She could no more have doubted him than she could have doubted that her own heart was beating.

"I thought it was Marjorie," she whispered. "It ought to have been Marjorie."

"It is *you*," he cried, "*you* only." And he lifted her hands and kissed them eagerly again and again. "Janie, let me see your eyes."

When they returned home Jane had a marvel of a West Indian ring on her finger, and Tyrrel marched at once into the parlor to have an interview with old Mrs. Marchmont. Jane went up stairs to her bedroom, and in ten minutes Marjorie came knocking at the door. When it was opened to her, she stood on the threshold, radiant—almost more radiant than one would have fancied she need be.

"Come in," said Jane, tingling all over.

She came in, and gave Jane a gentle yet half-excited embrace.

"You are not going to Lausanne?" she said.

"No, I think not."

"Oh, Jane, what—what a darling you are!"

And then next minute Jane found herself seated on a chair, with the princess at her feet, and the blonde head hidden upon her lap.

"He has been in love with you from the first moment he saw you," Marjorie was saying, "and I shall always like him for it. I was afraid at the very beginning, before you came, that—at least not that, exactly, but—Well, you know how grandmamma sets her mind upon a thing, Jane, and—and I did not want him to—"

"Did not want him to do what, dear?" interposed Jane, a faint light breaking in upon her.

"I," faltered Marjorie—"I have always been fond of—of Mr. Ruysland, but he thought that Mr. Tyrrel might make me care for him in the end, and I was half afraid of grandmamma, and now you have made it all easy. Last night Mr. Ruysland proposed to me, and I said yes, Jane."

Mrs. Marchmont received two shocks that day, but she was too thoroughly a well-bred and well-poised old dowager not to bear them with dignity when they came.

"You have disappointed me, Marjorie, my dear," she said to the royal young culprit, in her most majestic manner, "but I suppose old people must make up their minds to being disappointed by the young. You must marry whom you please, of course. The days of forced matches are over."

"Oh, grandmamma dear," cried Marjorie, in her sweetest tone of appeal, "you are not angry with me? Sidney—"

"Don't call him 'Sidney' before me yet, my love," was the stately reply. "It is not pleasant to me. But you may kiss me; and I am not angry, only disappointed."

But she never quite forgave Jane Rossitur, even after that young woman was Jane Tyrrel, and had ripened into a social power, and was unanimously voted the most bewitching and unique young woman of her day.

THE FIRST CENTURY OF THE REPUBLIC.

[Seventh Paper.]

AGRICULTURAL PROGRESS.

THE early colonists of the United States were largely agriculturists, or became so within a very few years after their arrival. A hundred and fifty years before our Independence, agriculture had already a promising foot-hold in several places within our present domain; a full century before the same date in our history the settlements were quite widely extended, nearly all the useful domestic animals and cultivated plants of Europe had been tried on our soil, and most of those we now have were already in successful use.

New and peculiar problems were presented to the new settlers. In the New World they found every thing new. The wild plants were new to them, and the good or bad qualities of each could only be learned by experience, for whether a plant was to be a valuable forage plant or a pestilent weed could not be foretold. Their crops as well as their flocks were subject to ravages by new enemies. Emigrants from nearly every part of Europe brought with them the useful plants they had known at home. But from whatever country they came, and wherever they settled here, they found a climate unlike any they had known before. In the North they encountered a most trying climate, where an almost arctic winter was followed by a semi-tropical summer; the severity of the winter prevented the success of some of the crops which flourished well during summer, while the drier air, clearer sky, and more fervid sun of summer proved unpropitious to others. The warmer parts, too, were unlike the warmer parts of Europe. As a consequence, the adaptability of each crop to our climate had to be tried for itself in each locality. This great experiment went on until one by one these questions were settled. Some crops, after repeated failures, were abandoned, and others found their appropriate localities. Hemp, indigo, rice, cotton, madder, millet, spelt, lentils, lucern, sainfoin, etc., were tried and failed in New England, as did other crops in the Southern colonies. Not only the plants of Europe, but many from Asia and the East Indies, were tried, including such spices as cinnamon, also various commercial plants. Some of these crops, on experiment, failed entirely. Others flourished after a fashion, but proved unprofitable; others flourished with peculiar luxuriance, and with characters unchanged; and still others, under the new conditions, assumed new characters or excellences. Before the war of the Revolution these trials had been made along or near the coast from Maine to Texas, and so completely had this century and a half of experiments solved the great problems of adaptation, acclimation (and often naturalization), that not a single important species of domestic animal has been profitably introduced since, and but one plant, *sorghum*, since added is of sufficient importance to be recognized in our official statistics.

The agriculture of most civilized countries is based on the rearing and use of certain domestic animals, and these in turn depend on the pastures and meadows. The only exception to this is where the cultivation of commercial plants greatly predominates over all other crops. The forage grasses used in Europe were practically indigenous there, and were such as ages of cultivation or use had adapted to the conditions there found. In Great Britain, and perhaps also throughout Northern Europe, the actual cultivation of their native grasses only became common toward the close of the last century. Before that they knew little or nothing of seeding lands to grass, and their pastures and meadows were fostered rather than cultivated. Such cultivation, however, had sprung up in the colonies much earlier, and from dire necessity. Of nearly 300 species of grasses now known to be indigenous to some part of the United States, very few indeed seem well adapted to cultivation. Perhaps more than nine-tenths of the forage of to-day in the cultivated parts of this country is furnished by plants introduced. How and why the artificial production of pastures and meadows and the cultivation of the true grasses sprung up in the American colonies north of the Chesapeake, how the grasses which we derived from Europe, half wild, were caught and tamed, as it were, and sent back for cultivation, is an interesting chapter in the history of American agriculture in colonial times, but it requires more space than we can give it in this review, and is only alluded to because of its relation to stock-raising, to be noticed later.

Agriculture as an *art* had reached nearly as high a point a hundred years ago as it occupies to-day, but agriculture as a *science* has nearly its whole history in the century we are to consider. Science belongs to no particular nation; and thus it is that we can not consider the agricultural progress of the United States entirely independent of that of other lands: it forms too intimate a part of the agricultural progress of the age.

The century is especially characterized in history by mechanical invention and by the growth of the so-called natural sciences, these two being intimately related; and it is through them that all the greater changes have occurred.

The mechanical progress of the century has been so fully treated in previous papers that its relations to agriculture will in this be treated only incidentally; but all improvements in tillage, in planting, in harvesting, in preparing for market, and in transportation are related to the subject under consideration.

The "Centennial of Chemistry" was celebrated in both Europe and America the last year. The specific branch of that science, agricultural chemistry, belongs properly to this century only. Through its influence have come more philosophical theories of the rotation of crops, of the nature and use of manures; and the whole commerce in and manufacture of "commercial fertilizers" is the direct result of this science. It has, moreover, thrown great light on the nature of the soil and its tillage, on draining and irrigation, on the nutrition and fattening of animals, and the production of wool, flesh, butter, and cheese. Moreover, chemistry, in its extensive applications in various manufacturing processes, has introduced new uses for agricultural products as raw material.

The biological sciences have aided in their way. The laws of vegetable and animal growth are better understood, and by the application of this knowledge old varieties and breeds are improved with more ease and certainty, and new ones are made at pleasure for specific uses.

In noting our agricultural progress along the three ways indicated, that produced by mechanical invention comes naturally first, but the three classes of improvements are parallel, and each blends with the other along nearly the entire course.

The first and most obvious aid of mechanical invention has been to lessen the amount of human labor required to produce a given amount of agricultural product. For many of the processes new machines have been devised, and in those cases where old kinds of implements or tools have remained in use, they have been improved in quality, and usually cheapened in price. The simpler tools of a century ago were made mostly on the farms where they were to be used, or by the neighboring mechanic. They were usually heavy and costly to use, that is, costly in labor. With the specialization of labor, and the use of special machinery for the purpose, the manufacture of agricultural implements has become a great industry, the last national census enumerating over 2000 establishments, the value of whose products for that year amounted to over $50,000,000, the value of the product in 1850 having been less than $7,000,000. The value of the farming implements in use on the farms in 1870 was about $337,000,000, while in 1850 it was only about $152,000,000. These figures of manufacture and use at these two periods indicate extraordinary progress in agricultural operations in those twenty years.

This will be more apparent if we consider, in a general way, the different processes. First, as regards the implements of tillage, we may say that either old ones have been improved or new ones devised. Scarcely one remains in its old state. Some of the improvements economize power, others material, and others time; and what the aggregate cheapening of labor in tillage actually is it is impossible to say. A single laborer can certainly till more than twice the acreage, and with some crops three, four, or five times as much. Beginning with the improvement in hoes and simple tools, then passing to iron or steel plows, cultivators, horse-hoes, pulverizers, crushers, etc., the entire process of tillage has been modified, and animal power performs much that was then done by human muscle. Steam tillage is on trial, or at least steam plowing is, but is not yet common enough to be considered more than a limited experiment.

Drilling machines for planting certain crops were used to a limited extent before the Revolution. In Eliot's "Fifth Essay on Field Husbandry," published in 1754, he says:

"Mr. Tull's Wheat Drill is a wonderfull Invention, but it being the first invented of that Kind, no Wonder if it be intricate, as indeed it is, and consists of more Wheels and other Parts than there is really any Need of. This I was very sensible of all along, but knew not how to mend it. Therefore I applied myself to the Reverend Mr. *Clap*, President of *Yale* Colledge, and desired him for the regard he had for the Publick and to me that he would apply his mathematical Learning and mechanical Genius in that Affair; which he did to so good Purpose that this new modelled Drill can be made for the fourth Part of what Mr. *Tull's* will cost."

We find that a drill for spreading manure was soon afterward devised, and various drills have been in use ever since. The history of the above drill has been repeated in numerous machines. The more intricate and expensive affair of Europe has been simplified and cheapened here, and thus brought into quicker use. The threshing-machine and reaper were both undoubtedly invented in Great Britain, but in America they were simplified, cheapened, and, to use an Americanism, were made *handier*, hence more practical. Although drills thus early came into use, nearly all the planting was done by hand until less than forty years ago, particularly for the cereals. Now drills or sowers of some kind are in almost universal use on the larger farms.

The improvement for harvesting has been much greater than for either tillage or planting. Previous to 1850 the scythe and sickle were the almost universal tools for cutting, and the common use of the modern reaper and mower dates back but about twenty years. Labor has always been dearer here than in Europe, hence the sickle was never so much used as was the scythe. As to what its capacity was here we have no precise data. Experiments and estimates published by the Highland Agricultural Society in Scotland in 1844, and approvingly quoted by standard authorities on British agriculture later, give "the average quantities of ground reaped by seven persons, on an average of ten hours' work," as one to one and a half acres of wheat, and two to three acres of oats and barley. (A *bandwin* of reapers consists usually of seven persons, who cut, bind, and stook the grain.) By the use of the cradle in this country, one and a half acres of wheat was not a large day's work to be cut by one man, raked, bound, and stooked by two others, but this was doubtless above the average. With hay, two acres per day is a reasonably large amount. At a recent meeting of a certain State Board of Agriculture, in a discussion concerning hay, the belief was concurred in that "hired labor with a scythe mows much less than one and a half acres per day per man on average." It is safe to say that a man with team of horses and modern mower or reaper will average about six times as much as with a scythe. Under the best conditions more is done (we hear of fifteen or twenty acres sometimes), but the *average* would be not far from this estimate. With our hay crop nearly every step in the process has been changed. The horse-rake came into general use before the reaper, the tedder and horse-fork later. A century ago all the processes were by hand labor; now the only labor performed in the old way is pitching on the load, loading, hauling, and stowing or stacking, and each of these is done with improved tools.

To obtain the most profitable yield of hay or grain, it must be cut and secured at just the right time, hence with most crops this has always been considered the most critical period, and the labor then required brings the highest wages. If cut too early, it is immature; if too late, it deteriorates or wastes. Moreover, it is then especially subject to damage by unfavorable weather. Taking all these into account, it is seen that the actual gain to agriculture by the use of the various harvesting machines can not be measured by merely noting the relative areas operated on by a man in a given time by the old methods compared with the new.

With the great crops of cotton, Indian corn, potatoes, and tobacco there has been no such great advance. With cotton, the nature of the crop and the prolonged harvest forbid hope for much improvement, and a similar condition exists in the case of tobacco. With potatoes and Indian corn there have been many attempts, with but very moderate success as yet.

Intimately connected with the harvest is the preparation for market; and in this the progress, as a whole, has been even more marked than in either of the processes already noticed. The most illustrious example is seen in the cotton crop. In no other case has the cultivation of a great staple by people of European civilization depended for its success upon the solution of a simple and single mechanical problem. We hear of cotton being planted in our colonies as early as 1621, and again, in the Carolinas, in 1666, and during the century after the last date it is often spoken of. It was tried over and again along nearly the whole extent of the colonies. Eliot, in his "Second Essay on Field Husbandry," published in 1749, tells of his experiments with it in Connecticut. It appears to have been, however, a rather rare garden plant until just after the close of the Revolutionary war, when it was introduced anew, and soon after that its field cultivation began. But its production was entirely limited to the means of getting it ready for market. Hand labor was expensive; and so long as a laborer could prepare but a single "pound per day" there could be no great breadth of culture, no matter how fertile and cheap the soil, how favorable the climate, or how complete the means of tillage. The invention of the cotton-gin in 1793 placed it on the same level with other field products. Since then the rapid increase of its production is one of the marvels of the century. A single generation saw the crop grow from nothing to be the great commercial plant of the world, constituting, some years, five-sixths of our entire agricultural exports. The relations of this growth to the civilization and prosperity of many countries, and especially its relations to our own social and political history, furnish perhaps the most romantic chapter in the history of agriculture.

Threshing-machines for our cereals were practically unknown here before the present century. We infer from the journals of that day that they came into somewhat common use in Great Britain between 1810 and 1820; their universal use there was still later by some years, the flail continuing to be a common implement down to 1850.

The dearness of labor and other reasons caused the flail to be used relatively less in this country than in Europe, yet it was not a rare implement by any means down to 1830 or later. Grain was, however, usually trodden out with horses, or threshed by dragging over it a great roller armed with large wooden pins. This was an approved implement, and received the official recommendation of at least one agricultural society as late as 1816, and the writer has seen it in use as late as 1835. In the better farming regions of the Middle States, early in the present century, eight to twelve bushels of wheat per day were considered a good average for a man to thresh with a flail. Threshing was largely done in the winter, and where horses were used to tread out the grain, twenty-three to thirty bushels per day for three horses and a man and boy were common results. The average was perhaps not much above the lowest figures here given. To illustrate: in a specific case in 1826, on one farm in a prosperous and old farming region, 1300 bushels of wheat were threshed, the grain winnowed, and the straw drawn from the barn to a neighboring field, in twelve weeks, two men and five horses performing the work. This was considered, in that neighborhood, good work. Before 1825 threshing-machines were in very rare use in this country, but between that and 1835 their use spread rapidly, and before 1840 comparatively little of the cereal grains was threshed by other means. For cleaning the grain the hand fan was in extensive use in 1776, but fanning-mills came in common use long before threshing-machines did. The first threshing-machines merely threshed, next separators were added, and then "cleaners;" and now the grain is threshed and cleaned for market by one operation. Horses were the universal power applied until quite lately. Now steam-power is extensively used, particularly in the Western States and in California. Horse-power, however, is still in general use.

What the possible capacity of the modern thresher is, when working under the most favorable conditions, although an interesting question, is not the one we have to consider here, but rather what is the average of good work, or work that can be commonly hoped for by good farmers. The larger machines are mostly employed in doing custom work, and time is lost in passing from farm to farm, and in the delays which are unavoidable in work affected by so many conditions. A steam-thresher, under such conditions as they have in California, will thresh, in actual practice, from 40,000 to 100,000 bushels of grain in a "season" of three months. With such a machine, operated by a gang of eighteen hands, whose combined wages last year (1874) would amount to forty-three dollars per day, 2000 bushels of wheat per day is fair work. A recent agricultural journal states of the actual practice that the "full capacity of such a machine is 1500 sacks a day, the average work about 1000, holding over two bushels each." This means that the grain is threshed, cleaned, put in sacks, and the sacks piled up ready for removal by cars or team, and amounts to over a hundred bushels per day per man. Vastly larger figures are cited for short periods under exceptionally favorable conditions. The agricultural papers of the same State mention incidentally, as a local news item, a horse-power machine which averaged 1500 bushels of wheat per day for thirty-one successive days, moving on twenty-eight different farms in that time, and of another (also horse-power) which, the last year (1874), threshed and cleaned 80,400 bushels in fifty-two days, of which 11,300 bushels were threshed in five and a half days.

The effect of these improved methods is best seen by noting the total saving of the several processes. A hundred years ago, to cut a hundred bushels of wheat required about three days' work (which could not be delegated to other power); to bind and stook it, four days; to thresh and clean it, five days, which, with the other processes between the standing grain and the merchantable product, would amount to some fifteen days' actual manual (and mostly very hard) labor for each hundred bushels. The average was doubtless more than this, that is, a day's labor would not get more than six or seven bushels of grain through these processes.

The president of an agricultural society in California in 1866 stated that on his farm that year 40,318 bushels of grain (three-fourths of it wheat) were harvested, threshed, cleaned for the market, and stored in the granaries in thirty-six days, including all delays, with an average of twenty-two hands. This is an average of about fifty bushels per man per day for the entire crop. Much larger figures are reported in other cases of later date; but the exact data are not at hand.

While such progress has not marked the gathering and preparing of *all* the crops, yet it has extended to so many of them that all the more laborious processes have been revolutionized.

It must be borne in mind that mechanical invention has not only aided agriculture, but that in turn it has been stimulated by the wants of agriculture, and some of the most profitable patents have been in this direction, and we get a vivid idea of the demand and supply of new methods and appliances in the fact that the Patent-office issues about twelve hundred patents per year relating to agriculture.

It is through the aids of mechanical invention, including the means of transportation, that what is known as "the Great West" has been so rapidly settled and its crops made accessible to the world.

That soils became exhausted by cropping, and that the exhaustion could be checked by manuring, were facts well enough known from remote antiquity: the philosophical reason why was left for agricultural chemistry to discover. So soon as chemical analysis became established on a reasonably sure foundation, and chemistry began to assume the character of an exact science, practical applications to agriculture began to follow. Chemical experiments relating to this art had been made earlier by Arthur Young and others, but agricultural chemistry, as the science we now know it, began with Sir Humphrey Davy. He first lectured before the English Board of Agriculture in 1802. He experimented on guano, phosphates, and various other manures, and analyzed them. He lectured again before the Board of Agriculture in 1812, and these lectures furnished the basis of his *Elements of Agricultural Chemistry*, published in 1813. This work was extensively read, and was translated and printed in several languages. During the next thirty years there were numerous experimenters, and it was a period rich in discoveries in chemistry. Sprengel made many analyses of the ashes of plants about 1832, and then came the works of Johnston, Mülder, and others; but it was left to Liebig to bring order out of the great mass of experiment and theory which had accumulated, and to really place agricultural chemistry on its present foundation. His *Chemistry in its Applications to Agriculture and Physiology* appeared in 1840, and soon after Boussingault published his *Économie Rurale*. Johnston published his *Lectures on the Applications of Chemistry and Geology to Agriculture* in 1844, since which time works on this department of science have been particularly numerous. While the science has had most of its development in Europe, America has not been without its workers, and the later researches of Professor Johnson have been republished in Europe in the English, German, and Russian languages.

"The art of manuring" was a favorite theme in olden times, and it was an art brought to high perfection; but it followed experience only. With the aid of chemistry the art assumed the features of a science. Manures known before were used to better advantage, rare ones brought into greater prominence, and new ones devised. The introduction of turnips and clover into extensive cultivation in England about the time of the American Revolution, and the great rise in rents soon after, produced a radical change in the systems of rotation and tillage, and the discoveries in chemistry came in at just the right time to supplement this. Bones had long been used, but their special merits were pointed out by Davy, and soon their use became very extensive. Then followed the manufacture of superphosphates. To show what great and speedy changes were wrought through these means, and where mechanical invention had but little to do with it, a single illustration may be given. A light-house, known as the Dunston Pillar, was built on the Lincoln Heath, in Lincolnshire, about the middle of the last century. This was said to be the only land light-house known. It was built to guide travelers over the barren and dreary waste, and it long fulfilled its useful purpose. This pillar, no longer a light-house, now stands in the midst of a fertile and wealthy farming region, where all the land is in high cultivation. For twenty-five years no barren moors have been in sight even from its top. Turnips and phosphates were the principal means through which this great change came. The abundance of fertile soil and its cheapness, and the cost of labor, in this country, while inducing the use of improved implements and machines earlier than in Europe, hindered rather than accelerated the use of chemical aids. It was easier to break new land, particularly if it was prairie, than it was to renovate the old. For a long while bones were extensively exported from this country to England, but for the last twenty-five years the use of fertilizers has been increasing, until now it has reached immense proportions.

The history of the use of guano is somewhat similar to that of the phosphates. This material has been in use as a manure on the western side of South America for centuries, and from time to time its merits were spoken of in European publications.* Its use, however, remained local until it was prominently brought into notice by the modern agricultural chemists. How early it was brought to Europe can not now be ascertained. Sir Humphrey Davy experimented with it as early as 1805; but it was not until after the recommendations of Liebig that it began to be an article of commerce. A few casks were imported into England in 1840 "as an experiment." It was followed by 2000 tons the next year, and in sixteen years its aggregated sales in Great Britain were reported at 100,000,000 of dollars. Its use began in this country somewhat later, the aggregate imports previous to 1850 amounting to less than 30,000 tons. At present it is a vast commerce, regulated by special national treaties, employing hundreds of ships and millions of capital in its transportation.

Along with the importation of guano and the development of beds of mineral manures and their preparation, comes the manufacture of "commercial fertilizers," one of the most rapidly-growing of our industries. This manufacture is of very modern growth in this country, but at the last census more than four millions of capital were employed in the manufacture, and the value of the product amounted to $6,000,000 for that year. The official estimates place the present product several times higher. Gypsum, which was not included in the above estimate, was used sparingly in colonial times, but to most farmers it was then an unheard-of substance. It was prominently brought into notice by Benjamin Franklin, after his return from France, but its rapid spread kept pace with that of the cultivation of clover between 1810 and 1830. At the last census there were 321 mills, the value of the ground product amounting to about $2,500,000, a part of which, however, is applied to other uses in the arts.

From the nature of the case, the actual value of these new aids to American agriculture can not be shown statistically. For obvious reasons, their greatest effect is as yet seen only in the older States and in the South. Throughout the North, where the farm-yard is, and perhaps always will be, the great source of farm fertilizers, these commercial manures come in as an auxiliary; but farther south, and in those regions where the cattle roam the fields throughout the year, preventing farm-yard accumulations to any considerable extent, the case is quite different. As cotton and tobacco, the two great commercial crops, have been heretofore cultivated, exhaustion was inevitable. The history of a region comprised, of necessity, first the settlement, then its rise and wealth during the increasing growth of the crop, then a period of prosperity of longer or shorter duration, regulated by the original fertility of the soil, and finally the inevitable decline. In actual history, many great plantations became so completely impoverished by cropping with tobacco that they were abandoned and returned to forest again, and more to sparsely peopled, impoverished places. The exhaustion by cotton-growing was similar, although not always so complete. The necessity of new lands for this crop when it was "king," and the relations of this necessity to political events, are familiar to every student of our history, while its relations to fertilizers was generally ignored. Here, as in Southern Europe, "great political and social events had their foundation in the dunghill."

The theory and largely the practice of

* In *The Art of Metals*, written "in the kingdom of Peru, in the West Indies, in the year 1640," translated and published in London in 1674, it is said that "out of the Islands of the South Sea, not far from the City of Arica, they fetch earth called *Guano*," etc. And then follows a description, and the statement that it is used for manure, and that the fields are "put in heart thereby for 100 years after."

tobacco and cotton cultivation are now changed, and we see no reason why, by the new methods, the profitable fertility of the soil may not be maintained indefinitely. Official reports in Georgia estimate that "the planters of that State pay over $10,000,000 for fertilizers" annually; and single towns in the Connecticut Valley, where tobacco is the leading crop, in addition to the home fertilizers, pay from $30,000 to $50,000 a year for those from outside sources.

To follow up this subject in its relations to the price of real estate, to vegetable or "market" farming near our cities, to other manufactures whose waste products are utilized, to the great question of the use of sewage and its relations to public health, would lead us entirely beyond the limits of this paper.

Draining and irrigation, although strictly mechanical processes, have been the subjects of much chemical investigation. Thorough under-draining was practiced to some extent long ago, but has only come into extensive use during the last sixty or seventy years even in Great Britain. In this country its use is more modern. Noah Webster, in an agricultural address published in 1818, speaks of "the art of draining wet lands, which is now in its infancy in this country." John Johnston, a Scottish farmer still living near Geneva, New York, was the first in the United States to use tiles, about 1835, making the tiles by hand after Scotch models. The few under-drains made earlier, as indeed many made since, were of stone. John Delafield, a neighbor of Mr. Johnston, and a man noted for his interest in agriculture, imported a tile machine in 1848, the first one in this country. The practice is now common enough, but there are no statistics to show the amount of land drained.

Irrigation has only come into any considerable use in those Western regions where the rain-fall is insufficient for all the purposes of agriculture. It is as yet carried on, for the most part, on a small scale and by private capital. Vast schemes are discussed or projected, but we must leave their results to the future.

We have already alluded to the class of improvements introduced through or aided by the biological sciences. We have already said that a hundred years ago all our *species* of field crops, except sorghum, were already in cultivation here. While this is true, the number of *varieties* of these crops then was less. A neighborhood would know perhaps three or four varieties of each species, rarely more. About that time many farmers began to grow more kinds, in order that if one failed because of a bad season, others might succeed. Old varieties were slowly improved by careful selection of seed, but the occurrence of new ones depended on accident, or on causes not then understood. Late in the last century and early in this the facts relating to the production of new varieties of cultivated plants began to be studied by new methods, and, through the observations and experiments of botanists and gardeners rather than by farmers, the laws came to be better understood. As a result of this knowledge, varieties are now multiplied almost at pleasure, and the kinds in cultivation, or at least known, amount to hundreds or even thousands for each species. As an example, we may mention potatoes. Deane, in his *New England Farmer*, a dictionary which professes to contain "a compendious account" of "the Art of Husbandry as practiced to the greatest Advantage in this Country," published at Boston in 1790, says, "No longer ago than the year 1740 we had but one sort, a small reddish-colored potato, of so rank a taste that it was scarcely eatable." He then enumerates twelve varieties known up to the date of writing, which had originated in various countries, some in the Old World. The paucity of kinds was often spoken of by writers before the Revolution. Guided by the knowledge since gained, a single American experimenter claims to have produced and tested 6000 different varieties. Other crops have a similar but not quite so striking a history. Several hundred varieties of wheat were grown and tried by one farmer in the Genesee Valley all in thirty years. This has given so ample means of selection, of choosing just the best kind for each soil and condition, that there is doubtless a great actual increase in production due to it, but its most obvious effect is to give us a choice as to quality. With fruits this application of science has had even more remarkable results than with grains.

Although but few field *crops* have been introduced since 1776, this is not true of field *weeds*. Some which actually came earlier only became numerous and troublesome later, and others were then introduced. Several local traditions exist in the New England and Middle States of weeds introduced by the British armies and their allies during that war, which have spread and maintained a foot-hold ever since. On the other hand, it is questionable if science has aided in the suppression of weeds except in a very general way.

Columbus, on his second voyage to America, brought various kinds of domestic animals with him, and importations have been frequent nearly ever since. In our own colonies there were many importations, and from several countries, from the north of Europe direct and from Southern Europe by way of the Spanish-American colonies. The live stock in existence at the time of the Revolution was the mongrel progeny of these numerous importations. There is no question but that the domestic animals introduced from Europe rapidly deteriorated here. Various travelers have borne testimony to this, and indeed it was to be expected. The pastures of Europe were such as fostering care for ages had made them, and, as already said, of peculiarly nutritious grasses. The early colonists found only crude grasses, and no natural meadows better than the salt-marshes near the coast or the coarse sedges by some of the streams. The pasturage in the forests was meagre. In the winter, straw, corn stalks, or in places wild marsh hay and the *browse* of the woods, were all the miserable animals had. Spring usually found the flock or herd reduced in numbers, poor, and weak. Too often the farmer's first work of the spring morning was to assist the weakened creatures to rise to their feet, and several native plants had reputation for strengthening cattle so that they could get up alone when weakened by the winter's starvation. The colonists early learned to plant grass seed from Europe, and to plant corn for the animals. Turnips, so valuable in the north of Europe, were of little value here. In the South they did not flourish well; in the North they grew well enough, but being very watery in their nature, and the winters being so cold, they froze very readily, and thus their value was greatly diminished. Maize was made to take their place, and sometimes beans were sparingly cultivated; but with this crop, again, we had to learn by experience and disappointment. The field bean of Europe did not thrive well here. It struggled for cultivation for more than a century, and was finally abandoned as a field crop. Other kinds of beans, however, partially took its place. Clover was introduced from England quite early last century. Eliot speaks in its praise as early as 1747, but for some reason it did not come into common use until sixty or seventy years later. It is, therefore, no wonder that all kinds of live stock deteriorated, that they fell an easy prey to the wolves, and that they only began to thrive successfully after so long experiment and so bitter experience. It must be remembered, too, that the laws of breeding were not then well understood; but special attention was given to this practical question during the last half of the last century. Sebright published about 1773, and Bakewell's experiments were then in full progress; and although he died without giving the secret of his successes to the world, the results were seen and many of the conditions known. In this period the breeding of all kinds of animals received special attention, and while the more scientific problems were being solved abroad, the colonists here had solved those of forage, acclimation, and adaptation.

Several of the more valued breeds of neat cattle were established early in the Old World, and improved during the period spoken of. Pedigrees began to be carefully looked after. The first volume of the *English Short-horn Herd-Book* appeared in 1822, but its pedigrees began at about this period, or a little earlier. Only thirty animals are recorded that flourished in 1780 and earlier; and while the blood of unrecorded animals afterward came in, for present purposes the pedigrees of all the thousands of thorough-bred short-horns date back to about that time, theoretically at least. Precisely when the first importations of this breed were made to this country is uncertain. It is now believed that they occurred very soon after the Revolutionary war, and there are traditions of several importations before 1800. Soon after that date importations began in earnest, and have gone on ever since. The first volume of the *American Short-horn Herd-Book* was published in 1846, the thirteenth last year, and in them are recorded some 33,000 pedigrees. Certain strains of this breed have thrived peculiarly well here, and the sale of one herd, September 10, 1873, at New York Mills, was doubtless the most extraordinary cattle sale that has ever taken place any where. At this sale 109 head sold for about $382,000, or an average of over $3500 per head, the higher prices being $40,600 for a cow, and several sold for over $20,000 each, a calf but five months old selling for $27,000. The Devons were also introduced early, and previous to 1840 were imported more abundantly than the short-horns, and have perhaps had as wide an influence on the improvement of American cattle as the last-named breed, or even a wider. Now all the more distinguished breeds of Europe are successfully bred here, and some five or six of the more numerous or important have American herd-books now published.

The effect of all this has been to enormously elevate the quality of American cattle; and so completely has the mongrel or "native" stock been improved through these that in certain agricultural societies where premiums are offered for the best "natives" it is found that all that are offered as such are, in fact, "grades," having had an infusion of better blood within three or four generations. Even the Spanish cattle of Texas and California are being rapidly changed and improved through and by these better breeds.

The history of American horses is in most respects similar to that of the cattle. There was at first deterioration, but in a less degree, then a slow improvement through selection and better feeding, then a more rapid improvement through better breeding and the importation of better stock. The race of trotters is peculiarly American. It originated here, and is here found in its greatest development. It appears to have followed and been caused by the introduction and improvement in light carriages. The thorough-breds of Europe, the race-horse and the hunter, are essentially *running* horses. For American uses trotters were needed; various causes tended to make them popular, and in the last fifty years the breed has been made. It has a large infusion of the English thorough-bred in it, yet few noted trotters are thorough-breds. The gait and speed are in part the result of training, and are in part hereditary. There has been a constantly augmenting speed and a great increase in the number of horses that are fast trotters. But a few years ago the speed of a mile in two and a half minutes was unheard of; now perhaps 500 or 600 horses are known to have trotted a mile in that time.

There is no question but that, as a whole, the quality of American horses has greatly improved in the hundred years. It was believed that the great increase of railroads would diminish the number required, but, as a fact, the reverse is true.

American sheep before 1776 were all coarse-wooled and mostly very inferior animals. In Europe the fine-wooled breeds were shut up in Spain, and various causes prevented the exportation of the English improved coarse-wooled breeds. Eliot, in his "First Essay" (1747), says: "A better *Breed of Sheep* is what we want. The *English* Breed of *Cotswold Sheep* can not be obtained, or at least without great Difficulty: for Wool and live Sheep are contraband Goods, which all Strangers are prohibited from carrying out on Pain of having the right Hand cut off." Before 1800 there were a few importations of improved coarse-wooled sheep, and very many importations since. Merino sheep were carried into Saxony from Spain in 1765, into France about 1776, and England about 1790. Three merinoes were brought into the United States in 1793, but the person to whom they were presented not knowing their value, they were eaten for mutton. In 1801 or 1802 a few more came, and there were several small importations from Spain and France before 1815. The Saxon merino was introduced in 1824. Various causes led to wild speculation more than once in fine-wooled sheep in the United States, but they have increased now to many millions, and some of the most noted flocks of the world have been or are here. Individual animals have sold as high as $10,000 and even $14,000. Both for fineness of fibre and weight of fleece the American wool is celebrated, and the finest fibre yet attained was from sheep bred in Western Pennsylvania about 1850. Since that time weight of fleece rather than excessive fineness has been bred for. The great pastures of Texas and California at home, and of Australia and South America, are now in competition in the markets of the world, but the wool produced in some of the older States, particularly in the Ohio Basin, is especially sought after by the manufacturers of the finer goods.

The statistics of live stock in the United States as given in the last census are confessedly very imperfect, hence no numbers are here quoted except the aggregate value, which was estimated as amounting to upward of $1,500,000,000.

Incidental to this branch of our subject, we may mention an American invention, the cheese-factory system. This was first put in operation in 1851 by Mr. Jesse Williams, in Oneida County, New York. Down to April, 1860, twenty-one factories had been started. Then the increase was so rapid that by the end of 1866 there had been 500 factories erected in the State of New York alone, and the capital incidentally employed in the farms and stock amounted to at least $40,000,000. In 1870 there were over 1300 factories in operation in the country, producing about 55,000 tons of cheese. The system is still growing here, and has extended to foreign countries.

The great improvements that have taken place in transportation, which make it possible for the wheat of Iowa and California to compete in the English markets with that raised on the Atlantic sea-board, and which place Iowa in competition with New England, have operated to *specialize* farming. The large farmer of to-day raises fewer kinds on his farm than did the small farmer of the last century. This specialization allows the use of the higher appliances and the use of capital as the former system could not. The true farms have doubtless grown in size, on the average. The early settlers of necessity could till but small farms. The tax lists of Long Island for years between 1675 and 1685 show that in nine English towns the average land-holding was about twenty-two acres, and in the five Dutch towns about thirty-seven acres, or for the whole fourteen towns it was twenty-five and one-third acres, and at that time over ninety per cent. of the tax-payers were land-holders. The national census of 1870 enumerates 2,660,000 farms, only six and a half per cent. of which were of less than ten acres, and more than half of the whole number contained over fifty acres. The cash value of the farms, implements, and live stock was placed at upward of $11,000,000,000, and the total estimated value of all the farm productions at about $2,448,000,000. Of the 12,500,000 persons "engaged in all classes of occupations," 6,000,000 were engaged in agriculture. We have absolutely no statistics of the agriculture of the colonies at the time of the Revolution; therefore the actual figures of progress can not be given, and we refrain from estimates.

Agricultural newspapers, societies, schools, and literature hardly had an existence before 1776. Less than forty newspapers were then published in the colonies, none of them agricultural. In 1870 there were ninety-three agricultural and horticultural newspapers and periodicals, with an aggregate annual issue of 21,500,000 copies.

Agricultural societies were organized just after the Revolution; exhibitions or "fairs" began between 1810 and 1820. It is believed that there are now 2000 agricultural societies, clubs, and boards of agriculture organized and in operation. Their annual "reports" amount to very many volumes. A few tracts and essays, which altogether would make but a single small volume, were the entire special agricultural literature the colonies produced. The agricultural literature of to-day is confusing by its quantity and variety.

Agricultural professorships were established in Europe some time last century, and the first agricultural school began in 1799. In this country, Samuel L. Mitchill was made "Professor of Chemistry and Agriculture" in Columbia College, New York, in 1791, but there is no record that he gave special instruction in agriculture. In various colleges professors of general chemistry treated more or less of agricultural chemistry. After special preparation for the office, John P. Norton was appointed "Professor of Agricultural Chemistry and Vegetable and Animal Physiology" in Yale College in 1846, perhaps the first actual professor of agriculture in an American college. His instruction began in 1847, since which time numerous other similar professorships have been established.

Agricultural schools and colleges were talked of for many years, and a few made an actual or nominal beginning before 1850, and several before 1860. In 1862 Congress appropriated certain lands to establish or aid schools in the various States, "without excluding other studies," to "teach such branches of learning as are related to agriculture and the mechanic arts." Stimulated by this, and aided by private and State aid, about forty schools are now in existence, trying in various ways to fulfill the purposes for which they were established. The most of them are recent, and they are mainly important, in this account of progress, because of what they indicate rather than what they have yet accomplished. A few of the older ones have, however, already had considerable influence, and all are ready for the coming century's work.

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New Haven, Connecticut.

KATY.

SHE had lived with us so long—as length of service counts here—that we felt as if we owned Katy; and we did, if ownership comes by right of discovery.

It was as if she had been left on our door-step, like any other foundling, and we had taken her in, cared for her, and loved and trusted her for six long, faithful years; living in the hope, as I used to tell mother, that the bond might "continue the same unto my life's end, Amen," like the pious desire in the catechism.

She came to our door one dark, wet night in March, half sick, utterly hopeless, asking for work. She had been in the country but a few weeks; came with her mother to spy out the land, and get things "sittled like" before sending for the remainder of the family.

"Siven childer, miss, an' no father to one o' thim," she said.

They had exhausted their small stock of money, and not being able to replenish by picking up gold on the highway, as they expected to do, Mrs. Brice was forced to whitewash and do general charring, and Katy came to us—a chance blessing.

I shall never forget her pathetic tone, when she said, "I work stronger than I look, miss."

It was bright and warm in the hall, making the outside darkness blacker by the contrast, and I hadn't the heart to say no.

Mother insisted it was the soft eyes and sweet voice that won me, more than any promise held out by Katy's self-commendations. And it may be, for she was neat and pretty in her seventeen-year-old freshness. Besides, we wanted just such a trim little maid. And I was justified; for she prospered in the brightness of our quiet life, and repaid a thousandfold our trust in her. I really had come to look upon her as much of a fixture in the family as mother or myself; so I was pretty well stunned one morning when a faint, meek voice, which I should not have known for Katy's only that she was busy in the corner, her back toward me, dusting the little fineries in her nice, dainty way.

"I want to be married, Miss Mary."

"Why, Katy Brice! I am ashamed of you," I said, severely. "Perhaps others may want to be married, but I don't think it modest to say so."

"But, ye see, miss, I have the chance," with an emphasis that, in another, might have passed for sarcasm, for I was sufficiently Katy's senior to stand in her estimation as an "ould maid," reasonably beyond such youthful frivolities.

"But what upon earth put marriage into your head? Don't you have trouble enough?"