ADDRESS:

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ON THE RELATIONS OF PHYSICAL GEOGRAPHY TO AGRICULTURE.

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The scope of Physical Geography is so ample, aiming to exhibit the heap of special knowledge gathered by descriptive geography, so as to constitute a harmonious whole, (allied by numerous relations and subordinate to the general scheme of the universe,) that it would be impossible to do more than bring a small portion of that information before you this evening.

My object, on this occasion, is to show how necessary an aid to agriculture it may become, by pointing out the close connexion which exists between the coast conformation and the altitude of this continent; between the trend of the mountains and the direction of the winds which pass over the whole surface.

Physical Geography may be described as involving a general description of the earth's surface; not in regard to man in his social and political relations, (this being descriptive geography,) but with reference to all mutual relations of matter and vitality on the globe. It comprises a very large and important part of an universal knowledge of nature; treating of the forces by which our globe is affected; of the atmospheric veil which is hung around our globe, and its varied appearances; of the vast ocean which covers so large a portion of the solid surface with an uniform fluid; of the way in which the land is distributed; the disturbances and alterations to which it is subject; the mode in which it has been elevated; and the natural families, both animal and vegetable, which exist upon it now or have existed in times gone by. It is in fine a combination of various observations, and an attempt to establish unity among a vast quantity of phenomena.

The importance of the study of Physical Geography lies not merely in its relations to agriculture, but also as forming a part of the history of our globe, which introduces to our view the preadamitic day when the sun shone and the earth did not regard it; when the seed-time and harvest of nature were in perpetual action; and when solar or external warmth was, if felt, not felt as that impetus to growth and awakening to vegetable life which was produced wholly by the increased and self-sustaining temperature of the crust of the globe; of the long epoch which elapsed until refrigeration was sufficient to allow of the perception of seasons, and during which period no wintry hand was held forth, at periodic intervals, to chill the operations of vegetable life.

The study of the ancient physical geography of the continent has been forced upon us by the advance of geology.

The present valley of the Mississippi was at no distant period (geologically speaking) occupied by an arm of the sea of considerable breadth, washing the base of the Rocky mountains on the one side and the Alleghanies on the other, and extending north or northwesterly by the present position of the larger lakes, and terminating by joining the great northern ocean. Our present continent consisted then of two islands, or groups of islands, running north and south, placed alongside this middle sea, and possessing an abundant flora of a warm and insular climate. The extent of the coal-beds and their position so far to the north of districts which could now sustain congeneric species shows at the same time the luxuriance of vegetable life and the change which the climate has undergone. In the early tertiary beds we have for the first time the cognizance of the occurrence of a winter, and also that of a gradually shallowing sea. The islets on each side gradually and slowly emerging, and forming ultimately a connected mainland, and obliterating the connexion between the cold and warm oceans, leaving our noblest river as the poor representative of the primitive sea.

This change of level, which made our continent one and entire, must have entailed a considerable change in the climate, of which the tertiary winter was the first appearance. The current which flowed originally through the internal sea passed toward the North, carrying the warm waters of the tropics towards the poles. The Gulf Stream, as it was, flowed along this channel and carried the warmth and vapors through the heart of the continent, and thus elevated its temperature far above its present level. This difference of temperature may of itself almost have been sufficient to allow of insular or tropical vegetation flourishing in high latitudes.

As the elevation of the land and consequent shallowing of the sea was very gradual, so must also have been the lessening of the temperature, and the occurrence of those extremes of heat and cold which characterize continents having extensive plane surfaces fronting to the North.

Unappreciable in a single generation, or perhaps many successions of them, it has yet made wonderful changes in the flora and fauna of the country, whose dependence for existence on temperature is so inevitable.

Looking upon our globe not as an inert, stationary mass of matter, but as constantly in motion, a motion not confined to it as a mass, but extending to its most internal particles, so that at no one period can we say of them that they occupy the same position they did the instant before, as exposed to various influences and reacting on its various parts, we have placed before our consideration many problems of deep and lasting interest.

And since the occupation of those whom I have the honor to address is connected with the surface of the earth and the changes by which it is affected, no apology, I am sure, is necessary from me when I endeavor to recapitulate some of the results of these reactions produced upon a larger and grander scale than the eye of a single observer can take in, and, viewing them in a more general way, mix a little philosophy with our every day work.

[Dr. Antisell exhibited four sections of the continent made on an extended scale, (40 miles to the inch,) which showed the altitude of the continent along several parallels, the vertical scale being at the rate of 1,200 feet to the inch. The line of the four sections ran as follows:

Section 1 lies between latitude 44° and 48° north. The length of this portion of land is about 3,200 miles from Puget Sound to the shores of Maine; it crosses the Cascade mountains, the Valley of the Columbia and Spokane rivers, the Bitter Root and Rocky mountains, to the Milk River valley; touches the Missouri, and reaches the Mississippi at St. Paul's; thence to Chicago and along the frontier.

Section 2 lies between latitude 38° and 41° 36′. The length of this section is about 2,600 miles from the Pacific shore north of San Francisco, California, to Council Bluffs, and thence to the Atlantic about parallel 40°; crosses the Sierra Nevada, Humboldt River valley and mountains, Salt Lake Valley, Wahsatch mountains, Green River valley, Park mountains; thence along the Platte, Kansas, and Missouri rivers to St. Louis; finally to the Atlantic along latitude 39°.

Section 3 lies between north latitude 33° 43′ and 35° 59′. Its length is about 2,400 miles. Commences on the Pacific ocean at San Pedro, crosses the Sierra Nevada, and enters the Mojave valley and the mountains separating it from the Colorado valley; thence up Bill Williams's fork to the valley of the Colorado Chiquito; thence to the headwaters of the Rio Grande, across the Pecos, to the Canadian, and down it to Preston, and thence to the Atlantic ocean along latitude 36°.

Section 4 lies between latitude north 32° on the western shore and 29° on the eastern shore. Its length is about 1,800 miles. This section commences at San Diego, on the Pacific shore, crosses the Sierra, the Colorado desert and river, ascends the Gila, crosses the region of mountains, basins, and strikes the Rio Grande at El Paso; thence southeast over the margin of the Llano Estacado to San Antonio, Texas, and terminates at Indianola, on the Gulf of Mexico.]

We will now consider the configuration of our continent. The sections showing the elevation or altitude of the continent above the sea level, which (we shall not now examine further) were obtained by the surveys made in the Pacific railroad examinations, indicate to us how greatly the country is exposed on the north to the fierce action of polar winds. An extensive plain north of 60°, sloping down to the Polar sea with its level, interrupted only by the chain of the Rocky mountains, terminating at the mouth of the Mackenzie river: this mountain range, although deranging the level, is no protection from northerly winds, which, ascending the gentle slope of the continent and taking the same or a similar trend with the mountain chains themselves, pour their immense volumes of dry and chilled air over the middle portions of the continent, reaching to the shores of Cuba. In 42° north latitude the continent gradually increases in altitude, owing to the development of parallel chains and the formation of a great plateau upon which these chains are figured—a plateau which drops both north and south—is bounded abruptly by the Sierra Nevada on the west side, and drops slowly down on the east to form the Mississippi valley. The sections presented illustrate this plateau and the mountain chains.

The effect of this geographical configuration is to give the continent a climate of extremes, and, by its increased summer temperature, to allow the development of a larger number of species of plants toward the north than could occur if transverse mountain chains were spread across the continent. The extreme cold of winter is produced by a combination of several causes; such as—

1st. The small quantity of land in the torrid zone.

2d. The Rocky mountain range and Sierra Nevada.

3d. The expansion of the continent to the north and northeast.

4th. The warmth of our tropics being carried away towards Europe by the Gulf Stream.

5th. The cold current of ice-water flowing close to our east shore.

While our summer warmth is produced by the southwest wind flowing over the southern slope of the continent, and running up the Mississippi valley to latitude 52° north, where its influence is distinctly felt in the valley of the Saskatchewan.

A continent whose projection and elevation is thus given to us must have a very different distribution of warmth over its surface from one in which transverse chains check the flow of both northern and southern breezes.

The meridianal disposition of the mountains allows the north winds to blow with unmitigated force, and also permits the warmer southeast wind to force its way northwards along the funnel-shaped valley of the continent, the effect of which is, that when such winds are prevalent, (as in summer,) the warmth is carried further north than it is either in Europe or Asia, and hence in the same latitudes the climates of continents differ, and even on the same continent the difference is great; so that lines of latitude give us no *exact* idea of climate.

In Europe, where the Alps, Pyrenees, and Carpathians form a barrier from east to west, the African winds are arrested or diverted from their northerly course by the mountain barrier, and the summer warmth of the Baltic Coast is not equal to that of the same latitude on this continent. The northern limit of maize in Europe is in latitude 47°, on this continent it is cultivated in latitude 54°, or seven degrees more to the north; the extreme limit of wheat growth is near Edinburgh, in Scotland, while it grows well 4° further north in the Saskatchewan Valley.

To Humboldt is due the merit of being the first to draw upon the map of the Globe lines of equal temperature, which represent an equal annual warmth everywhere over which it passes, these lines are always curved and might be termed climate lines, but have been called by their proposer by the name of isothermal lines. Were the surface of the Globe even, without any irregularities or local deposits of water, or were the Earth of an uniform nature so that absorption and radiation might go on equally well everywhere, then lines of latitude would convey to us all the information of the climate we need possess, but this is far from being the case. There are many disturbing causes which go to make a curve, of which the chief are, the influence of the currents of air and water, and the variations of the curve thus formed is due to local causes, such as mountains, valleys, &c.

The territory of the United States, is mostly included between the isothermals of 42° and 70° which usually are curves of a large circle extending nothward from the sea-coast on either side, but suffering a great deflection southwards where they cross the Rocky mountains. The western or Pacific termination of the curve is placed many degrees to the north of the eastern limit, owing to the cooling influence of the icy stream which flows southward along the New England coast reducing the temperature of that shore.

As we approach the tropics the lines of mean annual temperature run nearly parallel to one another, and of countries situated within these circles we might (knowing the mean temperature) be able to declare the character of its Agriculture In fact the temperature of each day differs little from that of the entire year, during which period vegetable life proceeds without interruption. It is altogether different with regard to places outside of these zones. The mean annual temperature alone would give us no correct idea of what plants might be cultivated, since it gives us no information what the variation between summer and winter temperatures may be in any place under these lines; and while the mean annual temperature of two places might be alike, the warmth of the summer might present a remarkable contrast; hence, lines of mean temperature for the several seasons were required, and of these that of summer and winter is especially demanded by Agriculture; these lines are termed *isotheral* and *isochimenal.*

In applying our knowledge of isothermal lines to agriculture, this fact must be borne in mind, that it is the *isotheral* line, or the line of mean summer temperature, which is of chief importance; in other words, it is the mean summer temperature, or the mean temperature of the time during which the plant is growing, which is of importance, and as most of the plants which are cultivated for food are annuals, this becomes an important consideration.

The question, can a plant grow or be cultivated in a certain latitude, is answered approximately by determining the warmth or mean temperature of that place during the season of growth.

To Boussingault are we indebted for the first clear insight into the importance of knowing summer temperatures; he showed us that by inquiring what time elapses between the sprouting of a plant and its maturity, and then determining the temperature of the interval which separates these two periods, we learn that each species of plant requires for its maturity a certain amount of heat, (which may be measured by the degress on the thermometer ;) that no matter where the plant is grown, this temperature is attained; if grown in colder locations, the exposure of the plant to the sun must be prolonged in a corresponding degree; in other words, the number of days between the germination of the seed and full ripening of the plant vary with the temperature, in order that the plant may receive its due share of heat.

Hence if we multiply the number of days which a given plant takes to perfect its growth in different climates by the mean temperature of each, we obtain numbers very nearly equal. Thus for Indian corn, we find that in order to ripen it takes an exposure equal to 7,000° to 8,000° of Fahrenheit, and for wheat it does not much exceed 7,200° Fahrenheit. In Wisconsin and the State of New York wheat requires from 7,200° to 7,600° of heat, and 122 days for growing, the mean temperature being 67° Fahrenheit. In Venezuela wheat ripens in 92 days, with a mean temperature between 75° and 76° Fahrenheit, which gives 6,918° Fahrenheit. At Truxillo 100 days mean temperature, 72° 1′ Fahrenheit, which is equivalent to 7,210° Fahrenheit. In Costa Rica it does not require more than 69 days to ripen, with a mean temperature of 81°, which gives 7,209° of warmth. These instances show the total absolute warmth which a plant requires to be exposed to for ripening.

M. Ad. De Candolle has applied this process of calculation of Boussingault to explain the limitation of species of plants toward the north of Europe with considerable success, and has shown that for wild plants as for food plants there is required a certain mean temperature under which only they can grow and propagate. But all these conditions of mere warmth would be lost upon our continent, and rendered useless as regards the growth of plants if moist winds cannot freely blow over the soil. The tropical winds which flow along with the equatorial current of water send a part of their mass along the Rio Grande and Mississippi valleys northward, dropping its moisture as it passes north, and spreading itself laterally so as to cover the whole east of the continent. As might be supposed, the largest quantity of rin occurs upon the first land over which it flows, so that about eighteen to twenty inches are deposited in summer in Louisiana, Alabama, and Florida. The fall of rain gradually lightens as it reaches higher lands, until it is confined solely to the mountain chains, the valleys being passed over without a shower, and this continues until the ocean wind loses all its excess of moisture, and even the mountain summits themselves receive but a scanty supply. Hence it happens that the great sloped plateau east of the Rocky mountains, and the upland plains and valleys of New Mexico, are so sparingly supplied with herbage as to resemble a desert. The atmosphere of the Gulf, so loaded with moisture at starting northward, has, by the time it reaches latitude 38° and 40° in that elevated region, lost almost all its watery vapor. Having now ascertained that moisture and warmth are essential to plant growth, we have yet to learn that a fall of rain over a district does not always imply fertility. In order to insure harvests, it is no immaterial thing when the rain should descend. Summer rains fall over the deserts of Arizona and East California, but they do not render it fertile, nor do the autumnal rains of a part of Texas prove sufficient for the wants of Agriculture; for these rains must fall in such quantities as will produce fertility, and about the time when the crop is being sowed, and during its growth; that is, it must have both spring and summer rains. A fair amount of rain in these seasons will give us (other things the same) abundant crops from annual plants, but this would not be sufficient for the growth of trees; these having their roots further in the ground, require that the nutritious matters in the earth should be supplied to them by a moist soil, a soil well saturated with moisture, which can occur only at seasons when the heat of the sun upon the earth is diminished and evaporation is going on more slowly, which process allows the moisture to pass downward to the rootlets. To produce a growth of trees either winter rains or the melting of winter snows is required. This is a point which has not been dwelt upon by writers.

This prime necessity for winter moisture which trees require leads me to make an observation on the cause of our western prairie lands. Prairies have been attributed to many origins, among which the frequent burning of the woods is deemed by many to be a sufficient cause. Mr. Ruffin, in his Essay on Calcareous Manures, with a pardonable zeal in the cause of lime, attributes the presence of a prairie to the absence of carbonate of lime in the ground, and Mr. Russell, a Scotch meteorologist, (whose views are worthy of being treated with consideration,) thinks that the limits of forest, and the cause of prairie land, to be due to an alteration in the physical character of the soil, by which its surface and subsoil becomes unfitted for the spreading of the roots of the tree. I am not aware that this altered character has been noticed by other observers, but that the cause of prairie land is mainly due to the limited fall of rain, especially in the winter season, is, I think, susceptible of some demonstration.

It is well known that the further west we proceed on the other side of the Mississippi, the more the trees diminish in number, until ultimately they disappear from the table land, being found only in river bottoms or on mountain sides; west of longitude 100° in the United States, trees are but sparsely found; in Texas a long and tolerable wide belt of oak denotes the western limit of trees. The burning of forest timber growth will no doubt repress its annual growth and may be the cause of the local prairies of Indiana, Missouri, and other States, but can in nowise explain the fact that the whole eastern slopes which skirt the base of the Rocky mountains are treeless. Neither Indian nor buffalo could have rendered it treeless. If we take the meridians between 90° and 100°, as being those where forest vegetation ceases to flourish and ascertain the fall of rain during three seasons of the year (the fourth not being material to our purpose) we find it to be thus:

Amount of rain-fall—	Winter.	Spring.	Summer.
	Inches.	*Inches.*	*Inches.*
Along parallel 50	2	5	8 to 10
Along parallel 45	2 to 3	6	8 to 12
Along parallel 40	2 to 7	10	10 to 14
Along parallel 35	3 to 7	11 to 12	8 to 15
Along parallel 30	5 to 18	12 to 14	8 to 20

Where two quantities are given under one parallel the left hand figures refer to the western portion (100°) and those on right hand to the eastern longitudes (90°) of the district in question. Let us select parallel 30° in winter; we find its western limit to receive not more than 5 inches of rain. What portion of the 5 inches will sink into the east and become available for tree growth? It may be stated in round numbers that in the latitude of 30°, one-fourth of the winter rain-fall may sink six feet deep into the soil; this would give us $1\frac{1}{4}$ inch of rain on the west side, and $4\frac{1}{2}$ inches on the east side of the district. The former quantity appears just sufficient to develop the growth of trees, but not to sustain a forest. Masses of trees do not appear until we get east of meridian 90°, where the winter rain-fall is much higher than in 100°; passing north along this meridian we find in latitude 35° the rain-fall of winter to be 3 inches, giving in that latitude six-tenths of an inch of rain for soakage. This is not sufficient for timber growth, and accordingly trees disappear. This probably then is the point of limit of tree growth: a rain-fall in winter equal to five inches. If we construct a hyetic line of five inches we would find it to stretch from the Sault Saint Marie, by Milwaukie, S. W., to the Rio Grande near its mouth; to the west of this line the fall varies from 2 to 3 inches. South of 40° latitude, not many forests are found west of the curve, until the highlands of New Mexico are reached. At the headwaters of the Rio Grande and along the Rocky mountain chains and plateau between 105° and 110° longitude, the fall of winter rain rises to 5 inches and trees reappear. In northern Sonora, in the valleys of the Great and Little Colorado, in the Great Basin, to nearly as far north as Humboldt river, in Arizona, and the southern part of New Mexico, and in northwestern Texas, the fall of winter rain does not exceed one inch, and trees do not occur in the lowlands.

In northern latitudes, where evaporation is much less, of course a lesser rain-fall suffices; but this does not affect the general statement made that the cause of prairies or absence of timbered land is due to insufficient rains during the season of least evaporation. The numerical statistics and the growth of timber here pointed out must stand in the relation of cause and effect, and then is rendered more probable by reference to other countries than our own.

We see analogous instances of the dependence of growth of trees upon the amount of moisture in the soil, in the case of the pampas of South America, where there is a loose sandy soil impregnated with saline matter, and inimical to vegetation as it exists; this tract, called the Traversia, when assisted by irrigation, is the most fertile soil imaginable, (Malte Brun.)

The Steppes of European Russia, and of northern Asia, are not morasses or low and watery places, but, on the contrary, dry, elevated, uninhabited plains, because destitute of trees and water.

Having placed this theory now permanently before the public, I leave it for the criticism of the well-informed, and will return to consider the results of warmth and moisture as regards agriculture as an art. The effect of these two agencies combined is to produce fertility in soils of normal composition.

The rapid partial exhaustion of some of our eastern lands has led to a belief that our soils are not as lasting as those of Europe, a belief which has no reasonable foundation. We do not know what the productiveness of the virgin soils of Europe first were; but cultivated imperfectly as they have been for two thousand years, they still yield abundantly, and they will ever do so so long as they possess depth and obtain moisture sufficient to dissolve soluble matters. The question indeed may be asked, can a soil be exhausted so as to be worthless? that is to say, a soil originally deep and rich. Experience gives us the answer in the negative. The plains of Egypt, still fertile, have been cultivated for four thousand years; the valleys of Arabia for nearly as long; the grapes of Canaan are as large and as luscious as in the days of Joshua. The plains of Greece, Troy, India, and China, cultivated for ~~ten~~ thousand generations, still retain their fertility. No proof has been yet afforded of sterility occurring on a large scale; partial exhaustion may indeed occur, and may be as easily overcome by the efforts of one or two generations. Are our lands inherently worse, less fertile naturally than

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those of the eastern continent, that we are compelled after a hundred years of cultivation to go further westward, in fact to become century nomads, and fill up the Mississippi valley at the expense of the population of the Atlantic States.

From what has preceded, it is evident that if the summer temperature be increased and accompanied by moisture the productiveness of such region is increased. Indeed it is to some extent in the power of each farmer to elevate the temperature of his land by good cultivation. As an example of what may be accomplished in the way of elevating the capability of soil, the efforts of Mr. Coke, of Holkham, (afterwards Earl of Leicester,) may be instanced here. When he commenced the management of his estate, his first agricultural adviser was a Mr. Overman, of Dutch descent, one well acquainted with the evil effects of raising wheat crops in succession. The heads of the covenants of all leases made by Mr. Coke were drawn by Overman, and only restrained the tenants from cultivating two consecutive corn crops, (wheat.) Working on this plan, Mr. Coke, by his turnips and sheep raising, so raised the fertility of his land that in 1850 the second Earl encouraged his tenantry to return to the once justly condemned system referred to, for the reason that the soil, which in 1770 had been exhausted, had in the course of eighty years, through high farming, become almost too fertile.

The whole history of Coke's farming shows to what condition a soil may be brought with profit to the proprietor, for the first Earl made a princely fortune before his death. When he succeeded to the estates of Holkham, the old mansion of the Leicester family lay in the middle of a tract, almost a desert, an uncultivated heath in Norfolk. The last Earl, speaking of the poverty-stricken and deserted condition of the land, used to say that his nearest neighbor was the King of Denmark, and his father described the sterility of portions of the surrounding property by the remark "that he found two rabbits quarrelling for one blade of grass." By his extensive growth of turnips, the use of drill husbandry, his improvement in stock, and, above all, the introduction of the use of oil-cake as food, he has materially improved agriculture. This latter event was in 1824. At that time four year old mutton was deemed the proper age for being slaughtered. By rape-cake and turnips the growth of the animal has so increased that two year old sheep are scarce in the market—the majority being only a twelve-month old.

A little of such practice applied to our tobacco lands would bring them again into valuable condition, and impress on our minds the double truth that while all profits of agriculture are made at the expense of the fertility of the soil, that loss of fertility can always be restored at will.

The estimate of the fertility of a soil is only true when latitude and climate are taken into account; a more genial sun in summer, a greater supply of rain in the growing season, more than compensates for a poorer soil. Perhaps we are not yet in possession of all the influences of meteoric agencies in producing rapid and abundant plant growth.

Our ideas of the richness of soil are derived very much from works published in England and northern Europe; but the conditions of climate so modify the growth of vegetation that we may overestimate a soil or its influence; sunshine and rain occasionally form a substitute for density or chemical constitution.

European observers, looking at the soil of New York or Ohio, on which wheat is now grown abundantly, would at once unhesitatingly pronounce the attempt to reap a crop on such land an absurd one; because on similar lands with their summer warmth no heavy crop could be raised.

The soils of New England would in Europe be considered sterile clays and sands, so that in fact, I am inclined to think that the chemical nature of a soil is of less importance than its physical character; that its color, consistence, and porosity, are more essential than an abundant supply of soluble salts in the land. Dr. Lindly, no mean authority, considers the growth of trees, especially of the forest kind, to be determined wholly by the texture or rather physical qualities of the soil. We need constant and repeated experimenting; no general rules or laws can be, as yet, laid down, agriculture having been so recently followed as a skilled art, not more than three or four generations having passed away since any improvement was introduced.

The advances made in agriculture in the last twenty-five years are the adoption of drill husbandry, and of drainage, the use of guanos, and fertilizers, and an acquaintance with the values of food. Still greater improvements are to be hoped from the future.

Since physical geography thus shows us how a plant is limited by the reduction of the summer temperature, and that limit extended as the soil is warmed, and since our own experience shows us that soil *per se* may have very different values, when exposed to different climates, it becomes a desideratum to increase the warmth of our soils, by those efforts which we know will most effectually accomplish that end, by letting the water out and the air in, by the adoption of drainage and irrigation.

Agriculture when compared with the capacity for progress shown by the other useful arts, is placed in a very peculiar position, and the approach to perfection surrounded by many difficulties; the limits of progress are fixed and inalterable. The problem which the farmer has to solve is not simply how to produce the greatest amount of food for man or beast, but how to produce it from a given area of the soil. The manufacturer may increase his produce by adding to his building and machinery, but the great agricultural machine connot be extended at will. The farmer is therefore in the condition of a manufacturer, who is unable to increase his factory and who must endeavor by a higher speed to obtain from it a greater profit. Like such a manufacturer he is forced to adopt new processes which save mere labor directly, and produce larger returns.* He is obliged to call upon knowledge to assist him, and among those branches which have been less trodden for his benefit, and which also would be of incalculable service to agriculture, physical geography must be reckoned and placed in the first rank.

* Professor Anderson in Transactions of Highland Society of Scotland.