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SOME EFFECTS OF CLIMATE UPON PLANT AND ANIMAL LIFE.

A brief residence in tropical America in contact not only with new forms of plant and animal life, but with familiar forms under new conditions was rich in experience and observation tending to show that some causative relation exists between climatic conditions and certain characteristic variations.

That profound variations frequently follow a change of locality has long been known, as has the corresponding fact that all closely similar forms inhabiting the same region tend strongly to assume a common type. For example, the horse will not attain his normal size in south eastern Asia, and no European breed of dogs, save only the spaniel, seems able to retain either his mental traits or his phys-

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ical type when raised in India. Dogs lose their voices in certain islands, and on portions of the west coast of Africa they become rapidly feral both in fact and in appearance. Wool loses its lustre in certain localities, and becomes hair in others.

All species of coffee ultimately assume a common type in Martinique. This seems to show not only that fixed conditions tend to the production of a fixed type, but that, when restricted to a limited area, they can produce but one. Flavor and quality are largely matters of locality, and within reasonable limits no influence either of cultivation, fertilizer or variety is so potent in affecting yield as that temporary balance of climatic conditions that we call "the season."

With every marked change of climate are associated differences in the character and habits of both plant and animal life too marked to be accidental, and in many cases directly traceable to climatic

influences. But while the influence of the sum of those external conditions that we term the climate is appreciated, the particular element or elements that may be responsible for a given variation is generally matter of grave doubt and uncertainty. For example, on one's first contact with tropical conditions he is amazed at the changes,--- at the tangled mass of countless species; at the climbers and hangers, the parasites and the saprophytes; at the harshness and thickness of leaf, and the universal presence of spines and thorns; at the deep purple of the sky, the height of the heavens, and the distance of the horizon; at the heat of the sun, and the cool of the shade; at the great drop in temperature from day to night. He is struck with the stillness and apparent absence of life; at the few species of insects as compared with the infinite variety of vegetation, and he is ready to believe the tropics to be the vegetable part of the world. He stoops

to pick up a leaf, and it flies away. He sees a familiar lichen, but it disappears in approaching. They were butterflies, and he sees more of mimicry than he ever dreamed of. As he lives with it he is overpowered with the sense of its unchangeableness as if it had always been so and was to go on and on forever, each day precisely like every other.

Many of these differences are only apparent or else arise from unimportant and simple circumstances, but others are undoubtedly due to climatic conditions dominant there, whose study reveals many an important truth and whose operation teaches many a general principle. ~~and~~ Others again plainly noticeable are at present beyond rational explanation.

Climates.

Climates are named from their prevailing temperature, but the constancy or variability of that temperature is a potent factor as is the intensity of light, the amount of rainfall, or the

degree of humidity. Some of the peculiarities of the principal climatic regions are:

Frigid: With a minimum temperature and maximum humidity, ~~but~~ provided at certain seasons with continuous light of low intensity, comparatively rich in rays that fix carbon and poor in those that check rapidity of growth, there are provided the most favorable conditions possible for rapid growth for a given short space of time.

Torrid: With maximum temperature, with varying but generally slight humidity and light rays passing vertically through an atmosphere singularly free from dust and haze,--- all conditions of life are present in maximum intensity of minimum duration as between day and night and of extreme constancy from day to day.

Temperate: Our own climate is exceedingly variable from day to day and from season to season, giving occasional temperatures in excess of ordinary tropical, and with light of less intensity

than the equatorial and less continuous duration than that of the higher latitudes,--- so does length of day in the growing season compensate for loss of heat by obliquity. It is to be always remembered that scarcely two places in the same latitude have the same climate, and that names of climates are but relative terms.

What now are the principal effects that commonly attend and that are likely, in a measure, due to these wide differences in atmospheric conditions of life?

Effects likely due to Light.

Contrary to a general impression, tropical grown timbers are exceedingly hard and dense, and, as a rule, of slow growth and small size. This should be expected. The quantity of light shed is enormous and the fixation of carbon correspondingly great. But the clear atmosphere of those latitudes arrests but few of the rays of high refrangibility, that are known to substantially

check the growth, and the plant enjoys therefore conditions highly favorable for formation of dry substance, but unfavorable for growth, in the sense of increase of size. It is plain that tropical conditions are most favorable for density of growth, and observations sustain the position. Not only among timber trees, but with vegetation in general a strong tendency to shrubbiness and woodiness is observable, and to such an extent as to destroy quality in many vegetables.

It must be understood however that certain species are of exceedingly rapid growth, and occasionally of such tender and brittle quality as that large horizontal limbs frequently break off from their own weight. Are these trees deficient in power of fixing carbon? Certainly their leaf surface is remarkably slight.

Motile organs of plants being sensitive to light it is in the tropics that movement in plants is found most common.

Light undoubtedly exerts some influence upon the formation of color, because cave animals are notably deficient in this particular. Whether coloration of pigment bodies is absolutely dependent upon light like the greening of chlorophyl grains is, however, doubtful, for a stem of a growing plant may be led into a darkened space, and, although its leaves produced there may remain white, it is capable of producing colored flowers and fruit if only other portions of the plant enjoy the sunlight.

It is undoubtedly true that intense light tends strongly to darken the complexion, but it is difficult to detect much effect of the kind in the tropical island of Barbadoes. It is to me a serious question if the humidity of insular and coast localities does not go far to counteract the effect commonly ascribed to light, as it certainly insures a fair complexion to our British cousins of the west coast.

If tropical species of plants or animals be more highly colored than temperate I am satisfied it is due mainly to other causes than increased light. One fact is marked. In the dazzling light of these regions all color effects are intensified, and if an animal is to find protection in mimicry the imitation must be exact. As I shall notice later the struggle for existence is terrific in these latitudes and every principle of selection or protection is utilized to its utmost. It is also true that many birds and insects are strangely silent, owing undoubtedly to their enemies, and, as we should expect, these forms are highly colored; but singers are, as with us, of a dull color, and of quick movement and rapid darting flight, in which they are closely imitated by many butterflies. Where all vegetation is ever green and blossoms are always plentiful, green with red is the prevailing color of the surroundings, and it is not surprising that these same colors are so

common among birds and butterflies.

Tropical foliage is notably less delicate than temperate, the leaves being either harsh and coarse, often with spines along the lower sides, or, if smooth, then thick and heavy and clothed with an epidermis of cells placed endwise to the surface. Even in this case the tendency to produce thorns is extreme, the midrib of a parallel veined leaf frequently being prolonged into a heavy thorn as in the century plant, and occasionally both margins and heavy midrib are thickly studded with strong hooked spines, as in the pine apple and related forms.

Experiments are conclusive that either bright sunlight or dry atmosphere tend to production of thorns and that shade and humidity tend to their suppression, so that arid regions afford all the conditions for spiny growth, and here it is most plentiful.

Whether it is the light or the heat that

is responsible for the harsh and forbidding leaf surface is difficult to decide. However the best representative I know of this form of leafage is the common potato. Being a native of Peru it may be supposed to bring to us something of tropical character of leaf. But while Peru is noted for its intense light, its temperature is moderate, owing to its elevation. Moreover the potato will not endure the heat of a tropical sun at ordinary levels and this to me is good argument for attributing to light the chief agency in developing the roughened leaf as we know it is in developing spines and the dense epidermis of elongated cells mentioned above.

Almost the only exception to the rule of a harsh leaf in the tropics is in the great grasses, in certain climbers which bear delicate foliage, and in the coffee with a leaf resembling the chestnut though heavier. It is fair to say that sunlight (or heat) sufficient to produce the

greatest possible yield of Mocha causes the dropping of the leaf.

Effects due to Dryness, or to Humidity.

That we enjoy the cooling effect of perspiration most perfectly and therefore endure high temperatures most comfortably in a dry atmosphere is readily seen, while in great humidity the perspiration stands in drops and becomes scalding hot. As aridity tends to produce hard and spiny vegetable growth and humidity softer and more delicate, so wool turns to hair in high temperatures and dry atmospheres, and extreme lustre and silky fineness are possible in but few localities. Humidity as well as coolness seems essential to thickness of skin and fineness of covering, for the tropics or sub-tropics produce no fur, except on burrowing species and on parts of the body in elevated regions, as on the neck and withers of the vicuna. It is a curious fact that only the same parts of the sheep retain the wool on being taken into the

tropics.

Effects due to Heat.

As among all the elements of climate, plant life seems most sensitive to light, so heat appears to be the controlling force in inducing variations among animals.

Hibernation, the ability to exist in a state of suspended or reduced animation is due to other causes than cold, though certain cold blooded animals are made inactive by reduced temperature alone. Hibernation among higher animals presupposes the ability to store, somewhere about the body, sufficient fat to sustain the reduced needs of the body during this period. With us, hibernation is contemporaneous with the winter season and the greatest cold, but I cannot avoid the conclusion that the real cause of hibernation is scarcity of food. When the food supply of any animal is cut off for any reason he must store,

hibernate, or starve.

The hog, in his ability to store fat, has the first requisite of hibernation and several authenticated instances of forced semi-hibernation of this animal are known.

But cold is not the only cause of scarcity of food and the camel by filling his hump in times of plenty is better able to endure hardship and short feed until the hump becomes an empty bag,--- that this is a step towards hibernation is easily seen.

Several species in the equator have the ability to go into suspended animation from excessive heat or drought, and so remain for many days or even weeks. This is closely analagous to the behavior of bacteria when threatened with adverse conditions, and to the phenomenon of seeds in which temperature and moisture are the two principal considerations that determine the limit of the period of suspended activities.

Hibernation then is to be regarded as forced by the lack of any essential condition of activity, whether temperature, moisture, or food, and it is easy to understand that after a long series of generations with constantly repeated seasons of cold and scarcity hibernation becomes habitual if not instinctive. But that it is an acquired habit with our hibernating species of temperate regions is shown by the fact that the same species so far as represented in the tropics show, there, no signs of the habit. There is no need of it when all trees and plants are "ever green." Hibernation there is from heat or from lack of moisture.

No climatic influence is more marked or interesting than the effect of high temperatures upon animal life. It may be well at the outset to caution against the idea that equatorial climates are necessarily torrid, or burning. I kept daily readings for two and one-half of the summer months at 20° south and the highest temperature recorded

under shade of a tree was in December 30° C. or 87° F., in January 33 1/2° C. or about 92° F., and in February 35° C. or 95° F. It was rarely below 28° C. at noon. It is in the temperate regions that we get the extremes of temperature, but only at or near the equator the cumulative influence of uniformly high degrees of heat.

The most marked influences of these temperatures long continued on humans and on all higher mammals is extreme lassitude, a depressing influence impossible to shake off, and this is attended by a diminished appetite for food. This might be expected and throws interesting light upon the physiology of feeding.

It is frequently taught that a good portion of the food in our climate is directly oxidized to provide heat to sustain the body temperature above that of the surrounding medium, and that warmer surroundings would materially lessen a wasteful consumption of food for heat only. If this be

a true principle why is the animal so distressed when the surrounding temperatures approach his own, and why, long before they become equal, does he begin to reduce temperature by perspiration? It seems conclusive that the animal body is a center of heat production, incident and necessarily consequent upon its vital and metabolic activities, and that it is necessary for the body either to exist in a temperature considerably below its own, to withdraw its surplus by radiation, or else to resort to some other expedient to prevent destructive accumulation and death from rigor caloris. Whenever radiation cannot keep pace with production then relief is sought first by the cooling effect of evaporation, and perspiration follows. As a last resort when sufficient reduction can be no longer effected either by radiation or by evaporation, and then only, is recourse had to relief by lessened production and this always means lessened acti activity and reduced demand for food. But this is

a last resort, and the lessened activity precedes and does not follow the diminished appetite. Under excessive heat the reduction may sink to a point where only the vital processes are sustained and all external labor stops of necessity.

The feeling of lassitude is therefore but the well known law that among warm blooded animals cold increases and heat diminishes the metabolism of the body. It is the premonition that we are being overcome by our surrounding temperatures.

Here is an important lesson in the housing of animals. Protection from extremes of cold is wise, economical and humane, but absolute lack of exercise and warm quarters leads most certainly to lessened activity. We keep a domestic animal for some labor or product which is the output of his functional activity. The vital processes must go on, and these functional activities that give us values are the first to be reduced or to disappear under adverse conditions, among which

nothing is more pronounced than excessive surrounding temperatures.

Precisely what constitutes depressing temperatures varies with the animal. I never saw in temperate climates the high degree of activity noticeable among the butterflies of the tropics. In this they may resemble the cold blooded animals whose body temperatures rise with surrounding heat, and whose activities are correspondingly accelerated. In any event both butterflies and reptiles are exceptionally active in the tropics, but I am satisfied that mammals are capable of greater exertion when the surrounding temperature is 30° below their own.

Whites, Negroes, and Indians manifest marked differences in enduring high temperatures, and the Indian suffers most. His skin is always hot, and he seeks the shade and the water for relief. The Negro's skin is comparatively cool and he is quite indifferent to the sun. I am con-

strained to believe that he is defended by his lessened production of heat, and this view is supported by his small consumption of food and sluggish movements.

The disease most likely to overtake man in hot climates is fever,--- that is to say, loss of the power of reducing temperature by perspiration induced by the shock from the sudden change from the heat of the day to the frequently uncomfortable coolness of the night. As everybody knows, during the progress of fever appetite for food ceases.

Effects of Constancy of Conditions.

The absence of annular rings is not the only effect of unchanging conditions of life, but the struggle for existence is a new battle in the tropics where the climate takes but little part.

The winter season of higher latitudes serves to reduce greatly the number of competing species. Again some start too late in the spring,

and others cannot endure drouth, and in the endless round of ever changing conditions but few species can be adapted to withstand the great variety of adverse conditions, and the competition of their neighbors as well. Hence it comes that a given area in the higher latitudes will be possessed by a few hardy and persistent species.

At the equator on the contrary the struggle is mainly for room and light. If a plant had opportunity to start it will have encouragement to live. Groves of a single species therefore seldom form, for the battle is not clearly to the strong, but thousands of species live together in tangled confusion growing tall and slender,--- an eternal race after light that forces many to lean against their neighbors for support, and ultimately to become climbers. How a single frost, or a longer drouth than common, or any pronounced irregularity of conditions would thin out species and turn the tide of war. In certain districts of the

Amazon subject to periodic overflow this circumstance interferes to kill the undergrowth that otherwise fills every chink and crevice of soil or light.

Under conditions of such fierce competition those plants that are able to reproduce without seeds by some runner or sprout or offshoot from the parent have a substantial advantage, and we are not surprised to find an unusually large proportion of vegetation reproducing in this manner.

So common is this that some species have nearly lost the seeding habit, as for example the sugar cane that almost never seeds, the bamboo and the century plant that blossom but rarely and multitudes of wild forms peculiar to these regions.

A seed may be regarded as a portion of a plant developed to maintain suspended animation during the continuance of conditions adverse to the species. Now under constant favorable conditions the primary necessity for seeding disappears,

and many have all but suspended the exhausting process. That it is a suspension is evident by its resumption and activity upon the advent of threatening conditions, as when all the bamboos of a given species in some locality flower and fruit in a single season.

The distinction between annuals and biennials does not obtain in the tropics. The distinction in high latitudes is convenient, though more apparent than real. If a plant requires a longer time to prepare for fruitage than is afforded by one season in our climate and cannot endure the winter it will disappear from our flora. If it can endure it resumes its activities the succeeding growing season and fruits. If fruiting kills it we term it a biennial, if not a perennial. Nearer the equator with no interruptions to growth no such distinction obtains, and plants, both species and individuals, fruit whenever the proper age and maturity are reached, whether in 3, 6, or

8 months, or 1, 2, or 10 or more years, or whenever the life of the species is threatened. It is marvelous, where all inducements are to vegetate and the tendency is plainly to postpone seeding, what a change takes place if some accidental circumstance brings adverse conditions, and seed is freely produced.

Often with us whether a plant is annual or biennial depends solely upon the season in which we start it and the time we allow it, for example spring and winter wheat, or rye. The same is true of any plant in any locality, if only it can endure the period of cold or wet or drouth of that region. On the equator the cotton plant becomes a tree into which a man may climb.

This principle has important bearing upon the matter of grain production. If the tendency is to avoid seed production and produce by other means if possible, then a climate that will not permit indefinite growth may thereby stimulate

seed production. I am strongly inclined to believe that the threatening check of autumn tends to seed production and is analagous to the practice of gardeners to increase flowering by withholding food. Is it not true that lessening any essential condition of life tends to seed formation? Maize will flourish on the equator but it requires six months to ripen and bears a small erect ear, high up on a heavily butted, scantily leaved and woody stalk.

Hardy hangs an important agricultural truth, founded I believe on natural law: To secure maximum yield of grain an early and vigorous growth is essential to provide material for its building, and to secure the fruit buds or the seeds the vegetative processes must be checked at a comparatively early stage. If the crop be corn then we should force its early growth and cease culture or any treatment to prolong its natural life period,--- to intensify rather than to prolong the conditions of growth.

Unchangeable environment affects the flora and the fauna differently,--- increasing the species of the one as we have seen, and as surely and naturally decreasing those of the other. That is to say the fewer and simpler the principles of selection the more species result among plants, and among animals the fewer. In the tropics an animal or insect is freed from danger of death by rigors of climate, but in the fierce struggle for food he is nearly certain to be eaten.

Now non-carnivorous forms, unless protected by distasteful odors or mimicry, are always subject to reduction by their carnivorous fellows, without means of retaliation. It is only a question of time when the carnivorous forms will prevail and much more surely than if they themselves were subject to some destructive conditions.

This reduces species to comparatively few, all but exterminates the beetles and establishes on safe ground the pugnacious wasps and ants and

the butterfly with his distasteful pigment or his marvelous mimicry.

In some localities where the bird tribe are surrounded by enemies especially destructive they become gregarious --- all species together --- for common protection, the silent and timid attracted into the company of the noisy. One may thus be for a time in the midst of a noisy chattering multitude of all sorts of birds on a hunting march, which soon passes leaving the neighborhood as silent as before. It is marvelous to note to what extent animal life subsists upon itself.

The principles connected with fatigue of nerve or muscle so far as known seem to indicate clearly that it is vastly more exhausting to endure a constant tension of a given degree than to sustain even greater nerve or muscle exertion when relieved by periods of rest. Nerve and muscle response to stimuli is naturally periodic and the body wearies under perpetual exertion even to a

moderate degree. This is reason for believing that the changes of climate and food incident to temperate regions are exceptionally favorable to the highest degree of both physical and mental development.

Not due to Climate.

It is frequently asserted that high temperatures are favorable for the production of starch and fat, but unfavorable for the production of proteids, and the examples given are the difference between northern grown and southern grown varieties of wheat, and between this great cereal and rice.

But northern grown wheats are spring wheats. As in all seeds, the highly nitrogenous germ forms first. The northern summers are too short to complete the process of supplying the full complement of starch, and a shrunken kernel results comparatively rich in albumen, because absolutely poor in starch. The same thing given a longer season either by making it a winter crop or by mov-

ing it into lower latitudes would take on its normal amount of starch.

But this is simply a case of arrested development, and has nothing to do with the relation of high temperatures to production of albuminoids. True, rice is comparatively starchy and sugar cane is a tropical plant, but the millets are not especially deficient in protein, and the sugar beet was improved in Germany. Though certain fruits of the tropics are sufficiently oily to burn if lighted or to furnish acceptable food for dogs, it is also true that the same regions afford a higher percentage of leguminous trees and plants than any other region on earth. I am therefore led to believe that the difference popularly ascribed to climate in this particular is apparent rather than real;--- that the wonderful flora of equatorial regions affords species of almost all known or conceivable characteristics, and that if a short season produces a seed comparatively rich in nitrogen it is

rather to be looked upon as being poor in starch because of arrested development. Grain harvested before maturity, shows the same character of lack of plumpness, i. e., of starch.

A strong notion prevails that climate exerts a controlling influence upon the appetite for certain kinds of food leading one to choose fruits in hot climates, and meat, even fat, in cold. This rests, so far as I can ascertain, upon our own liking for fruits and cooling drinks in the summer season, and the current stories of esquimaux and tallow candles. I can find explanation for the belief, but no basis in fact.

Man~~kind~~ is decidedly omnivorous and he can extract the means of existence from almost any digestible part of any plant or animal not actually poisonous. His ability to endure a great variety of conditions and foods is in no small degree responsible for his universal distribution and great development.

Of one thing we may rest assured. His love for animal food is pronounced and universal as to climate and condition. Not so many domestic animals are kept in hot climates because it is vastly less labor to live on the spontaneous vegetation. But the appetite is there and I have seen diseased and dying cattle killed and eaten. In certain districts many cattle are poisoned by drinking the juice washed out of the mandioca root in making tapioca. These are always consumed for food. Large quantities of salt cod fish are eaten on the Amazon, and I never saw so much fat pork eaten nor with such evident relish as in Brazil.

Chinamen are vegetarians from necessity, not from choice, as witness their eating rats, and even mice. Population is too dense and demands upon food supply too great to support domestic animals, and the self introduced rat pays the penalty by discharging the debt to the carnivorous tooth of man.

Whole sections of Parana eat nothing but beef, and I have seen near the equator the most insignificant little animals resembling ground moles cooked for food, not to mention locusts, ants, and almost anything to satisfy this universal appetite.

Juicy fruit in great quantity is avoided in hot countries as sure to impair digestion and induce fever. It is not " cooling." Of this I feel satisfied and that our own changed appetite in summer is primarily due to desire for drink and for a lessened amount of food.

I have endeavored to learn if climate has any influence upon the appetite for stimulants or opiates, but thus far with little success. Certainly the impression prevails in warm countries that stimulating drinks are necessary. I look upon it as a theory to bolster up the practice. It can be readily understood that something to arouse for a time from the natural lethargy of the

country might be grateful, and it is true that while drinking is general it is a rare thing to see a man " dead drunk." Whether this is due to its constant and not periodic use, or to climatic influences I do not know. It is a common saying that to drink in the shade is to get drunk. But the quantity of liquor, tobacco, and strong coffee used is enormous, and shows strong appetite for those things which will act upon the nerves, but I doubt if the appetite is climatal.

The use of opiates seems to be racial. Whether in the remotest degree connected with the climate or the food of these people would be interesting to know. But the appetite of man is so decidedly omnivorous and new habits so readily learned that it is hazardous to consider coincidence in these matters as much indication of causal connection.

I am utterly unable to explain the unusually high percentage of leguminosae in the

Amazon district. I do not understand this to be true of all hot countries. It is true that this region is geologically behind, and can it be true that leguminous herbage preceded other vegetation and provided a store of nitrogen in the soil?

The prevalence of plants with a milky juice is unexplainable as is the greater proportion of conspicuously flowering trees.

Parasitism is unbounded, and weakened and dying vegetation is every where covered with parasites to be succeeded by saprophytes, and dead animals are immediately consumed by carnivorous birds and insects --- buzzards, wasps and ants --- so that decomposition of organic bodies is rapidly effected, and without the ordinary slow process by putrefaction.

While the total shade cast by the combined vegetation is deep and complete, still I was never able to account for the open and irregular foliage and limited leaf surface of most individual plants.

Whether the evergreen habit of gradual and continuous replacement of foliage, or whether the intense light renders it unnecessary, or the great heat undesirable I am unable even to approach an answer.

Human inhabitants of warm countries are notably early maturing, and, especially females, early to decay. Mothers of twelve years and grandmothers of twenty-five are not unknown nor even uncommon. Is this early maturity due to heat? Probably not alone. The earliest maturity does not go with the apparently most successful development, but rather with the children of the poorer classes who show unmistakable signs of lack of nourishment --- drawn features, thin shoulders and limbs, and protruding abdomens. When children do not play, development is in some way abnormal. I am disposed to look upon this early maturity as a matter of arrested and consequently hastened development, partly due to depressing effect of excessive heat and often to deficient and irregular food supply.

This is further borne out by the fact everywhere observed that this early maturity and decay is doubly true of women as compared with men, and is explainable by the weakening effect of frequent childbearing at an early age and before full development. One cannot dispel the conviction too, that all this is encouraged by the nudity among children in hot countries, apparently operating to the abnormally early development of the sexual instincts.

Another principle bears upon this most important fact. There are several ways in which a species may fade out and disappear,--- by crossing, by failing to reproduce its kind, and by a shortened life period generally accompanied by increased reproduction at an abnormally early age. The two first are universally recognized and easily understood, but the last is everywhere about us and is equally effective. Its unmistakable signs are many young and few matured or old, with degeneracy and quick breeding among the females. All

of our tropical races and sub-races are old and many are fading out. One is surprised even in thinly populated districts at the many children and the few old people. Here is where a woman is wrinkled at twenty and old at thirty.

This has important bearing on the raising of particular strains of domestic animals. It is not that strain capable of producing young in greater numbers which will ultimately prevail, but the one whose individuals are vigorous, long lived, and surely fertile in a normal steady fashion, not discharging this most important function in an erratic abnormally active, but physically imperfect manner. The study of departing races, and of degenerating lines of our own or of any race, is replete with lessons along this line.

The effect of climate upon size is involved in the above, but seems not sufficiently accounted for. For example, the native horses of northern Scotland are abnormally small. Is it on

account of cold? The pawing habit of the horse shows him to have been a native of a country much covered by snow. Besides, in all southeastern Asia no full sized horse is produced. Excessive heat certainly reduces size except in cold blooded animals, easily understood, and in pachyderms as not so readily explained. Humidity has been held to be the all controlling force in reducing size in the horse, but we are indebted to north central Europe for large size of most of our domestic animals, if not of man himself.

Certainly size being primarily a matter of development will be influenced by any circumstance that will affect the metabolic processes of the body; that is to say, insufficient food, deficient nutrition, or extremes of heat or cold would operate to reduce size, and I am disposed to believe that the ability and the opportunity to consume a full ration of good food regularly in a stimulating temperature includes the fundamental

requisites of complete development and tendency to increase of size.

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