our command records of the relative humidity in the Salt River Valley for more than a period of six months, we feel quite safe in assuming that the difference is due to this cause. Phoenix is situated low down in the valley near the Salt River, and ac-

TABLE II.

SHOWING THE DIFFERENCE BETWEEN THE TEMPERATURE OF TUCSON AND VARIOUS POINTS ON THE ATLANTIC COAST, MISSISSIPPI VALLEY, GREAT LAKES AND GULF OF MEXICO.

Table for nine months, October to June inclusive, 1891-2.

Stations.	Oct.	Nov.	Dec.	Jan'y	Feb'ry	March	April	May	June	Mean Average
Philadelphia	59.9	44.2	42.8	31.4	35.2	35.8	50.9	61.9	74.3	47.95
New York	54.2	43.8	41.8	30.3	33.	34.6	49.9	59.4	72.	46.55
Boston	51.6	41.4	40.4	28.3	28.4	32.9	48.4	55.9	69.6	44.10
Richmond	59.8	49.2	47.2	39.2	43.9	44.9	57.7	69.9	78.4	54.46
Asheville	51.8	44.3	43.7	34.	45.1	43.8	53.8	64.8	68.4	49.96
Aiken, S. C.	58.	51.5	49.2	41.1	48.	50.				
Atlanta	58.7	49.	47.	38.3	47.8	48.	59.	68.8	72.2	54.75
Chicago	52.6	33.8	35.4	19.5	30.2	31.	44.	52.4	64.4	40.36
St. Louis	57.6	41.2	42.8	25.9	40.	40.4	54.	62.8	76.6	49.03
Tucson	70.8	58.9	44.4	49.2	52.8	57.	61.8	69.6	79.2	60.41

Humboldt, far above the line of vegetation, is all but perpetually covered with snow.

It is astonishing how few physicians in the east are familiar with the climatic conditions of the arid west. For example, hundreds of invalids come to Arizona every year who have been recommended by their physicians to go to Arizona or New Mexico. They might almost as intelligently be instructed to go to the equator or to the North Pole. The patients usually go first to New Mexico, where they find all the towns where accommodations can be had, at an extremely high altitude. A high altitude in winter means cold weather. They are compelled to remain indoors, and after suffering intensely from the cold, for the accommodations are usually poor, they finally decide to try a warmer

according to the well known principles of gravity as applied to atmospheric drainage, the cold moist air settles in the most dependent localities. This is quite apparent by the sense of appreciation in the difference between the sensible and

TABLE III.

SHOWING THE RELATION BETWEEN TEMPERATURE AND ALTITUDE.

STATIONS.	ALTITUDE	MEAN MINIMUM	MEAN MAXIMUM
Yuma	141	42	106.3
Phoenix	1068	32	107.3
Tucson	2400	35	100.8
*Prescott	5389	20	84.9

*Prescott, in Northern Arizona. But the conditions are the same as for regions in Southern Arizona at corresponding altitudes.

actual temperatures, to which anyone will vouch who has driven through a river valley or an irrigated bottom in the arid region. The sensible difference between the temperature of Phoenix and other points of southern Arizona is decidedly marked; Phoenix being sultry in

*Mean annual temperature of New Orleans, 68.6°; of Yuma, 71.4°. Report of the Chief of the Weather Bureau for 1891.

the hot season and chilly during the cold. The actual temperature shows greater extremes for reasons which depend on the fundamental principles of natural philosophy. Moist air is heavier than dry air, and is a poorer conductor of heat and cold. Consequently during the intense heat of summer radiation does not take place with sufficient rapidity during the night to lower the temperature to that of other localities outside the irrigated district. For the same reason in winter the heat of the sun during the day is not sufficient to raise the temperature to that of the other stations. It is not the presence of the river which causes the increase of relative humidity, for Yuma, which is situated at the junction of the Gila and Colorado rivers, has the lowest relative humidity of any region of the territory where the records are kept. But at Phoenix, for several miles above and below the city, the country is watered by irrigation and the soil is so thoroughly saturated that the level of the water beneath the surface has been raised from a depth of seventy, to from twenty-five to thirty feet. This condition is no more pronounced at Phoenix than at any other point where irrigation is practiced. As for example, in northern Colorado where, prior to the introduction of irrigation an extremely low percentage of moisture existed. Since all that region has been irrigated the relative moisture has been so increased that they now have dews where formerly dews were unknown. The emanations from the growing vegetation also increase the relative humidity, although sufficient areas have not been irrigated to make any perceptible difference in the amount of precipitation by rainfall. What these artificial changes may bring about in time, no one can predict; but it is well known that bodies of water which are surrounded by irri-

gated regions, such as the Great Salt Lake in Utah, are gradually increasing in volume. The surface of the Great



A CAÑON IN THE MOUNTAINS, NEAR TUCSON.

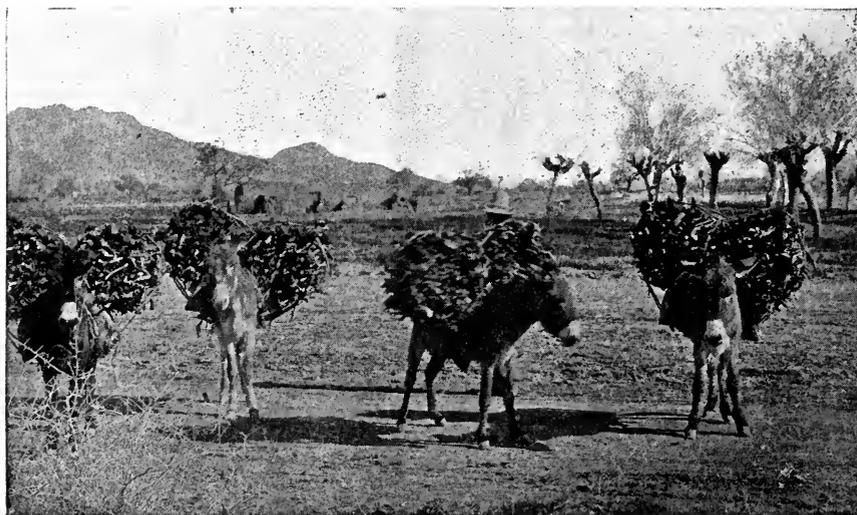
Salt Lake has risen several inches in the last few years.

The report of the United States Weather Observer at Phoenix, makes the relative humidity at that point, for the six months October to March, 1895-6, inclusive, 52.82 per cent. Records for Tucson during the same period are not obtainable. But compared with other years, when the precipitation was about the same as for this season, we find the relative humidity in the irrigated districts about twelve or fifteen per cent. higher than at the other points in Southern Arizona.

What the invalids from the north and east seek, is a winter climate. Very few of them can be induced to go to the arid regions during the summer months; but with the advent of cold weather, after they have taken a few colds, they set out for a warmer climate.

The climate of Arizona is peculiarly adapted to the requirements of people suffering from pulmonary disease. They need a climate wherein they can live out of doors. No one will dispute the statement that the out-door life is the one for the consumptive. Observations made by veterinary surgeons show that tubercular cattle always improve when turned out to graze, and almost every

seventy-six. He had contracted tubercular phthisis in the spring of 1850, while a resident of the State of Indiana. He emigrated to California at that time, and was compelled to make the journey on horseback. He stated that he was a year in making the trip, and, during that time, he recovered. Since then he has had no trouble save on one occasion when he visited New York. He then became worse, and was compelled to terminate his visit abruptly and return to the west. The writer examined this patient, found impaired resonance, increased fremitus and all the signs of marked involvement over both apices and over almost the entire area of the



TUCSON'S FUEL SUPPLY.

case of tubercular phthisis which I have known to recover in the west, has given a history of out-door life. By out-door life, I do not mean that the patient is to spend a few hours each day in the open air, to return in-doors when he becomes a little fatigued. I mean that he should remain in the open air as do the cattle which are turned out to graze, day and night, and for weeks and months at a time.

A few months ago the writer visited the city of Sacramento, and while there was taken by Dr. Wallace A. Briggs to see an interesting case. As the writer now remembers the case, it was as follows: The patient was a man, aged

left lung. By auscultation and percussion, he detected a cavity in the left apex which was quite the size of a small orange. The patient stated that his lungs gave him no trouble whatever. Dr. Briggs informed me that he was suffering somewhat from tachycardia and was developing some symptoms of senile inanition, but was not troubled with his lungs.

This I considered an exceedingly instructive case, as it impressed upon me the necessity for out-door life in the treatment of pulmonary tuberculosis. I have pronounced hopeless many a case which was not so much involved as was this one, and seen my prognosis verified.

In order that the patient may live continuously in the open air for a period of several months, or, for that matter, for a year, or several years, a climate is required which is continuously warm and dry. Such a climate the United States does not possess. But the nearest approach to it is, I believe, in the deserts of Arizona. But the ideal climate cannot be found above the frost line. While I believe that the climate of Southern Arizona possesses features which are far superior to those of any other section of the United States, yet I am compelled to admit that I think there are many climates which will in time be found to be superior. A desert region in the tropics, at an altitude sufficiently high to avoid a too intense heat, would be superior to anything yet described, and would, according to my idea, fill the requirements much better.

What the people seem to look for is a winter climate. Even physicians rarely send their patients to the arid regions during the summer. This I consider a great mistake. I think the patients should be sent to the arid regions so soon as there is evidence of infection from the tubercle bacillus, and should be made to remain there until they are well, or until it is apparent that the case is hopeless. The climate of Southern Arizona is a winter climate. We do not recommend that the patients

doors, and this I consider more important than any other feature of the climate.

It is not necessary that patients be required to remain in one town, or at the same hotel, all the time. If they have the means to travel about, there are many places of interest which they can visit and thus add greatly to their pleasures. For example, during the hot months of summer, when the heat of the low lands becomes well-nigh unbearable, the patient may go to the northern part of the territory where he will find, besides a dry, warm climate, many of the most interesting and remarkable natural wonders which the world possesses. Among these may be mentioned the Grand Cañon of the Colorado; the Wind Carved Rocks, and the Petrified Forests. Such attractions as the Moqui Indian villages, Cliff Dwellings, and the ruins of many ancient civilizations are frequent. In the Salt River valley there are ruins of a city which must have contained a population of 300,000. These numerous ruins, which are found all over the territory, with their hieroglyphics and pictoglyphics, will well repay investigation by the student of ethnology. In the country surrounding Flagstaff, in the San Francisco Mountains, is the largest unbroken pine forest in the United States. Here, the sportsman

TABLE IV.

SHOWING THE DIFFERENCE BETWEEN THE RAINFALL AT TUCSON, ARIZONA, AND OTHER POINTS IN THE UNITED STATES.

Stations.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Boston	4.39	3.66	3.94	1.71	1.56	3.06	3.73	3.87	2.29	5.56	2.35	3.58	39.7-
New York	5.73	4.69	4.22	2.37	3.10	1.18	4.11	5.87	2.12	2.69	2.06	3.30	41.4
Philadelphia	3.65	4.71	4.42	2.34	1.74	2.51	4.65	4.22	1.90	2.57	1.70	3.78	38.1
Richmond	4.30	6.89	9.70	2.21	4.45	5.51	5.86	5.86	2.32	2.04	2.02	1.67	52.8
Atlanta	6.73	8.50	10.16	1.58	2.17	4.71	5.38	2.59	1.19	0.02	3.26	3.68	49.7
Jacksonville	1.19	0.32	4.02	1.72	2.78	3.31	4.08	3.67	0.83	4.43	1.53	3.46	41.3
Mobile	6.50	4.54	6.96	1.65	0.67	7.09	7.50	3.50	4.05	0.20	7.60	6.41	57.0
Meridian, Miss.	9.18	8.15	10.59	1.95	1.36	6.65	10.13	0.86	0.36	0.07	6.80	7.17	63.5
New Orleans.....	3.75	7.42	2.67	0.26	0.76	4.45	4.57	1.69	3.43	2.38	3.31	3.93	38.6
Chicago.....	1.99	1.95	2.13	3.14	2.09	2.42	2.47	4.52	0.32	0.36	3.83	1.32	26.5
Denver	1.60	0.27	3.10	2.49	4.15	2.93	0.59	2.84	0.73	0.48	0.69	1.56	21.4
San Diego.....	1.21	4.84	0.27	0.76	0.35	0.65	T	0.00	0.08	0.04	0.10	1.29	8.9
Los Angeles.....	0.25	8.56	0.41	1.26	0.31	0.00	T	0.00	0.06	0.00	0.00	1.99	12.8
San Antonio, Tex.	5.63	0.09	1.18	4.57	2.36	2.16	0.85	1.06	3.60	0.60	0.92	5.73	29.2
Tucson, Arizona	0.12	2.08	0.17	0.00	0.18	0.22	0.70	2.26	0.65	0.00	0.00	0.23	6.61

Report of the Chief of U. S. Weather Bureau, 1891.

come here for the summer, unless they enjoy or are able to stand the heat. For those who can stand warm weather, I think the summers much better than the winters; for, owing to the heat, everybody is compelled to sleep out of

may find deer, antelope and bear, not to speak of small game or fish. After several months of outing, he may return to the southern part of the territory to spend the winter. There, day after day, he may bask in the sun, and lead a life

which is practically an out-door one, all the winter through. In southern Arizona, almost the entire rainfall occurs in two months, usually the months of August and December; while in the northern portion of the territory, the greatest precipitation is in the winter snow. Unfortunately we have not at our command the records of rainfall, humidity and temperature for the northern part of the territory, but it will suffice to say that it is no place to send tubercular patients during the winter months.

The rainfall in the territory of Arizona varies directly as the altitude (see Table I). At an altitude of 7000 feet (Flagstaff) it is about twenty-three inches. The table below shows the rainfall at Tucson as compared with some other points in the United States.

A warm dry climate is the one which seems most suitable for the tubercular patient. We have already discussed the element of temperature in Arizona as compared to that of the Atlantic Coast and the Mississippi Valley. But there is another element in connection with temperature which we have not discussed, and which has, I think, a great bearing on the selection of a climate. I refer to the *sensible*, and *actual* temperatures. In this matter, I can do no better than quote from the report of Professor Edward M. Boggs, of the University of Arizona. In his article on the "Climate of Arizona,"* he says:—

"The simple thermometer, no matter how accurate it may be, does not measure temperature as felt by animal life. Its records must be considered in connection with certain other data in order to afford a mode of comparison with the climates of other portions of the earth. We may term the reading of an accurate thermometer the *actual*, and the sensation of heat or cold as felt by the higher orders of animal life the *sensible* temperature. Neither of these is a measure of the other. The fact is well known to meteorologists, that the thermometer alone cannot indicate the *sensible* temperature, but that the humidity of the air must be considered in connection with the actual temperature. This fact

is also known to dwellers in the arid region, but it is not known to the majority of otherwise intelligent people throughout the world.

"Where the percentage of atmospheric moisture is high, both extremes of temperature are felt to be greater than the thermometer indicates. Everybody knows something about that condition of the weather which is variously termed 'sultry,' 'close,' or 'muggy.' These terms describe the result of a combination of heat and moist air. This is the condition which exists commonly in the tropical regions of the world where the rainfall is heavy, and in the same way, though in a smaller degree, throughout the United States outside of the arid region. It is especially noticeable in the States bordering on large bodies of water, such as the Gulf of Mexico or the Great Lakes, and is conspicuously absent from the greater portion of Arizona.

"In the dry air of this territory sun-strokes are unknown, while in the Mississippi Valley and in the states lying eastward whole columns of the newspapers are filled with accounts of prostrations from heat; and the fatalities are numerous whenever the thermometer indicates 90° F., or upwards. At many places along the sea-coast, where the humidity always remains near the point of saturation, a temperature of 85° brings excessive discomfort, and exertion or exposure to the sun is extremely hazardous. Men and the lower animals perform in safety their customary labor beneath the cloudless skies of Arizona, under the highest temperature ever experienced here. The dry air induces exceedingly rapid evaporation of the abundant perspiration, thus keeping the body at a comparatively low temperature. As a matter of course, the supply of fluid must be maintained, hence the great thirst so often experienced by travellers in desert regions, and the imperative necessity for an adequate supply of drinking water. Of all the lives lost on the desert stretches of Western America—and their number is not small—not one is directly attributable to heat, but to thirst. The experienced traveller provides an ample supply of water and fearlessly invades the worst desert yet discovered.

"An amount ranging from fifteen to

*Arizona Agricultural Experiment Station, Bulletin No. 20.

perhaps thirty degrees, according to the humidity, should be subtracted from the maximum *actual* temperatures in Arizona, during the hot season, to indicate the *sensible* temperatures. In like manner, the dry air of the arid regions enables extremely low temperatures to be endured without discomfort. The winter cold of the Canadian Northwest Territory is much less disagreeable than that of the United States immediately south of the Great Lakes. The lowest temperatures known on the high plateau of Arizona, bring less discomfort than a chilly day in New Orleans.'"

It is when we come to study the relative moisture which exists in the atmosphere of Arizona that we see the most striking peculiarity of the climate. Table V shows the difference in relative humidity between the climate of Tucson and that of other portions of the United States. It will be noted that the relative humidity does not always depend upon the amount of precipitation, as for example, San Diego, Cal., which has a rainfall almost as deficient as that of Tucson.

I think that this feature of the climate of Arizona is what makes it so beneficial to "pulmonary" patients. I know of no country which possesses, in addition to a moderate altitude, a warm equable temperature with such a low degree of relative moisture. If it be a dry at-

mosphere which the patients need, and I think all observers agree that a dry atmosphere is the most essential element, then Arizona can surpass anything on this continent, if not, indeed, anything in the world.

TABLE V.

SHOWING THE RELATIVE HUMIDITY AT VARIOUS POINTS IN THE UNITED STATES AND AT TUCSON, ARIZONA.

For the nine months, October to June inclusive, 1891-2.

STATIONS.	S A. M.	S P. M.	AVERAGE
Boston.....	70.	66.4	68.2
New York.....	73.4	69.7	71.6
Chicago.....	80.2	75.5	77.8
Norfolk, Va.....	80.4	73.	76.7
Atlanta, Ga.....	78.8	65.4	72.1
Mobile, Ala.....	85.2	77.4	81.3
Jacksonville.....	79.8	72.2	76.
Meridian, Miss.....	85.7	73.2	79.4
San Antonio.....	70.1	50.4	60.5
Los Angeles.....	77.	65.4	71.2
San Diego.....	78.2	69.1	73.6
*Asheville, N.C.....			68.7
Tucson, Arizona.....	56.5	28.7	42.6

**Therapeutic Gazette, Oct. 16th, 1893.*

Were we, in our report, to exclude the two months of heaviest rainfall, the mean relative humidity would be fully ten per cent. lower than that given in the table; while in other portions of the United States there is no corresponding decrease. For example, in the month of June 1892, the average relative humidity was twenty per cent., and for August and February of the same year (the months of greatest rainfall) the average relative humidity was respec-



ARIZONA LANDSCAPE

tively thirty-eight per cent. and sixty-nine per cent. During the greater part of the year the inhabitants of southern Arizona sleep out of doors. I have slept, night after night, for weeks at a time, without being aware of the presence, even, of dew. It is difficult, at first, to induce the "tenderfoot" to sleep in the open air. He has visions of tarantulae, scorpions and centipedes, which are disquieting. But in the course of time, he learns that these insects are so rare as to be curiosities, and that their sting is to be dreaded not so much as that of a California flea. The sensational Arizona tales of poisonous reptiles and insects, of murderous Apache raids, and of cow-boy and desperado shooting scrapes exist only in print. They have no modern foundation in truth.

Many physicians in the east order patients to California for the winter, apparently with a view of sending them to a dry climate. California is deficient only in rainfall. If the reader will look at Table V, he will notice that relative humidity in southern California is as great, and in some instances greater, than that of the Atlantic Coast. He may also be surprised to know that many of the best physicians in California regularly send their tubercular and asthmatic patients to Tucson. California is a beautiful country, and is a delightful country in which to live if one can stand a high percentage of humidity. But the fogs which come in from the sea, and the emanations from the vast irrigated regions, make it far inferior to the inland desert regions for phthisical patients. I think it may be assumed as a general rule that wherever there is irrigation, there is a high degree of relative humidity. It is my opinion that patients suffering from pulmonary phthisis should never be sent to an irrigated district. In addition to the high degree of humidity, there is usually associated the miasmatic micro-organisms. Indeed, some of the California physicians have declared that "irrigation and malaria go together."

The city of Tucson has, in my opinion, advantages as a health resort which cannot be equalled anywhere in North America. I know of no locality where such a moderate winter climate and

such a low degree of relative humidity are combined with the same latitude and altitude. It is no longer considered imperative to send tubercular patients to an altitude of 5,000 feet, or over. In fact, clinical experience has proven that more frequently patients require to be sent to an altitude of less, rather than more than 3,000 feet. The altitude of Tucson is 2,400 feet, and that seems to be amply high for all but the most exceptional cases. The city is situated in a basin, near the underground Santa Cruz river. It is completely walled in by massive mountain ranges. To the north is the Santa Catalina range; to the east, the Rincon; to the south, the Santa Rita; and on the west, the Tucson. Each of these ranges has an altitude of 5,000 feet, at least. Mount Lemmon, the highest peak of the Santa Catalinas, has an elevation of over 7,000 feet, and Mount Wrightson in the Santa Ritas, reaches an altitude of nearly 11,000 feet.

Surrounded as it is by this impassable wall, the city is protected from wind and rain. The humidity is less than that of any other city in the United States. Moreover, it will always remain virtually unchanged, for irrigation is not, and never can be, carried on to any extent. The reasons for this are two: First, there is no water; and second, the soil is such that nothing more than a few shade trees and small fruits can be grown, and these only when great care and attention have been devoted to them. I must make an exception in regard to flowers. Roses bloom in the gardens in magnificent profusion, almost every month in the year.

The scenery at Tucson is as impressive as anywhere in the Rocky Mountains. The gorgeous sunrises and sunsets beggar description. There are fine drives, cañons and ruins. The characteristics are those of the desert, the charming peculiarities of which are novel and entertaining to people who have been accustomed to live in the humid regions.

I wish to call attention to one more of the features of southern Arizona before I close. I refer to the sunshine. During the nine months, October to June, inclusive, 1894-5, there were but

twenty-five cloudy days, and nine of these were in one month. Some idea of the transparency of the atmosphere may be had when I state that, at mid-day, and with the unaided eye, I have seen Venus when it was but ten degrees east of the sun.

The writer feels kindly toward Ari-

zona. One year ago, in Philadelphia, he was attacked with two hemorrhages from the lungs. He had a bad cough, and was losing flesh rapidly. On the advice of a distinguished member of this society, he went to Tucson. Since that time he has gained twenty-six pounds in weight, and now is a well man.





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