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THE PREFERABLE CLIMATE

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THE COMPARATIVE IMPORTANCE OF DIFFERENT CLIMATIC ATTRIBUTES IN THE ARREST OF CHRONIC PULMONARY DISEASES.

BY

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BY CHARLES DENISON, A. M. M. D.,
Of Denver, Colorado.

With a proper elimination of negative conditions, the writer takes the affirmative side of the following divisions of the discussion. He illustrates his argument by the climatic or physical causes of "purity of atmosphere," as well as by evidences of experience.

The order in which the first five subjects are arranged is intended to indicate the relative importance of the attributes considered, the last five being added as confirmative of these main propositions.

SYNOPSIS OF THE DISCUSSION.

1. *Dryness* as opposed to *moisture.*
2. *Coolness* or cold preferable to *warmth or heat.*
3. *Rarefaction* as opposed to *sea-level pressure.*
4. *Sunshine* as opposed to *cloudiness.*
5. *Variability* of temperature as opposed to *equability.*

CONFIRMATORY PROPOSITIONS.

6. *Marked diathermancy* of the air to be preferred to the *smoky atmosphere* of cities or the dense air strata of moist currents.

7. *Radiation and absorption of heat* by rocks and sandy loams better than *latent absorption* by water and damp clay soils.

8. *Mountainous configuration* of country (quick drainage) contrasted with the *flatness*, etc., of level sections.

9. Frequent electrical changes of atmosphere, also *moderate winds* (except in quite cold weather) preferable to *continuous stillness of the air.*

10. *Inland altitudes* contrasted with *sea air* (total absence of land influence); but in certain cases sea voyages and island resorts to be preferred as compromise substitutes for high altitudes.

INTRODUCTION.

The discussion of this most important question of "Climatic Influence in Phthisis," to be fair, must be general, with no unworthy prominence given to any one of its many elements. The subject is necessarily complex, and in order to reach right conclusions must be candidly considered, without reference to the convenience of the medical adviser or of the patient.

Hitherto, the chief obstacles in the way of right conclusions have been :

1. Ignorance of the exact nature and progress of the disease, and

2. A lack of appreciation of the relative importance of different climatic attributes in its arrest.

With reference to the first obstacle, the writer accepts with confidence the germ theory of Koch, *i. e.*, that the bacillus of tubercle is the essential principle in all tubercular lesions.

The discussion of this theory is foreign to our present purpose, yet its acceptance helps to explain the confidence the writer has in his classification of climatic attributes. To him the harmony is most evident which is found to exist between our limited knowledge of the life conditions of the bacillus tuberculosis and our experience in the arrest of phthisis in the dry, cool, rarefied, sunny, and stimulating atmosphere of high altitude climates.

As to the second obstacle mentioned, the medical profession did not start out right, and so of necessity has to go through the process of getting righted. It was a clear case of theory not being supported by experience. The sanguine anticipations of benefit from warm, equable, low altitude climates were not realized. There may have been gain in flesh, strength, appetite, and sensations, or the scanty building up of the system may have been wholly neutralized by the fostering and feeding of the sources of its consumption. The trouble was, there was always a deficiency of elimination. So when the fact of something to be eliminated dawned on the medical mind, then those climatic attributes which were able and suited to eliminate began to be appreciated.

There is nothing equal to facts and experience in correcting the errors of mere theory. The medical profession has come to insist upon the largest possible collection of facts, supported by an ample array of experience, before the superior utility of any theoretical cure will be accepted as established. Especially is this the case with reference to the climatic treatment of consumption; and the teacher of therapeutics who has not the time nor inclination to investigate an extended array of climatic data, which constitutes the basis of a given discussion, cannot of necessity speak with any authority against the evidence of those facts.

The value of comparisons and conclusions as to climatic data largely depends upon the time involved and the area represented, presupposing, of course, an impartial and universal method of collecting such data.

It was the value of the records of the United States Signal Service Bureau, and the importance to the medical profession of condensing the averages of all climatic attributes in a convenient and graphic form, that led the writer to compile some eight million separate signal service observations into the annual and seasonal climatic maps of the United States, which are the authorities for many of the conclusions reached in this paper.*

The preliminary synopsis of this paper is sufficient evidence that no particular attribute is held to be the only cause or the only cure of phthisis.

The proper sequence of these attributes, and the validity of their defense, are what need to be proved.

I. DRYNESS *vs.* MOISTURE.

At the outset we should have a line of demarkation between these two opposing qualities of the atmosphere ; a subdivision that would be fair and acceptable to all, so that there could be no confusion in the use of the terms *dryness* and *moisture*. It seems to the writer that the average of the combined hygrometric conditions of the atmosphere, for the whole inhabited portion of the country, is a fair division-line between these two opposite conditions.

If you please, we will accept this as the line of definition.

Of course, temperature must be accounted for, as the capacity of the air to hold moisture varies so greatly according to this record, the variation being from about half a grain to the cubic foot at zero to nearly twenty grains at 100° F. when the air is saturated. This was the basis of the writer's " Rule for the Determination of Moisture and Dryness."†

This rule was based upon the calculation of a table representing the average of the combined humidities of the air (cloudiness, absolute and relative humidity) for the whole

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* " The Annual and Seasonal Climatic Maps of the United States." Rand, McNally & Co., publishers, Chicago, Ill.

† " Moisture and Dryness." Report made to the American Climatological Association, 1884. Rand, McNally & Co., Chicago, Ill.

United States and for every degree of temperature. The averages of these three evidences of humidity were found to be 44½ per cent. of the time for cloudiness, 67 per cent. for relative humidity, and consequently 67 per cent. of saturation for absolute humidity. These means were accepted by the late chief signal service officer (General Hazen) to be as nearly correct as could be determined. A rating table of means of these three attributes having been constructed for every degree of temperature (see table on map for spring on climatic charts, previously referred to), the following rule was formulated :

First, find for the given time and place the per centum of relative humidity and cloudiness and the absolute humidity in tenths of a grain of vapor to the cubic foot of air. Then compute the difference between one-third of these three and the standard number (the mean) given opposite the proper temperature in the rating table, and the result, plus or minus, will show the relation of the given climate to the average for the United States. An excess of six locates a place in moderate moisture and over six in extreme moisture, while a deficiency of six belongs to moderate dryness and of more than six to extreme dryness.

The graphic illustration of this rule, compared with mortality statistics, shows that the arrest of phthisis is far more surely to be accomplished as you go toward the extreme of dryness from the mean, than as you go in the opposite direction from the mean toward the extreme of moisture. Indeed, it is the very moist climates which furnish most of the cases to be arrested in the very dry sections.

The first of the inclosed charts gives a pictorial illustration of the operation of this rule as applied to the winter season of 1882-3. As compared with the annual mean of the United States, every signal station is rated into one of the even divisions of *moisture* (blue) or of *dryness* (red), according to the combined records of atmospheric moisture (cloudiness, relative and absolute humidities) of each locality.*

However, in the writer's opinion, the chief argument in favor of atmospheric dryness is based upon the increased transpiration of aqueous vapor from the lungs, in a degree according to the dryness of the air breathed.

The germs of disease need warmth and moisture in which to live and flourish—a climate tempered and constituted according to the requirements of their peculiar existence. It is reasonable to infer that the preference shown by the bacilli of tubercle for a *locus habitandi* in pulmonary tissue is in no small degree governed by the catarrhal or other products of inflammatory change, which clog or close the alveoli and connecting bronchioles. Well, then, if these secretions or morbid products could be removed, and at the same time the bacilli which inhabit them thrown off, the result would certainly be salutary. These could be so expelled if they could be reached by the inhaled air, and this in turn had the requisite absorbent power.

This absorbent power is just what the inhaled air possesses through its quality of dryness, and in proportion thereto. Absorption takes place through the difference in percentage of saturation (relative humidity) between the inspired and expired air, and also much more through the difference in weight (relative humidity) between the moisture inhaled and that expelled. This especially takes place if cold air is inhaled, which is then raised to the temperature of the body.

Valentin, Sanctorius, Lavoisier, Seguin, Dalton and others have investigated the subject of transpiration, but not to differentiate between persons at different altitudes and temperatures. In the analysis of humidities already referred to † the writer made an attempt to compute this difference in transpiration.

He took Draper's statement as the basis of his calculations, namely, that the dew point of the expired breath is 94° F. ‡

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* For fuller description and for the evidences which show the greater value of these humidity records combined than of their separate representation, the reader is referred to the full series of annual and seasonal charts as published by Messrs. Rand, McNally & Co., Chicago, Ill.

† "Moisture and Dryness," pages 27 to 29.

‡ Candor compels expression of the suspicion—chiefly based upon the increased thirst and augmented respiratory activity in those who live in elevated and very dry sections—that the dew point given may be too high for such dry regions. However, this is less than Dalton's estimate, who says the expired air is in a state of saturation. So we will call it that the expired breath is saturated at 94° F.

Two divisions of the calculation were made.

1. Difference in vapor transpiration between a warm moist (Jacksonville, Florida) and a warm dry climate (Yuma, Arizona). These two signal stations were chosen, and for the autumn of 1883, because their temperatures were the same, *i. e.*, 71.3°. An ordinary-sized man was assumed to breathe eighteen times in a minute (Quintelet), and to expire when at rest twenty cubic inches at each breath (Hutchison, Flint, Jr., and others), and that the loss of breathing—*i. e.*, the used-up atmosphere—from $\frac{1}{10}$ to $\frac{1}{30}$ in volume (Davy and Currier), is made up by the expansion of the air in the lungs through its being raised from 71.3° to the heat of the body.

The calculation resulted in the following table:—

TABLE I.

Autumn, 1883.	Yuma.	Jacksonville.
Mean temperature	71.3°	71.3°
Grains of vapor in saturated air per cubic foot at given temperature (Glaisher)	8.33	8.33
Mean relative humidity	.428	.774
Cubic feet of air breathed in 24 hours	300.	300.
Grains of vapor inhaled	1070.	1934.
Grains of vapor exhaled with dew point at 94°	5007.	5007.
Vapor exhaled more than inhaled	3937.	3073.

Excess of Yuma over Jacksonville 864 grains a day.

This is the moisture thrown off from the lungs in a given dry climate in excess of that in the rather moist one of the same temperature and no exercise taken. When one makes an allowance for the increased respiratory activity due to exercise he is enabled to realize the still greater difference in transpiration, as shown by Dr. Edward Smith's calculation that "one at sea-level, walking at the rate of three miles an hour, consumes three times as much air as when at rest." Ordinary every-day exercise of a man would make this difference in transpiration, under the given conditions, equal to about a gill in twenty-four hours.

2. It is when we make this calculation for places of different temperatures and elevation that the argument becomes still more conclusive, for cold is probably the most important factor in the production of dryness, and elevation is not far inferior, because it in turn produces cold as well as expansion in the volume of the air. It is just to allow for elevation an equivalent to the proportionate rarefaction of the air, *i. e.*, if the pressure is one-fifth less (twelve pounds to the square inch) at Denver than at Jacksonville, then one-fifth more air will be breathed at the former station. In this calculation we will assume a good-sized man, thirty years old, as breathing, in both Denver and Jacksonville, twenty breaths a minute and thirty cubic inches per breath (Dr. Grehant), ordinary exercise included, and for the same season as that used before. The result is as follows :—

TABLE II.

Autumn, 1883.	Denver.	Jacksonville.
Mean temperature, Fahr	50.4°	71.3°
Grains of vapor per cubic foot at saturation for given temperatures	4.44	8.33
Mean relative humidity	.501	.774
Quantity of air breathed in 24 hours, cubic inches	1,062,800.	884,000.
Or cubic feet	615.	492.
Amount of vapor inhaled at the given humidity and temperature, grains	1,364.	3,172.
Vapor exhaled at dew point (94°), saturation being 16.69 grains per cubic foot (Glaisher), grains	10,264.	8,111.
Vapor exhaled above that inhaled in 24 hours, grains	8,900.	4,939.

Excess of transpiration in favor of Denver 3,961 grains, or over eight ounces, or two gills, in twenty-four hours.

There are two important considerations which would further add to this difference in evaporation of moisture from the lungs in favor of the high-altitude station.

1. The expansion of the air in being raised in the respiratory tract from the lower temperature of the atmosphere to the higher temperature of the body.

2. The increased amount of exercise naturally indulged in at the higher station, due to the stimulation of cold, electrical influence, etc., and the augmented effect of exercise upon the respiratory functions.

For the purpose of still further comparison it is instructive to take a cold, dry place in winter (Cheyenne, Wyoming) and a warm, moist one in summer (Charleston, South Carolina) on the same basis (though Cheyenne is a little more elevated than Denver). The calculation is as follows :—

TABLE III.

	Cheyenne, Wyo., Winter, 1883.	Charleston, S. C., Summer, 1883.
Mean temperature, Fahr	23.2°	81.2°
Weight of vapor at saturation for given temperature, grains	1.30	11.38
Mean relative humidity	.478	.803
Amount of air breathed in 24 hours, cubic feet	615.	492.
Weight of vapor inhaled, grains	383.	4,496.
Weight of vapor exhaled, dew point 94°, saturation being 16.69 grains per cubic foot, grains	10,264.	8,111.
Vapor exhaled above that inhaled in 24 hours	9,881.	3,615.

Excess of respiratory evaporation in favor of Cheyenne in winter over Charleston in summer, 6,266 grains, or thirteen ounces.

If the two modifying effects previously mentioned were to be taken into consideration, together with the usually increased activity of the respiratory organs in such cold as compared with such warm atmospheres, the result would show for Cheyenne in winter a daily passing off of vapor from the lungs of at least a pint more than for Charleston in summer. This calculation accords with the sensations and the greatly-increased thirst experienced in cold, dry climates, especially when exercising.*

This is the argument of the increased pulmonary evaporation due to the coldness and dryness of the air. It can not be ignored, though the stated records of pulmonary transpiration may be modified by different allowances for elevation and the dew point of expired air.

It is not claimed that dryness itself is an independent feature. On the contrary, it will be seen as we proceed how every successful climatic constituent really favors or produces this one which we have placed at the head of the list. †

II. COOLNESS OR COLD PREFERABLE TO WARMTH OR HEAT.

The importance of cold, in the composition of the curative atmosphere we seek, is hardly less than that of dryness. In fact, the two are so interdependent and necessarily associated, they can not be easily separated.

1. How much atmospheric humidity is influenced by the element of temperature is shown by the sensational effect of cold. It is through conduction chiefly that the body parts with its heat. Evaporation and radiation together do not equal this agency of conduction, which the circumambient atmosphere, in common with everything that touches the body, possesses in no small degree. Now the conductibility of the air depends greatly upon its moisture. It is with the air as it is with solid substances. A bar of iron feels very much colder than the same-shaped piece of dry pine, though they both be of the same temperature. The iron is by far the better conductor, the same as is moist cold compared with dry cold air. To those who have never previously experienced a dry, cold, and sunny morning on the eastern slope of the Rocky Mountains, there is a deception in the sensation of cold which is equivalent to fifteen to twenty-five degrees. One seems to be in a much warmer atmosphere than that in which he really is. Temperature, then, is a relative attribute, and can not be considered as independent of humidity.

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* How much the activity of the skin is relieved by this increasing pulmonary evaporation would be a very interesting problem to work out, if it could be done.

† Aside from exceptional effects merely upon sensations, the only consideration which seems to be arrayed against atmospheric dryness is the announcement of Lehmann that "the exhalation of carbonic acid is greater in a moist than in a dry atmosphere, temperature remaining the same." (Lehmann, "Physiological Chemistry," Philadelphia, 1885, vol. iii., p. 414.) *Per contra*, Crawford's experiments prove that the pulmonary exhalation of moisture is much greater in low than in high temperatures, while Draper says twice as much carbonic acid is liberated with a temperature of 68° as at 106°. Well, then, a slightly lower average of temperature compensates for the little difference mentioned by Lehmann. Besides, we are in favor of the cooler temperature for other reasons than because of the remarkable power cold has in drying the atmosphere. As Dr. Lombard has expressed it : "In the altitudes the digestion, the muscular exercise, and the lowering of the temperature increase and accelerate the exhalation of carbonic acid."

Aside from the drying effect of cold upon the atmosphere already alluded to, low temperature has several remarkable as well as useful effects in the arrest of phthisis.

2. Heat expands the air, so that the contrast between the temperature of the atmosphere and that of the body indicates the swelling effect cold air produces when full breaths are taken. Any doubt about this can be dispelled by trying the simple experiment of breathing one's utmost into a spirometer in a heated room, when the air is frozen out-doors. Then step to the door, take a full breath, and try again; the difference should in part indicate the expanded force heat imparts to the inhaled air. This lung-stretching capacity of inhaled cold air is especially appreciated by those of us who hold that it is most often the lack of use which paves the way to infiltrations or tubercular deposits in the apices or other portions of the lung periphery. It is to these out-of-the-way places the expanding air carries the evaporating influence of dryness.

3. Cold stimulates and heat depresses. This is a generally accepted proposition which needs no extended elaboration. The sensations themselves are a good guide, and the colder the air the more stimulating it is. As Dr. Wise expresses it, when introducing the winter climate of the snow-covered region of the Alps, "A bright sun and blue sky overhead, a clear and quiet atmosphere, distant sounds transmitted to the ear through the still air, combine with the charms of the scenery to produce such a buoyancy of spirits that a man is braced and invigorated for almost any exertion." *

It is in harmony with this stimulating effect of cold that the respiratory function should be diminished in activity in hot climates, and an increased amount of blood be found in the lungs of those who live in cold countries, as is shown by Parkes, Rattray, and Dr. Francis of the Bengal army. The last of these found, from a large number of observations, that the lungs are lighter in Europeans in India than the European standard.

The increased quantity of blood circulating through the lungs, of course, means increased oxidation of the blood and renewal of tissue. The pulmonary lymphatics join in the increased activity, the nervous system is exhilarated, and the whole nutrition is improved.

4. Cold is not only stimulating and encourages needed exercise, but under certain conditions it may result in a desirable sedative effect. The sleep which comes at night after the day's exhilaration and excitement induced by cold, is the most refreshing of all rest. Dr. Wise refers to the analogous somniferous effect of cold upon animals which hibernate. Dr. George Bodington, one of the first to appreciate the dry, cold-air treatment of consumption, wrote, in 1840: "The application of cold, pure air to the interior surface of the lungs is the most sedative, and does more to promote the healing and closing of cavities and ulcers of the lungs than any other means that can be applied." †

5. The effect of cold in destroying or impeding germ life, especially the life of the bacillus of tubercle, is a most important consideration.

This is diametrically opposed to the fostering of nearly all germ life, which is the effect of moisture and mild heat. If one has ever camped out on the top of a Rocky Mountain pass, as on a given occasion did the writer, he will never forget the noiselessness of that insectless and germless locality. The only sound heard was that of a solitary cricket, and as for bugs or flies, it would have been a paradise for some tormented housewife whose life is made a burden by these evidences of atmospheric vitality. The nightly freezing of the air, together with its dilution through lessened atmospheric pressure, are enough to render germ life impossible. But the best evidence is that which has reference to the climate and natural life conditions of the bacillus, limited as they are to a narrow range of temperature. This most interesting information is given us by Dr. Hermann Weber in his excellent "Croonian Lectures on Chronic Pulmonary Phthisis." "The air which we inhale perhaps does not so often contain the fully-developed bacillus as is supposed by many people, for this microbe does not thrive in the air at the usual temperature, but requires, according to Koch, a temperature approaching that of the human body. Its growth entirely ceases below about 82° F., and above 107°, and it thrives best at about 98° to 100°, while other pathogenic microbes

* "Alpine Winter in its Medical Aspects," by Dr. A. Tucker Wise.

† Essay on "The Treatment and Cure of Pulmonary Consumption."

have a much wider field: for instance, the anthrax bacillus, which grows luxuriantly between 67° and 74° and up to 110°."*

This evidence should be borne in mind by the defenders of Italian and Florida heat or Pacific Coast dampness.†

6. The investigation of seasonal effects in phthisis shows the salutary influence of cold. This may appear strange to those people of the North Atlantic, Middle, and Lake States who flee to the South in terror of the winter weather. Admitted; but do not thousands yearly leave moist England for a winter stay in the frozen uplands of Switzerland? The force of this consideration is not appreciated except through a recognition of the importance of dryness. Notice on a winter seasonal map the prevailing northwest, west, and southwest winds, some one of them everywhere moving toward the great interior lake region of the United States. The cooling of the air currents, causing condensation of vapor, with the addition of moisture already existing, is enough to produce cloudiness in this section six to eight-tenths of the winter season. The effect of cold moisture (already referred to) renders this a climate to be avoided by enfeebled lungs. When, however, the other attributes—dryness, elevation, and sunshine—are favorable, the winter is the best time of year for most consumptives. In cases suitable for positive treatment, these favorable climatic conditions, by means of this cooler temperature, can be increased to a climax, so to speak, of success not otherwise attainable. The experience of invalids in Colorado bears out this conclusion. It is to secure the cooler temperature in summer time that some of the phthisical patients from the plains are sent higher up to the parks and divides of the Rocky Mountains. The effect of the change is very generally good; and a tubercular fire, which had been re-kindled in Denver on the approach of warm weather, had been re-arrested, as appearances indicated, by a sojourn in a cool park 8,000 feet above the sea.‡

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* "A further point against the spread of the tubercle bacillus out of the human body is that it does not form spores in the air, while the anthrax bacillus does. Another peculiarity in the life of the former is that it grows slowly—that it requires as many days for its development as the anthrax bacillus requires hours. This circumstance seems to diminish our danger considerably, for we may presume that the bronchial mucous membrane, when healthy, materially assists the expelling act of expiration, by its ciliary functions. We are, however, less secure when by catarrhal or inflammatory conditions the mucous membrane of the bronchi, and especially of the smallest divisions, is deprived of its protecting surface, and when the respiratory acts are imperfectly performed, especially the expiratory, thus allowing the stagnation of impure air in the alveolar spaces and permitting the bacilli and their spores to develop under circumstances most favorable to them."—"Chronic Pulmonary Phthisis," by Herman Weber, M.D., London.

† Here it is that the writer ventures the inquiry: What relation have the chills and low temperature of tuberculosis, regularly succeeded by the intense fever, to the limited range of temperature which bounds the existence of tubercle bacillus? Does Nature appreciate the presence of this myriad enemy, and, worked up to a given point of resistance, try to freeze and then heat it out?

Is the life principle carrying on single-handed this unequal fight with millions of germs, only in the end to be worn out and to succumb? Do we know enough of this bacillus of tubercle—this microscopic enemy of the human race—to exterminate it? The relation of this germ to that of "malaria" is another difficult problem. Is there a bond of brotherly love, or a cousinship only, between the malarial germ and the tubercular, or do their climates and life conditions in no way harmonize? The writer sought to have this question answered for this Congress by Professor W. H. Walche, of London. In regretting his inability to be present, he says: "Ah, malaria! That is a subject for an emperor of pathology, climatology, and various other ologies. How curious it is; one fancied, in the boyhood of one's medical career, that the whole affair was clear enough. Now, in the evening of one's days, one knows that the whole subject remains to be re-worked, on absolutely new lines."

‡ The following case illustrates in a striking manner this favorable influence of cold. Being that of a careful and observing physician, the evidence is thereby strengthened.

Dr. W. H. R., of Kansas City, examined July 12th, 1887, at Denver; age 29, graduate of Bellevue, '83; single; no especial inheritance; well until spring of 1884; then had a cough, and in summer lost more flesh than usual. Cough and expectoration stopped each fall and during winters. Each spring they returned, and he lost more weight each summer. Since May, 1886, cough has been continuous. In May and June, 1886, had drenching night-sweats. "Over one-half pint each night of gangrenous and purulent-looking expectoration," which continued more or less after arriving in Colorado. This was July 5th, 1886. Felt elevation only slightly, and went to Cassells, west of Denver, 8,050 feet above sea level. Elevation not too high, and in two weeks went up to "timber line" (11,000 feet), a course to be repeated very cautiously, if at all, by any other like affected invalid. Night-sweats ceased two weeks after arrival, and temperature fell from 103° to 100° F., and then to 99½°. The morning temperature was normal instead of sub-normal, as before arrival. There was decided arrest by the last of August, when he returned to Kansas City. In two weeks after return evening temperature back to 102°. Night-sweats returned, and had two hemorrhages, the first in his case. The fall was dry and favorable, and after frost he gained rapidly. By January 1st was back to his normal weight, and ceased to have night-sweats. Temperature about 99¼°. February 1st returned to Denver, fearing the approach of warm weather, and April 1st went up to Cassells and remained until July 10th. Always better in dry weather; the altitude not unpleasant.

III. RAREFACTION *vs.* SEA LEVEL PRESSURE.

That altitude is not made to precede dryness and coldness may need to be explained, in view of the great prominence given to elevation by Jaccoud in his excellent work on pulmonary phthisis, which, by the way, contains a better appreciation of the benefits of climatic treatment than any other similar book extant. The difference is this: In the present classification the qualities which altitude produces are given their due prominence without special reference to their causes, while rarefaction is considered as an individual quality, with special reference to its mechanical effect upon the respiratory function.

The consideration of elevation is divided into:

1. The effect upon other climatic attributes.
2. The physical influence upon man in health.
3. Its effects in disease, and the experience of invalids.
4. The evidence of immunity from phthisis.

First. We have already adverted to the influence of rarefaction in producing dryness and coolness. Its effect upon sunshine, diathermancy, variability of temperature, wind movements, radiation, quick drainage, etc., will appear as we proceed.

The expansion of the air is equivalent in degree to any given elevation. The extra space occupied carries with it its due proportion of atmospheric moisture. In favorable localities for health resorts this deprivation usually more than counterbalances the condensation of vapor which is due to cold. The result is a total decrease of moisture, which is shown by the small percentage of cloudiness, low relative humidity, and also a small absolute humidity for all such favorable localities. (See Seasonal Charts already referred to.) Then through its expansive effect on the air, as well as by its influence upon other producers of dryness, elevation is a powerful agent in controlling atmospheric humidity.*

2. As to the physical effect of rarefaction upon human beings the evidence is not insignificant or to be lightly called in question by those who have had no experience with high altitude resorts. Jordanet † gave us a most complete and elaborate exposition of the physiological effects of diminished air-pressure, and, not content with this analytical investigation, he induced Paul Bert ‡ to work out by experimentation, chiefly on the life of birds, the effects of the equivalents of various elevations, even up to starvation limits, as to the supply of oxygen. These and many other investigations could be elaborated if space permitted. Ignoring their trivial differences, we will state only settled conclusions.

Lessened atmospheric pressure leads to an equivalent loss of oxygen, which deficiency Parkes, in his "Practical Hygiene," says is not felt by animals till a rarefaction equal to 14 per centum is reached. This loss is about equal to an elevation of 10,000 feet, and many animals—cats, for instance—do begin to live an abbreviated existence at this height. But there are previous effects which man can appreciate all the way from 3,000 to 6,000 feet, at which latter limit the air is one-fifth rarefied, and this appreciation is from nothing to considerable, in a state of rest, according to the sensitiveness of both the heart and lungs, or one of them.

There is an adaptability of these organs in perfect health which more than compensates for a rarefaction of one-fifth, so that only a pleasant exhilaration is felt, even with moderate

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Weight now 134 pounds; in health 145 to 150; on arrival a year ago 125. Pulse 92; respiration 20; temperature, 10 A. M., 99½°; height five feet seven inches; spirometrical record 167 cubic inches; chest expansion 31½ and 33 inches. Chest well preserved in form; movement decided on right and restricted on left. Dullness more or less over most of the left, especially marked at apex front; tympanitic in character in left infraclavicular region; "cracked metal" sound on stethoscopic percussion below and along inner two-thirds of a clavicle and to the left of the upper third of sternum; with moist râles crackling and high-pitched and cavernous voice and whispered sounds. In left interspinatus region, leathery, squeaky râles at end of forced inspiration. Diagnosis: tolerated third-stage fibro-tuberculosis, now in arrest.

* Upon temperature elevation has a constant effect in the production of cold. It is differently estimated by those who make accurate calculations, but does not vary greatly from about three degrees for each 1000 feet rise. In some favorable localities, as the eastern slope or base of the Rocky Mountains, this lowering temperature is neutralized by local conditions, such as the preponderance of sunshine, the character of the soil—being dry and sandy—and the protection of mountain ranges which drain western humid air currents of their moisture, so that the isotherms, as a given elevation is reached, continue on a western course till the high mountains turn them southward.

† "Le Mexique et l'Amérique Tropicale."

‡ "La Pressure Barométrique, Recherches de Physoiologie Expérimentale," Paul Bert, Paris, 1878.

DENISON'S SEASONAL CHART,

SHOWING

COMBINED ATMOSPHERIC HUMIDITIES FOR WINTER.

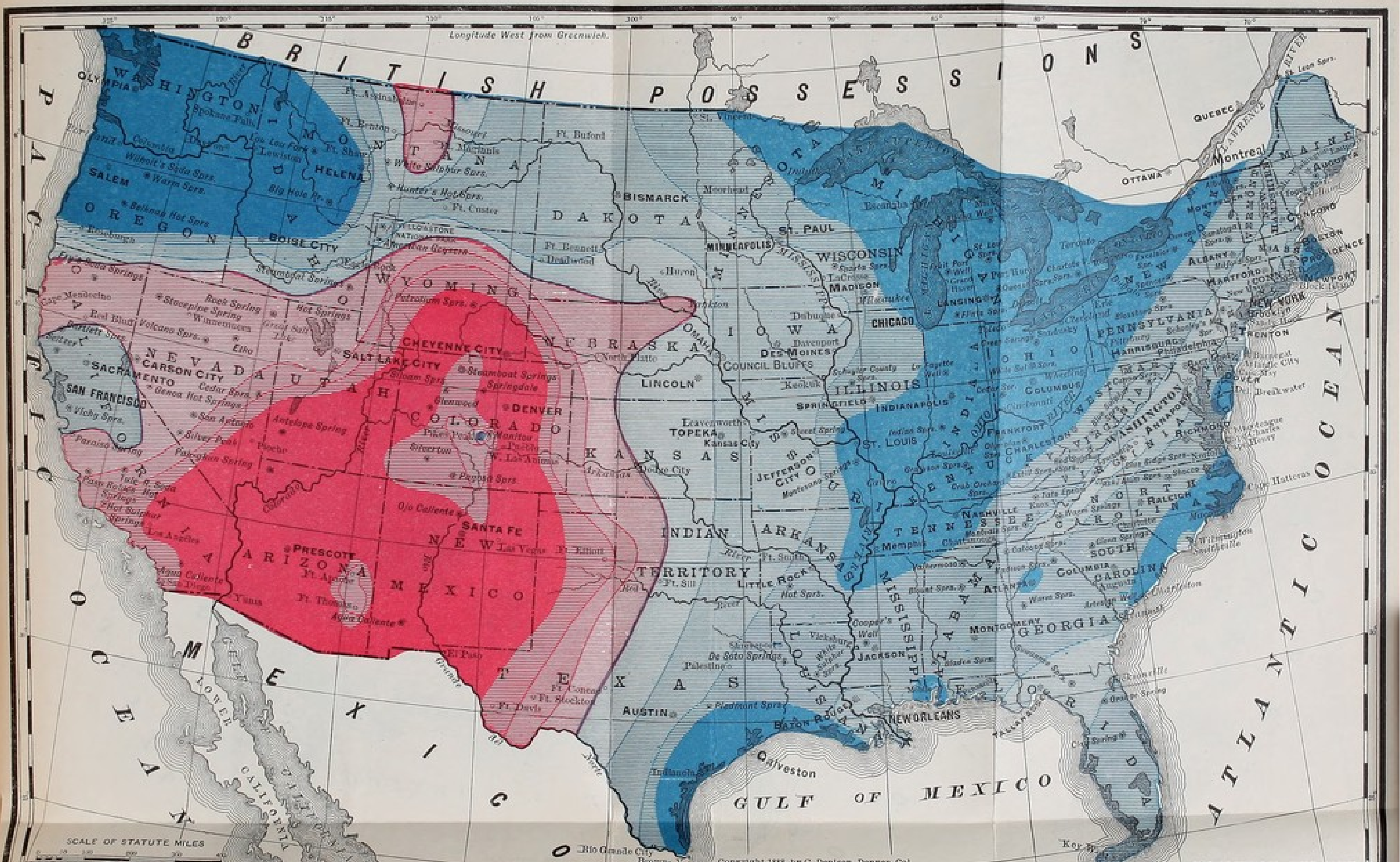
1883.

EXPLANATIONS.

CLIMATE.

Moisture. ...... Extreme .... 2d half. 1st "
Moderate .... 2d " 1st "

Dryness. .... Moderate .... 1st " 2d "
Extreme......... 1st " 2d "



DENISON'S CLIMATIC CHART,

ILLUSTRATING

ANNUAL CLOUDINESS.

AVERAGE, OVER 10 YEARS.

EXPLANATIONS.

PERCENTAGE OF TIME THE SKY IS CLOUDY.

Under 30 — 30 to 40 — 40 to 45 — 45 to 50 — 50 to 55 — 55 to 60 — Above 60

exercise. Much exertion strains this adaptability, and a degree of breathlessness may be reached, which indicates a decided deficiency of oxygen compared with the immediate requirements. However, it is not the point of injury or danger that is intended to be recommended, but the altitudes which produce healthful and well-born respiratory activity in states of rest and moderate exercise. The effect of altitude varies according to the pulmonary or cardiac susceptibility of the individual. We divide the effects into (1) first effects and (2) permanent effects, or acclimatization.

On arrival of a healthy individual in a high altitude there is first an increase, both in frequency and in the depth of respiration. When adjustment to the new conditions has taken place, which requires a variable period, according to the altitude and the individual, the respirations are not nearly so much increased in frequency during rest, but the depth of breathing becomes habitually greater. This is shown by the large spirometrical records of those who live at great elevations and the increased size of the chest in children and in resident adults. This is further shown by the necessity of the climatic change to supply the usual, if not augmented, demand for oxygen which is to meet an increased combustion or change of tissues. The increased exhalation of carbonic acid, due to the chest expansion and lower air temperature, as well as the increased chest measurements in those invalids who are not so far advanced in disease but that the affected lung tissue can be returned to use (an effect noted in the writer's cases, as well as in those of C. T. Williams, Weber, and others), are in perfect accord with the habitual use of more air for all the purposes of living in high altitudes.

The heart and lungs having a reciprocal relation to each other, are both proportionately more active. In imperfect respiratory states, or incipient phthisis, the impeded circulation feels the "boom," so to speak, especially in those portions of the body which were the least active before, namely, in the lung periphery and capillary system generally. The result is a more perfect circulation of the blood and oxygenation of healthy tissues, as well as of carbonaceous and effete materials. The supply and waste are more completely attended to, and the sewer work of the respiratory system, especially, is a cleaner and more finished process. Not only this much, but there is a change in the relative density of the air in the lungs, due to this increased activity and to the fact that the air breathed is rarefied. There is a "pneumatic differentiation," as the inventors call it, going on all the time, and this is better than any spasmodic or artificial effect.

There exists an alternate greater pressure or density with expiration, and less pressure or rarefaction during inspiration, with each respiratory act, *i. e.*, compared with the air-pressure outside the body, and also compared with the usual change of density of the air in the lungs during respiration. This increased outward pressure within the lungs is especially salutary in chronic hypertrophies, etc., of bronchial and alveolar lining membranes, and it has a tendency to open up passages closed to the entrance of pure dry air. Some of the worst cases of phthisis are those where the air cannot reach the microbes or morbid products.

3. It is this question of increased and lessened air-pressure, the augmented respiratory activity and the rush of blood into and through the pulmonary capillaries, which seems to disturb the judgment of many physicians with reference to the liability to the occurrence of pneumonia or pulmonary hemorrhage in high altitudes.

The writer has always maintained, and still holds, that there is no cause for fear if proper precautions are taken as to extreme elevations and the character and stage of the disease existing in the lungs, *i. e.*, that there should be no spots of softened lung tissue (especially near the root of the lungs) which are insufficiently protected by Nature's great conservative process—the deposition of fibrous tissue. Only those cases should be sent who can bear the expansion and augmented circulation without rupture of blood-vessels. In portions of lungs where there is no softening this increased pressure acts on the distended vessels as does a properly-adjusted bandage to a swollen limb. The alternate crowding of the dry air against hypertrophied or diseased alveolar walls, and the suction directly applied through the push given to the circulation, tend to relieve congestion and clean out the products of morbid processes.

There is, as mentioned by Dr. C. T. Williams, "first, hypertrophy, or more complete development of certain portions of healthy lung tissue ; second, emphysema of other portions, specially of those in the neighborhood of the consolidations and cavities." *

* "The Treatment of Phthisis by Residence in High Altitudes."

This increased action and the dilitation help to isolate caseous or tubercular portions, prevent the spread of infection, and promote the cicatrization or fibrination of these affected parts.

Of course, in very acute conditions we are "on the other side of the fence," and it is *rest* which is needed.*

As to pneumonic and hemorrhagic cases, the writer's later experience, and it has been considerable, tallies well with that tabulated in his report to the International Medical Congress of 1876, when records were presented of 202 consumptives who had spent a total of 350 years in Colorado. The pneumonic cases and the hemorrhagic (without cavity) were by far the best influenced of all varieties.†

4. The question of an altitude of immunity from phthisis is important, because there is strong presumptive proof that those climatic conditions which prevail where phthisis seldom or never originates are best suited to arrest the disease when it has commenced elsewhere.

Reference must be briefly made to the considerable evidence of medical writers in favor of an altitude of approximate immunity from phthisis, which, with us in America, ranges not far from 8,000 feet in the southwestern part of the United States to about 4,000 on our northern boundary.‡

As to the quality of the climate which affords this immunity, Jaccoud says: "Altitude is the most important element. . . . Climates with a high altitude, having tonic and stimulating effects, can alone confer on the inhabitants absolute or relative immunity from pulmonary phthisis."

While altitude is the governing element, all the associated favorable conditions of the atmosphere, somewhat in the order in which we have named them, seem to go hand-in-hand until they reach the climax of success in conferring a more or less complete immunity from consumption among the residents at the given altitude.

In illustration of this influence, the records of the mortality from phthisis in the city of Denver during the last year might be cited. The Health Commissioner's report gives the total number as 195 deaths, of which only five originated in Colorado.§

If the much better results were obtainable from the country, instead of from the city, and from a little greater elevation, say at or above 6,000 feet, the immunity would most likely be more apparent.

IV. SUNSHINE AS OPPOSED TO CLOUDINESS.

There is little necessity of advocating the utility of the sunshine. Proof is sufficient, but it is necessarily combined with that of other climatic attributes. Everybody acknowledges the goodness of sunshine, though in summer time they may have a personal preference for shade.

Undoubtedly the effect of light upon man's physical and moral wellbeing is analagous to the fructifying influence of the sun's rays upon the vegetable kingdom. All life depends upon sunshine and, for successful existence, must have it.

The proportion of sunshine to cloudiness depends on the length of day, the exposure of a given place, whether or not concealed in a valley, and on the cloudiness of the sky.

The distribution of clouds in the United States is computed by the Signal Service Bureau in tenths of obscuration of the sky, and from these observations the percentage of cloudiness, and conversely of approximate sunshine, can be noted for the whole country.

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* Therefore, experience in high altitudes naturally leads to the appreciation of using restraint to chest movements in pneumonia. The cotton jacket, with pressure to the limit of comfort, is the writer's custom in catarrhal or bronchial pneumonias of children, which are more apt to occur during extremely cold weather in high altitudes.

† It was the writer's intention to give cases illustrating effects mentioned in different parts of this paper, but lack of time compels their omission.

‡ Jourdanet's "Le Mexique et l'Amérique Tropicale." Dr. Hermann Weber's "Climate of the Swiss Alps." Dr. S. Jaccoud on "The Curability and Treatment of Pulmonary Phthisis," pp. 286–295. The writer's "Rocky Mountain Health Resorts," p. 94. Among other authors who have furnished proofs of an altitude of immunity, the following should be included: Drs. H. C. Lombard, C. T. Williams, Kuchenmeister, Bremer, Archibald Smith, Fuchs, Nubry, Spengler, Kirsch and Guilbert.

§ It is unnecessary here to refer to the effect such imported deaths from phthisis have upon the mortality statistics of a given locality.

To illustrate this distribution of cloudiness, the writer has drawn the lines representing all these records of the United States Signal Service Bureau up to January, 1886. (See accompanying chart.)

The variations for cloudiness range from above sixty per cent. of the time, over the interior lake region, down to less than thirty per cent. in the southwestern portion (New Mexico and Arizona).

Taking so broad a field into calculation, a striking harmony is noted between cloudlessness or sunshine and the other favorable attributes. They all go together.

A preponderance of sunshine should be mentioned as favoring the possibility of much-to-be-desired out-door life, and also of the camping-out idea in summer time. Many excellent illustrations resulting therefrom could be cited if time permitted.

V. VARIABILITY *VS.* EQUABILITY.

How uniformly variability goes with dryness and equability with moisture can be illustrated by the daily and monthly ranges of temperature at places which represent dry and moist climates.

Chosen without reference to this particular evidence, twenty-five dry and twenty-five moist prominent stations and health resorts in the United States give the following means :—

TABLE IV.

	Means of Daily Ranges.	Means of Monthly Ranges.
First—Extreme dryness	36.51°	53.65°
Second—Moderate dryness	20.63°	49.38°
Third—Moderate moisture	17.09°	45.48°
Fourth—Extreme moisture	13.61°	41.55°

Again, taking the fifteen most and the fifteen least variable signal stations in the United States for 1883 (out of the 136 stations), we have the following daily ranges averaged by seasons and for the year :—

TABLE V.

Fifteen Stations.	Spring.	Summer.	Autumn.	Winter.	Year.
Most variable	30.7°	29.1°	28.4°	28.5°	28.7°
Least variable	12.1°	12.9°	10.8°	12°	11.9°

The first are extremely dry, and the second fifteen decidedly moist localities.*

Seasonal ranges of temperature likewise show the inseparability of equability from atmospheric moisture and of variability from dryness. Compare the winter and summer temperature lines on seasonal charts. The sea is the great equalizing influence, and the colder land in winter turns these isotherms to the south for a considerable distance in the United States, viz., about parallel with the Pacific Coast. In the summer, however, when they leave the ocean, these lines are turned nearly as much to the north as the winter ones are to the south. The further we get away from humid influences the greater is the variability of temperature.

It is not claimed that extreme variability should always be sought for, nor that of two places with all other advantages the same the more variable one is the better. On the contrary, the less variable would certainly be preferred in cold weather. It is claimed, however, that variability is quite a uniform constituent of dry, high climates, and that as the dryness predominates, the marked variability is less felt, and is less, if at all, objectionable. On the other hand, marked atmospheric equability, wherever found, is *prima facie* evidence of excessive humidity.

The worst that can be said against combining variability with the favorable attributes of climate for phthisis is that its defense is necessary, because it is a *sine qua non* of the preferable combination. Very well; but there would be no excuse for advocating a false theory of climate, even if this one element were unfavorable. There is a prevalent exaggeration of the effect of temperature changes. The change gets the blame which rightly belongs to the

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* The highest average variability for the winter of that year was La Mesilla, N. M. (34.6°), and the lowest both San Francisco, Cal., and Key West, Fla. (8.8°).

element of humidity, which constituent is always excessive when a given change is injurious. For instance, a change of 20° from a warmer to a colder temperature, with relative humidity .50 per centum, does not equal in sensation or shock to the system a change of 8° with relative humidity at .80. The former change does not produce saturation, but the latter does; so does a change of 5° with humidity at .90, and even 2° with humidity at .95. (See Glaisher's table.) Therefore it is the humidity of the air which, through conduction of heat from the body, makes a slight temperature change, with air near saturation, equivalent to a much greater change with the air dry.

It is toadyism to the mistakes of medical antiquity for equability to be any longer insisted on as a constituent of the best climate for phthisis. It is all right and essential for humid climates, but for dry, cool, and elevated resorts it is out of the question. There is something wrong with the reasoning powers of an author who jumbles together climatic attributes so that his "ideal climate" has no real counterpart among the known climates of the world! The trouble is chiefly with the vague use of the words "equability" and "variability." There has been no accepted line of definition between these two terms. If the mean of variability for the whole country were taken as a just division, and the daily and monthly ranges of temperature were the criterion to decide by, we would then have a division-line approximately represented by 18° to 20° for the daily, and 46° to 48° for the monthly range, the same being in harmony with the dividing line between moisture and dryness.

Besides the quality of stimulation, which is associated with variability, there is an important consideration in the purifying of the atmosphere which variability indicates. This happens through the alternate expansion by heat and contraction of the air by cold, together with the nightly chilling and sometimes freezing, which regularly renders it inimical to germ life.

The purity of atmosphere which is represented by warm, moist, and equable climates is not to be compared with that purity which is represented by the opposite attributes. The first is where the temperature so continuously hovers within the limits of the microbe's needs —where sound as well as heat is smothered within a short distance, and the sun's rays give a dusky-red glow. The second, indicating a comparative absence of germs—is where exposed meat can cure and not spoil, where far-distant objects appear near, and the unobstructed rays of the sun give nearly as white a light as does an electric lamp.

VI. DIATHERMANCY *VS.* DENSE, MOIST, OR SMOKY ATMOSPHERES.

The clearness or transparency of the air is a decided indication of its purity. It is with the atmosphere as with water. The larger the lake, with perfectly clear water, through which one can see to a great depth, the better is the evidence of purity. So a large area, having throughout a similar atmosphere, through which one can see most remarkable distances—and besides, probably, be deceived as regards the same—must indicate, as does its coldness, rarefaction and dryness: that the purity is approaching the absolute.

This increasing purity of atmosphere—that is, the absence of dust or smoke, or of moisture with its attendant infusoria—is a decided feature of elevation, because with each rise of 1,000 feet an equivalent stratum of air has been left down below, and, according to Prof. Tyndall, each successive stratum contains less and less of infusoria.

Prof. Miquel, of the Observatoire de Montsouris, near Paris, has achieved a result in the analysis of the air which, as mentioned by Dr. Poore in his Cantor Lectures, is very interesting in this connection.*

Miquel found the following numbers of bacteria in ten cubic metres of air taken as nearly as possible at the same time, in July, 1883, at the respective places :—

TABLE V.

At an elevation of from 2,000 to 4,000 metres	None.
On the Lake of Thun (560 metres)	8
Near the Hotel Bellevue, Thun	25
In a room of Hotel Bellevue, Thun	600
In the Park of Montsouris (near Paris)	7,600
In Paris itself (Rue de Rivoli)	55,000

* "Chronic Pulmonary Phthisis," by Hermann Weber.

These figures, whatever way they are studied, are certainly suggestive of the fact that atmospheric purity, in so far as its aseptic nature is concerned, keeps pace with diathermancy.

A rule for the average change in diathermancy, for each rise in elevation, was devised by the writer in 1876 from consecutive observations of the sun temperature at two P. M., and at different elevations.* It is as follows:—

For each rise of about 235 feet there is one degree greater difference in temperature between sun and shade at 2 P. M., as shown by metallic thermometers.†

VII.

An attempt by the writer to graphically illustrate the distribution of soils in the United States, on the basis of their absorbent or moisture-retaining proclivity, was met by many obstacles. Such work pertains rather to the duties and obligations of the Government. This much, however, is evident, that the distribution of atmospheric moisture closely coincides with that of soils. The dry soils, the rocky and sandy portions of mountainous configuration, and the dry, sandy loams, with rapid absorption of air vapor and radiation of heat, nearly represent the dry sections, atmospherically speaking. *Per contra*, the clay soil and marshes of level sections, with their moist cold and the easy solution of organic emanations, are closely associated with the moistest atmospheres, excepting where there are humid currents from over large bodies of water or extensive marshes. This correspondence with reference to broad areas becomes a strong proof of the utility of our preferable combination of climatic attributes.

VIII.

A mountainous configuration of country, aside from the benefit of elevation above the sea, has many advantages over a level region. Chief among these are the quick drainage, which allows of no detention of stagnant water; the greater surface of the earth exposed to absorb atmospheric moisture; the many faces of rocks, etc., favoring radiation of heat and reflection of light; the element of stimulation, both atmospheric and electric; the controlling of severe winds; the variations of scenery, temperature, and exposure afforded; and the facility with which one can indulge in the useful "climbing treatment" and pleasurable out-door activities. When these advantages are compared with the moisture-retaining properties, the sameness, the "siroccos," the trade winds and the "northers" of level regions, there is not much difficulty in choosing between them.

IX.

The changes in the atmosphere, in consonance with the variability of temperature of high climates, are in no small degree electrical. There is an increase of electrical tension and an easier and more frequent interchange between the positive electricity of the dry air and the negative quality of the ground and of clouds, so that the condition is decidedly stimulating. This quality in mountainous sections is associated with light showers, especially in summer time, when most needed to clean the atmosphere. The simultaneous whirl of a light or rapid wind, often seen in high altitudes, purifies by its substitution of an unused and fresh supply of air for that which is contaminated.

Where people crowd together in large numbers, the daily freezing of the air is the only sufficient substitute for the movement which is caused by a mild wind. We thus arrive at the conclusion that, in densely-settled sections, *continuous stillness of the atmosphere is only to be preferred in the freezing weather of winter.* In other words, the warmer the atmosphere, the more is air-movement desirable.

X.

It is where there is a total absence of land influence, as in sea voyages and on islands far out at sea, or on dry, sandy coasts with favorable sea winds prevailing, that low climates

* "Rocky Mountain Health Resorts."

† At great heights the protection of thermometers from extraordinary radiation must be secured to get a fair test.

may, if necessary, be substituted for high ones. The malarial and organic emanations from the soil, which are a fruitful source of increased mortality from phthisis (Buchanan and Bowditch), are thus excluded from the climatic calculation.

The aseptic condition of the atmosphere (Miquel), with its quality of stimulation, and the tonic effect of the change, with the invigoration of all the bodily functions—including the improvement of appetite and digestion—are all akin to the best effects of high climates, though the bacillus of tubercle is not so decidedly eliminated.

There is nothing more evident about this discussion than that the element of altitude is inseparable from the best climate for phthisis. A natural question then follows: What is the limit up to which this combination of qualities can be carried, that the best results may be obtained? The answer is, It is a question of *individual adaptability*.

The best method of conclusion is to determine what conditions or diseases are suitable for the extreme of the preferable combination of attributes, and then arrive at modifications or rejections of the high climate cure by a system of *exclusion*. This is the position always held by the writer,* and he is pleased to see the confirmation of it by the extended experience of Jaccoud, as given in his late work on "The Treatment of Phthisis." Jaccoud's conclusions are in the main correct; but it must be borne in mind that they pertain to a more northern latitude than we reason about in the United States, where the limit of timber growth is at about 8,000 feet elevation, as compared with a similar limit at 11,000 feet in Colorado; that the gradual rise, distance, and the peculiar protection of our interior altitudes make the change from low levels less severe here. Also, that we in America have an immense advantage over most European high climates, in that we keep up the curative effect by suitable increase of altitude in summer. Instead, they are compelled, as at Davos, St. Moritz, etc., to give up the chosen climatic treatment during the warm weather.

The plan of deciding if the preferable climate can be utilized in a given case, *by exclusion because of negative conditions*, will not be readily accepted by the advocates of low climates. This is because, generally speaking, the more reasons there are for exclusion from the better climate the less likelihood is there of an ultimate recovery, and no set of physicians want to take only unfavorable cases.

Sometimes it is not an easy matter to decide what change of climate a given patient shall have, because of the many varying considerations to be weighed, both as to patient and climate.

This already too protracted essay can not allow of elaboration. We may only summarize by saying, the preferable climate for the great majority of consumptives in the United States varies, according to the case, from 1,500 feet elevation in the North in winter, to 10,000 feet as a possible extreme in the Southern portion in summer. As to patients, not omitting social and economic bearings, it varies all the way from hopeless cases, with almost no discernible lung lesion, to probably successful ones, with marked pulmonary destructions; as well as from the usual mild remediable cases (simple chronic inflammations) to severe incurable ones.

Of course, then, any rule of procedure must be susceptible of much variation, and the physician who takes the most factors into account, and weighs them best, will be most suc-

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* "Lessened barometric pressure, twenty-five to twenty-four inches, being an important condition of successful climatic treatment, a resort to a well-chosen elevated climate should constitute a part of the physician's advice to every consumptive who can follow it, and for whom the elevation is not specially contraindicated."—*Rocky Mountain Health Resorts*.

cessful in the management of each individual case. With this broad proviso we state some *general contraindications to an otherwise preferable high climate* :—

1. The coldest season of the year, intensifying the effect of altitude.

2. Advanced age of the individual, rendering acclimatization difficult.

3. An excitable, nervous temperament, aggravating the stimulation of climate, producing irritability and sometimes wakefulness.

4. Women, for a like susceptibility, and less adaptability to the change and to out-door life than men.

5. Valvular lesions, with rapid action of the heart, especially with the previous exceptions.

6. Marked and extensive emphysema, pneumothorax and hydro-pneumothorax.

7. Active pneumonia or existing hæmopthysis. If these are recent the contraindications are much less than if they are present; if remote, and without other objections, these diseases are most favorably influenced by the change. If there is reason for some doubt, in any such otherwise favorable case, a gradual rise in elevation should be chosen.

8. High bodily temperature, whether it be rather constant, as in some inflammatory states, or in catarrhal extension beyond a tubercular zone, or whether it be regularly vacillating, as in a tubercular infection, *i. e.*, daily low or subnormal in morning and up to 103° or more later in the day, especially with suspicious laryngeal complication.

9. Extensive involvement of lung tissue in diseased action, *i. e.*, so that the healthy spirometrical record is more than one-half abridged. Of course advanced stage of disease renders this contraindication much stronger.

10. The stage of softening, if accompanied by marked pyrexia, or in one of decided hemorrhagic diathesis.

Allowing patients to go to Colorado, which many physicians have done, as a *dernier ressort*, when they have not a five per centum chance of living more than six months anywhere, needs our strong condemnation.

It must always be remembered that every rule has its exceptions, and that contraindications may be neutralized by favorable circumstances, such as the best time of year for the change, previous experience of the individual in high climates, and the association of opposite conditions in the same patient. For instance, the writer has in mind an excitable lady with aortic insufficiency, neurasthenia, and some fibroid lung, who has done excellently well in Colorado.

Another case of asthma and enlargement of the heart, with mitral regurgitation, was free from asthma while he remained, and was very little troubled with his valvular lesion.

Other and finer distinctions or indications are necessarily omitted for lack of time to consider them. Enough, however, has been here presented to indicate the way to a desirable harmony between *the adaptability of an affected person to the preferable climate for phthisis*, which in most cases is in the dry, cool, rarefied, sunny, clear and pure, though variable, atmosphere of a well-chosen high altitude.

and