

Chapter IX.

Of The Law Of The Increase Of Production From Land.

§ 1. The Law of Production from the Soil, a Law of Diminishing Return in Proportion to the Increased Application of Labor and Capital.

Land differs from the other elements of production, labor, and capital, in not being susceptible of indefinite increase. Its extent is limited, and the extent of the more productive kinds of it more limited still. It is also evident that the quantity of produce capable of being raised on any given piece of land is not indefinite. This limited quantity of land and limited productiveness of it are the real limits to the increase of production.

The limitation to production from the properties of the soil is not like the obstacle opposed by a wall, which stands immovable in one particular spot, and offers no hindrance to motion short of stopping it entirely. We may rather compare it to a highly elastic and extensible band, which is hardly ever so violently stretched that it could not possibly be stretched any more, yet the pressure of which is felt long before the final limit is reached, and felt more severely the nearer that limit is approached.

After a certain, and not very advanced, stage in the progress of agriculture--as soon, in fact, as mankind have applied themselves to cultivation with any energy, and have brought to it any tolerable tools--from that time it is the law of production from the land, that in any given state of agricultural skill and knowledge, by increasing the labor, the produce is not increased in an equal degree; doubling the labor does not double the produce; or, to express the same thing in other words, every increase of produce is obtained by a more than proportional increase in the application of labor to the land. This general law of agricultural industry is the most important proposition in political economy. Were the law different, nearly all the phenomena of the production and distribution of wealth would be other than they are.

It is not generally considered that in the United States, where in many sparsely settled parts of the country new land is constantly being brought into cultivation, an additional population under existing conditions of agricultural skill can be maintained with constantly increasing returns up to a certain point before the law of diminishing returns begins to operate. Where more laborers are necessary, and more capital wanted, to co-operate in a new country before all the land can give its maximum product, in such a stage of cultivation it can not be said that the law of diminishing returns has yet practically set in.

When, for the purpose of raising an increase of produce, recourse is had to inferior land, it is evident that, so far, the produce does not increase in the same proportion with the labor. The very meaning of inferior land is land which with equal labor returns a smaller amount of produce. Land may be inferior either in fertility or in situation. The one requires a greater proportional amount of labor for growing the produce, the other for carrying it to market. If the land A yields a thousand quarters of wheat to a given outlay in wages, manure, etc., and, in order to raise another thousand, recourse must be had to the land B, which is either less fertile or more distant from the market, the two thousand quarters will cost more than twice as much labor as the original thousand, and the produce of agriculture will be increased in a less ratio than the labor employed in procuring it.

Instead of cultivating the land B, it would be possible, by higher cultivation, to make the land A produce more. It might be plowed or harrowed twice instead of once, or three times instead of twice; it might be dug instead of being plowed; after plowing, it might be gone over with a hoe instead of a harrow, and the soil more completely pulverized; it might be oftener or more thoroughly weeded; the implements used might be of higher finish, or more elaborate construction; a greater quantity or more expensive kinds of manure might be applied, or, when applied, they might be more carefully mixed and incorporated with the soil.

The example of market-gardens in the vicinity of great cities and towns shows how the intensive culture permits an increase of labor and capital with larger returns. These lands, by their situation, are superior lands for this particular purpose, although they might be inferior lands as regards absolute productiveness when compared with the rich wheat-lands of Dakota. New England and New Jersey farms, generally speaking, no longer attempt the culture of grains, but (when driven out of that culture by the great railway lines which have opened up the West) they have arranged themselves in a scale of adaptability for stock, grass, fruit, dairy, or vegetable farming; and have thereby given greater profits to their owners than the same land did under the old *régime*. Even on lands where any grain can still be grown, corn, buckwheat, barley, oats, and rye, cover the cultivated areas instead of wheat.

Inferior lands, or lands at a greater distance from the market, of course yield an inferior return, and an increasing demand can not be supplied from them unless at an augmentation of cost, and therefore of price. If the additional demand could continue to be supplied from the superior lands, by applying additional labor and capital, at no greater proportional cost than that at which they yield the quantity first demanded of them, the owners or farmers of those lands could undersell all others, and engross the whole market. Lands of a lower degree of fertility or in a more remote situation might indeed be cultivated by their proprietors, for the sake of subsistence or independence; but it never could be the interest of any one to farm them for profit. That a profit can be made from them, sufficient to attract capital to such an investment, is a proof that cultivation on the more eligible lands has reached a point beyond which any greater application of labor and capital would yield, at the best, no greater return than can be obtained at the same expense from less fertile or less favorably situated lands.

"It is long," says a late traveler in the United States,(130) "before an English eye becomes reconciled to the lightness of the crops and the careless farming (as we should call it) which is apparent. One forgets that, where land is so plentiful and labor so dear as it is here, a totally different principle must be pursued from that which prevails in populous countries, and that the consequence will of course be a want of tidiness, as it were, and finish, about everything which requires labor." Of the two causes mentioned, the plentifulness of land seems to me the true explanation, rather than the dearness of labor; for, however dear labor may be, when food is wanted, labor will always be applied to producing it in preference to anything else. But this labor is more effective for its end by being applied to fresh soil than if it were employed in bringing the soil already occupied into higher cultivation.

The Western movement of what might be called the "wheat-center" is quite perceptible. Until recently Minnesota has been a great wheat-producing State, and vast tracts of land were there planted with that grain when the soil was first broken. The profits on the first few crops have been enormous, but it is now said to be more desirable for wheat-growers to move onward to newer lands, and to sell the land to cultivators of a different class (of fruit and varied products), who produce for a denser population. So that (in 1884) Dakota, instead of Minnesota, has become the district of the greatest wheat production.(131)

Only when no soils remain to be broken up, but such as either from distance or inferior quality require a considerable rise of price to render their cultivation profitable, can it become advantageous to apply the high farming of Europe to any American lands; except, perhaps, in the immediate vicinity of towns, where saving in cost of carriage may compensate for great inferiority in the return from the soil itself.

The principle which has now been stated must be received, no doubt, with certain explanations and limitations. Even after the land is so highly cultivated that the mere application of additional labor, or of an additional amount of ordinary dressing, would yield no return proportioned to the expense, it may still happen that the application of a much greater additional labor and capital to improving the soil itself, by draining or permanent manures, would be as liberally remunerated by the produce as any portion of the labor and capital already employed. It would sometimes be much more amply remunerated. This could not be, if capital always sought and found the most advantageous employment.

§ 2. Antagonist Principle to the Law of Diminishing Return; the Progress of Improvements in Production.

That the produce of land increases, *ceteris paribus*, in a diminishing ratio to the increase in the labor employed, is, as we have said (allowing for occasional and temporary exceptions), the universal law of agricultural industry. This principle, however, has been denied. So much so, indeed, that (it is affirmed) the worst land now in cultivation produces as much food per acre, and even as much to a given amount of labor, as our ancestors contrived to extract from the richest soils in England.

The law of diminishing returns is the physical fact upon which the economic doctrine of rent is based, and requires careful attention. Carey asserts, instead, that there is a law of increasing productiveness, since, as men grow in numbers and intelligence, there arises an ability to get more from the soil.(132) Some objectors even deny that different grades of land are cultivated, and that there is no need of taking inferior soils into cultivation. If this were true, why would not one half an acre of land be as good as a whole State?

Johnston(133) says: "In a country and among poor settlers ... poor land is a relative term. Land is called poor which is not suitable to a poor man, which on mere clearing and burning will not yield good first crops. Thus that which is poor land for a poor man may prove rich land to a rich man."(134) Moreover, as is constantly the case in our country, it often happens that a railway may bring new lands into competition with old lands in a given market; of which the most conspicuous example is the competition of Western grain-fields with the Eastern farms. In these older districts, before the competition came, there was a given series of grades in the cultivated land; after the railway was built there was a disarrangement of the old series, some going out of cultivation, some remaining, and some of the new lands entering the list. The result is a new series of grades better suited to satisfy the wants of men.

This, however, does not prove that the law of which we have been speaking does not exist, but only that there is some antagonizing principle at work, capable for a time of making head against the law. Such an agency there is, in habitual antagonism to the law of diminishing return from land; and to the consideration of this we shall now proceed. It is no other than the progress of civilization. The most obvious [part of it] is the progress of agricultural knowledge, skill, and invention. Improved processes of agriculture are of two kinds: (1) some enable the land to yield a greater absolute produce, without an equivalent increase of labor; (2) others have not the power of increasing the produce, but have that of diminishing the labor and expense by which it is obtained. (1.) Among the first are to be reckoned the disuse of fallows, by means of the rotation of crops; and the introduction of new articles of cultivation capable of entering advantageously into the rotation. The change made in agriculture toward the close of the last century, by the introduction of turnip-husbandry, is spoken of as amounting to a revolution. Next in order comes the introduction of new articles of food, containing a greater amount of sustenance, like the potato, or more productive species or varieties of the same plant, such as the Swedish turnip. In the same class of improvements must be placed a better knowledge of the properties of manures, and of the most effectual modes of applying them; the introduction of new and more powerful fertilizing agents, such as guano, and the conversion to the same purpose of substances previously wasted; inventions like subsoil-plowing or tile-draining, by which the produce of some kinds of lands is so greatly multiplied; improvements in the breed or feeding of laboring cattle; augmented stock, of the animals which consume and convert into human food what would otherwise be wasted; and the like. (2.) The other sort of improvements, those which diminish labor, but without increasing the capacity of the land to produce, are such as the improved construction of tools; the introduction of new instruments which spare manual labor, as the winnowing and thrashing machines. These improvements do not add to the productiveness of the land, but they are equally calculated with the former to counteract the tendency in the cost of production of agricultural produce, to rise with the progress of population and demand.

§ 3. --In Railways.

Analogous in effect to this second class of agricultural improvements are improved means of communication. Good roads are equivalent to good tools. It is of no consequence whether the economy of labor takes place in extracting the produce from the soil, or in conveying it to the place where it is to be consumed.

The functions performed by railways in the system of production is highly important. They are among the most influential causes affecting the cost of producing commodities, particularly those which satisfy the primary wants of man, of which food is the chief. The amount of tonnage carried is enormous; and the cost of this service to the producers and consumers of the United States is a question of very great magnitude. The serious reduction in the cost of transportation on the railways will be a surprise to all who have not followed the matter very closely; the more so, that it has been brought about by natural causes, and independent of legislation. Corn, meat, and dairy products form, it is said, at least 50 per cent, and coal and timber about 30 per cent, of the tonnage moved on all the railways of the United States. If a lowered cost of transportation has come about, it has then cost less to move the main articles of immediate necessity. Had the charge in 1880 remained as high even as it was from 1866 to 1869, the number of tons carried in 1880 would have cost the United States from \$500,000,000 to \$800,000,000 more than the charge actually made, owing to the reductions by the railways. It seems, however, that this process of reduction culminated about 1879. In order to show the facts of this process, note the changes in the following chart, No. V. The railways of the State of New York are taken, but the same is also true of those of Ohio:

Chart V.

Cost of 20 Barrels of Flour, 10 Beef, 10 Pork, 100 Bushels Wheat, 100 Corn, 100 Oats, 100 Pounds Butter, 100 Lard, and 100 Fleece Wool, in New York City, at the Average of each Year, Compiled by Months, in Gold; Compared Graphically with the Decrease in the Charge per Ton per Mile, on all the Railroads of the State of New York, during the Same Period.

Year	Price in Charge for one ton of products	Decrease in Charge per Ton per Mile	Decrease in gold of carrying one ton	Profits staple farm ton
1870	776.02	1.7016	1.1471	.5545
1871	735.33	1.7005	1.1450	.5555
1872	675.92	1.6645	1.1490	.5155
1873	662.50	1.6000	1.0864	.5136
1874	748.54	1.4480	.9730	.4750
1875	696.40	1.3039	.9587	.3452
1876	651.74	1.1604	.8561	.3043
1877	751.95	1.0590	.7740	.2850
1878	569.81	.9994	.6900	.3094
1879	568.34	.8082	.5847	.2295
1880	631.32	.9220	.6030	.3190
1881	703.10	.8390	.5880	.2510
1882	776.12	.8170	.6010	.2160
1883	662.11	.8990	.6490	.2500

In 1855 the charge per ton per mile was 3.27 cents, as compared with 0.89 in 1883.

Tons moved 1 m. in 1883 by 9,286,216,628 railroads of N.Y. At rate of 1855, would cost \$303,659,283
Actual cost in 1883 83,464,919 Saving to the State \$220,194,364

The explanation of this reduced cost is given by Mr. Edward Atkinson(135) as (1) the competition of water-ways, (2) the competition of one railway with another, and (3) the competition of other countries, which forces our railways to try to lay our staple products down in foreign markets at a price which will warrant continued shipment. Besides these reasons, much ought also (4) to be assigned to the progress of inventions and the reduced cost of steel and all appliances necessary to the railways.

The large importance of the railways shows itself in an influence on general business prosperity, and as a place for large investments of a rapidly growing capital. The building of railways, however, has been going on, at some times with greater speed than at others. Instead of 33,908 miles of railways at the close of our war, we have now (1884) over 120,000 miles. How the additional mileage has been built year by year, with two distinct eras of increased building--one from 1869 to 1873, and another from 1879 to 1884--may be seen by the shorter lines of the subjoined chart, No. VI.

That speculation has been excited at different times by the opening up of our Western country, there can be no doubt. And if a comparison be made with Chart No. XVII (Book IV, Chap. III), which gives the total grain-crops of the United States, it will be seen that since 1879, although our population has increased from 12-½ per cent to 14 per cent, our grain-crops only 5 per cent, yet our railway mileage has increased 40 per

cent.

The extent to which the United States has carried railway-building, as compared with European countries, although we have a very much greater area, is distinctly shown by Chart No. VII. This application of one form of improvement to oppose the law of diminishing returns in the United States has produced extraordinary results, especially when we consider that we are probably not yet using all our best lands, or, in other words, that we have not yet felt the law of diminishing returns in some large districts.

Chart VI.

Miles of Railroad in Operation on the 1st January in each Year, and the Miles added in the Year Ensuing.

Year.	Miles of Railroad.	Miles added.
1865	33,908	1,177
1866	35,085	1,716
1867	36,801	2,449
1868	39,250	2,979
1869	42,229	4,615
1870	46,844	6,070
1871	52,914	7,379
1872	60,293	5,878
1873	66,171	4,107
1874	70,278	2,105
1875	72,383	1,713
1876	74,096	2,712
1877	76,808	2,281
1878	79,089	2,687
1879	81,776	4,721
1880	86,497	7,048
1881	93,545	9,789
1882	103,334	11,591
1883	114,925	6,618

Railways and canals are virtually a diminution of the cost of production of all things sent to market by them; and literally so of all those the appliances and aids for producing which they serve to transmit. By their means land can be cultivated, which would not otherwise have remunerated the cultivators without a rise of price. Improvements in navigation have, with respect to food or materials brought from beyond sea, a corresponding effect.

§ 4. --In Manufactures.

From similar considerations, it appears that many purely mechanical improvements, which have, apparently, at least, no peculiar connection with agriculture, nevertheless enable a given amount of food to be obtained with a smaller expenditure of labor. A great improvement in the process of smelting iron would tend to cheapen agricultural implements, diminish the cost of railroads, of wagons and carts, ships, and perhaps buildings, and many other things to which iron is not at present applied, because it is too costly; and would thence diminish the cost of production of food. The same effect would follow from an improvement in those processes of what may be termed manufacture, to which the material of food is subjected after it is separated from the ground. The first application of wind or water power to grind corn tended to cheapen bread as much as a very important discovery in agriculture would have done; and any great improvement in the construction of corn-mills would have, in proportion, a similar influence.

Those manufacturing improvements which can not be made instrumental to facilitate, in any of its stages, the actual production of food, and therefore do not help to counteract or retard the diminution of the proportional return to labor from the soil, have, however, another effect, which is practically equivalent. What they do not prevent, they yet, in some degree, compensate for. (136)

Chart VII.

Ratio of Miles of Railroad to the Areas of States and Countries--United States and Europe. The relative proportion is 1 Mile Railroad to 4 Square Miles of Area.

No.	Name.	Rank in Size.	Relative.
1	Massachusetts	67	98
2	Belgium	62	96
3	England and Wales	29	88
4	New Jersey	62	81
5	Connecticut	68	80
6	Rhode Island	71	65
7	Ohio	44	60
8	Illinois	32	59
9	Pennsylvania	40	55
10	Delaware	69	53
11	Indiana	50	52
12	New Hampshire	65	45
13	Switzerland	59	44
14	New York	39	41
15	Iowa	33	39
16	German Empire	4	38
17	Scotland	52	37
18	Maryland	63	36
19	Vermont	64	35
20	Ireland	51	29
21	Michigan	31	28
22	France	5	27
23	Denmark	60	26
24	Netherlands	57	25
25	Missouri	26	24
26	Wisconsin	34	23
27	Austrian Empire	3	21
28	Virginia	45	19
29	Italy	13	18
30	Georgia	30	17
31	Kansas	22	16
32			

Kentucky 46 15 33 South 49 14 Carolina 34 Tennessee 42 14 35 Minnesota 21 13 36 Alabama 36 13 37 West Virginia 55 12 38 Roumania 41 12 39 North 37 12 Carolina 40 Maine 48 12 41 Nebraska 23 10 42 Mississippi 38 9 43 Spain 6 9 44 Portugal 47 9 45 Sweden 7 9 46 Arkansas 35 8 47 Louisiana 43 8 48 Colorado 16 8 49 California 8 7 50 Turkey 27 7 51 Texas 2 7 52 Utah 20 6 53 Florida 28 6 54 Dakota 7 6 55 Russia in 1 5 Europe 56 Nevada 15 5 57 Norway 11 5 58 Oregon 18 4 59 Bulgaria 54 4 60 New Mexico 12 3 61 Wyoming 17 2 62 Indian 25 2 Territory 63 Washington 24 1 64 Arizona 14 1 65 Idaho 19 1 66 Greece 58 0 67 Montana 10 0 68 Bosnia and 53 0 Herzegovina 69 Servia 56 0 70 Eastern 61 0 Roumelia 71 Montenegro 70 0 72 Andorra 72 0

(The United States have substantially one mile of railway to each 540 inhabitants. Europe has one mile to each 3,000 inhabitants, if Russia be included; about one mile to each 2,540, exclusive of Russia.)

The materials of manufactures being all drawn from the land, and many of them from agriculture, which supplies in particular the entire material of clothing, the general law of production from the land, the law of diminishing return, must in the last resort be applicable to manufacturing as well as to agricultural history. As population increases, and the power of the land to yield increased produce is strained harder and harder, any additional supply of material, as well as of food, must be obtained by a more than proportionally increasing expenditure of labor. But the cost of the material forming generally a very small portion of the entire cost of the manufacture, the agricultural labor concerned in the production of manufactured goods is but a small fraction of the whole labor worked up in the commodity.

Mr. Babbage(137) gives an interesting illustration of this principle. Bar-iron of the value of £1 became worth, when manufactured into--

£ Slit-iron, for nails 1.10 Natural steel 1.42 Horseshoes 2.55 Gun-barrels, ordinary 9.10 Wood-saws 14.28 Scissors, best 446.94 Penknife-blades 657.14 Sword-handles, polished steel 972.82

It can not, however, be said of such manufactures as coarse cotton cloth, wherein the increased cost of raw cotton causes an immediate effect upon the price of the cloth, that the cost of the materials forms but a small portion of the cost of the manufacture.(138)

All the labor [not engaged in preparing materials] tends constantly and strongly toward diminution, as the amount of production increases. Manufactures are vastly more susceptible than agriculture of mechanical improvements and contrivances for saving labor. In manufactures, accordingly, the causes tending to increase the productiveness of industry preponderate greatly over the one cause which tends to diminish it; and the increase of production, called forth by the progress of society, takes place, not at an increasing, but at a continually diminishing proportional cost. This fact has manifested itself in the progressive fall of the prices and values of almost every kind of manufactured goods during two centuries past; a fall accelerated by the mechanical inventions of the last seventy or eighty years, and susceptible of being prolonged and extended beyond any limit which it would be safe to specify. The benefit might even extend to the poorest class. The increased cheapness of clothing and lodging might make up to them for the augmented cost of their food.

There is, thus, no possible improvement in the arts of production which does not in one or another mode exercise an antagonistic influence to the law of diminishing return to agricultural labor. Nor is it only industrial improvements which have this effect. Improvements in government, and almost every kind of moral and social advancement, operate in the same manner. We may say the same of improvements in education. The intelligence of the workman is a most important element in the productiveness of labor. The carefulness, economy, and general trustworthiness of laborers are as important as their intelligence. Friendly relations and a community of interest and feeling between laborers and employers are eminently so. In the rich and idle classes, increased mental energy, more solid instruction, and stronger feelings of conscience, public spirit, or philanthropy, would qualify them to originate and promote the most valuable improvements, both in the economical resources of their country and in its institutions and customs.

§ 5. Law Holds True of Mining.

We must observe that what we have said of agriculture is true, with little variation, of the other occupations which it represents; of all the arts which extract materials from the globe. Mining industry, for example, usually yields an increase of produce at a more than proportional increase of expense.

It does worse, for even its customary annual produce requires to be extracted by a greater and greater expenditure of labor and capital. As a mine does not reproduce the coal or ore taken from it, not only are all mines at last exhausted, but even when they as yet show no signs of exhaustion they must be worked at a continually increasing cost; shafts must be sunk deeper, galleries driven farther, greater power applied to keep them clear of water; the produce must be lifted from a greater depth, or conveyed a greater distance. The law of diminishing return applies therefore to mining in a still more unqualified sense than to agriculture; but the antagonizing agency, that of improvements in production, also applies in a still greater degree. Mining operations are more susceptible of mechanical improvements than agricultural: the first great application of the steam-engine was to mining; and there are unlimited possibilities of improvement in the chemical processes by which the metals are extracted. There is another contingency, of no unfrequent occurrence, which avails to counterbalance the progress of all existing mines toward exhaustion: this is, the discovery of new ones, equal or superior in richness.

Professor Jevons has applied this economic law to the industrial situation of England.(139) While explaining that the supply of cheap coal is the basis of English manufacturing prosperity, yet he insists that, if the demand for coal is constantly increasing, the point must inevitably be reached in the future when the increased supply can be obtained only at a higher cost. When coal costs England as much as it does any other nation, then her exclusive industrial advantage will cease to exist. In the United States the outlying iron deposits of Lake Superior, Lake Champlain, and Pennsylvania, so geologists tell us, will find competition arising from the new grades of greater productiveness in the richer deposits of States like Alabama. In that case we shall be going from poorer to better grades of iron-mines, but after the change is made a series of different grades of productiveness will be established as before.

To resume: all natural agents which are limited in quantity are not only limited in their ultimate productive power, but, long before that power is stretched to the utmost, they yield to any additional demands on progressively harder terms. This law may, however, be suspended, or temporarily controlled, by whatever adds to the general power of mankind over nature, and especially by any extension of their knowledge, and their consequent command, of the properties and powers of natural agents.