"Paper Read by Arthur S. Mason at the Chicago Literary Club March, 1917."

SOME STUDIES IN AGRICULTURE BY A NON-FARMER

Some half a dozen years ago at Panama, strolling around the great work in progress, I met an old friend, a boyhood friend—long forgotten. This old friend was nothing more than a stock of hay from California made from oats, many bales, built like a child's playhouse of blocks into a great structure.

To one who has lived long in the Middle West, hay is something made out of grass. This paper is an attempt to describe five years of effort to account for that obsession—to realize its tremendous importance and to discover a remedy for the drawback it entails.

It is one of the anomalies of our present situation that those parts of the world where the climate and soil are most friendly to the growth of plant life should all, save for desultory native operations, get their animal food from the temperate zone thousands of miles away. Thus nearly all the grain and fodder needed in the Philippines and Central America come from California; that for Cuba from our Central States. In like manner, Iowa, Illinois, Indiana, Kentucky, have been supplying our Gulf States for half a century.

Some fifty years ago, Darwin, through his little book on vegetable mould, surprised the world by making clear that our agriculture rested on the work of the angleworm. This little creature, sans eyes, ears, nose, or brain, with only a sensitive skin in lieu thereof, performs an enormous service to mankind.

John Burroughs, in a late essay, "The Still Small Voice," shows that all the great operations of Nature are really accretions of millions of minute effects. The poor little worm has not even a voice at all, still or small. These minute effects escape our notice, and we have come to take them for granted, like the glorious fresh air or sunlight itself.

Most men suppose that the farmers' work is to supply food for man, but the fact is that but about 10 per cent of our agricultural operations are devoted to this end. It is likely that the creation of fibre for clothing constitutes an amount of work equal to that necessary to produce the food directly used by human beings. Far the greater part of our agriculture is appropriated to the support of domestic animals.

All the products of agriculture are perishable.

All the products of agriculture involve seasonal operations.

All the products of agriculture are created under a hanging sword of Damocles, the caprices of the weather, and of all the caprices of the weather, perhaps the most destructive are excessive rains at the time of harvest.

These are the conditions which separate husbandry from nearly all other industry, and must be constantly in mind in studying the farmer, his family, his character, and his products; principally these, but also isolation entailed from the space necessary, and in turn the problem of communication, that is, roads, in a rich soil and severe climate.

In Illinois the very uniformity of the landscape, the land and the climate limit the range of products, so that the farmer may be said to follow the composite judgment of his neighborhood rather than his individual reasoning. I have said enough to sharply define agricultural and city activities.

Allow me abruptly to state here what I apprehend will meet with certain ridicule. My statement is that an hour's work on a farm is now paid eight or ten times as much as an hour's work in a factory, if the estimate be based on product. This comes out when we compare, say, brick made in Chicago with hay sold here. There is more work in creating a ton of brick, yet brick will be delivered at your building site miles away from the kiln for two dollars a ton; hay is not often delivered for ten times as much per ton. The comparison might be extended—the principle will be found constant.

The reason is clear. The brick maker follows a continuous process from day to day. The farmer has but a week in June to

make hay. If that week happens to be wet, he makes none; and this happens only too often.

But it is interesting to remember that brick making, too, used to be a caprice, when bricks were dried in the sun preparatory to burning. The brick maker, too, had then a little of the gypsylike quality we now associate with well diggers, threshing outfits and like desultory occupations.

I now come to my theme. I propose that all agricultural products be cured; that is, dried artificially. All the other arts now dessicate their materials with artificial heat. The most precious, the most delicate of material, our food, is the only one suffering on a large scale from moisture in the wrong place. Moisture in agricultural products may only be present in quantity varying from 6 to 18 per cent, depending on the material, without causing decomposition. (It is safe to say that the annual damage from rain to agricultural products is at least one thousand million dollars in this country alone.)

My preliminary studies developed a seeming paradox. I found the value of hay to be highest where it grows in most abundance; lowest in desert places. Thus $6.00 was the price in Idaho; $25.00 the price in Louisiana. These are not abnormal for the localities. *The price of hay may be said to rise with the rainfall.*

But rainfall notoriously stimulates vegetable growth when associated with warmth and rich land. The truth is, the price of hay is determined by the uncertainty of saving; that is, drying it. The very moisture which accelerates growth today forbids harvesting tomorrow.

Consequently Louisiana, which can grow twice as much suitable material per acre as can Illinois, has for years received hay from us.

I think the question of saving a crop is a more potent element than generally realized, for it, rather than the ability to raise the crop, determines success or failure; and really it fixes the crops of the world.

This statement seems naive, but the fact is not always apparent. There are men present who own, or did own, a peach orchard in Michigan. Is such a one with a recollection of the fatigue of effort

necessary to pick and transport to market his perishing tender crop aware, I say, of the handicap he bears as against the California grower? The Pacific Coast man does not need to rush his fruit at the moment of ripening to an overstocked market; he has an alternate. His whole orchard is a favorable drying floor, by means of which he may put his product into a condition to keep long periods. Here lies the explanation of the fact that tender fruits are more and more being raised in desert places. Only in such places can a reversible climate be obtained. Nature, as ever, seems callous of our desires. The rain which is the farmer's best friend up to a certain moment, becomes thereafter his worst enemy.

In Illinois we have perhaps the richest body of land of the same extent in the world—the so-called corn belt. It is handicapped, however, with a short growing season and, therefore, produces but one yield each year.

The value of our best lands may fairly be said to have reached a price of $250.00 per acre.

The gross return per acre in a term of ten years will probably not exceed $20.00 per year. After deducting the cost of making the crop, it is plain no reasonable return in interest is left. We must admit that the social distinction attached to ownership of land plays a part in land values. We don't usually associate such an aristocratic sentiment with our rural population, but to my mind this is a fact of the first importance.

No one can doubt that in this country the home building instinct has waned in the last fifty years. This home making instinct is not altogether a matter of finance, but is more an impulse like that actuating birds, some of which build a complete and perfect nest; others roughly gather a few sticks together, both birds with equal opportunities.

Compare the homesteads of farmers in Ontario or Australia after a generation of occupation with those of many parts of Illinois on far richer land. On the one hand, substantial brick or stone houses, stone curbing around the spring, fine shade trees planted by the pioneer, flowers, fruit, appurtenances in order—all appealing to the pride and love of the family, binding them to that home.

I hardly need contrast our case. To the mind of each man present will come the vision of the entrance gate temporarily repaired with baling wire and a whole series of expedients. Of course, as in other matters, there are exceptions.

Vocational pride and craftsmanship have only too plainly waned in our farm life.

The colonial farmer makes a sport of his vocation, in his plowing matches, his wood-chopping contests, etc.; he takes pride in the workmanship shown in his fences.

I think it is safe to say that the lure of the city and urban opportunity are more powerful in the United States than elsewhere. For that reason we suffer most from the constant draining of the energetic spirits from farm to city.

It is not generally appreciated that the perfection of farm machinery has enabled and caused a man to work more and more alone. Now, man is a social animal and needs contact with and stimulation from group work in his daily avocation. Again, our corn belt, for various reasons, has slight appeal to the imagination differing vastly from California, which offers a large range of possibilities and whose physical features are stimulating to the imagination

Gradually in our journalism has been built up a sort of good natured disdain for the farmer's life. To put a nut on a bolt wrong side out is "the farmer's way." When a fly ball is muffed a baseball, the bleachers are apt to call out "Farmer!" to the chagrined player.

There are many signs just now of drift towards better times in rural life: good roads, the automobile, the telephone, the picture show entertaining and instructing, and the fine work of our agricultural colleges. But there will always remain the three facts I mentioned earlier, and I will emphasize them by reiteration:

1. All the products of agriculture are perishable.

2. All the products of agriculture are seasonal operations.

3. All the products of agriculture are under this constant threat of the weather.

Bad weather in the country is itself depressing on the spirits—much more to the isolated man than to those in city life, for there contact with other men and opportunity in other directions lift a man out of his troubles.

The traditions current amongst us are inherited traditions derived from England. For that reason we take it for granted that agriculture is a permanent occupation in a given district, for such is the truth in England and in a strip across Northern Europe.

Apart from the steady unquestionable loss of fertility now going on, and which I have confidence to believe may be stopped and the land restored by the scientific treatment taught and practiced at our state institutions, our rich lands are slowly being washed into the sea at a rate much faster than the creative agencies which exist for the manufacture of soil can do their work.

The question may well be raised whether any upland rich soil under cultivation can withstand 40 inches of rainfall coming largely in downpours accompanying thunderstorms.

If it cannot, then the cornbelt must be regarded in the light of a mine, rather than as like the traditional agricultural lands of Northern Europe or the deep volcanic soils of Italy.

The loss of soil I allude to is not the scouring producing gullies and obvious wash in the chrystaline soils of our Southern States, but the imperceptible loss all over a field—a sort of emulsion of the finely divided soil with the heavy rain is set up, and the best part of the land carried off as a coloring matter in the run-off—a process as inevitable, constant and effective as that sub-areal denudation which we know to be the parent of our boldest topography, "The Still Small Voice" of John Burroughs again.

I now come to the second stage of my theme.

Is there any type of agriculture which will prevent or at least substantially retard this slow bleeding to death? There is, I think, in the so-called "soiling system," best known, perhaps, in Germany.

The soiling system consists of cutting crops when green, as at the milk stage in oats, and carrying them to the animal to be fed, immediately planting another crop in its place.

The soiling system has been specialized in at the experimental state farm in New Jersey for many years past. Some of its results cannot be questioned. Amongst these are:

1. That by it four or five times as much animal life may be supported per acre as by our current practice.

2. That under it the soil is constantly bound together by vegetation and is protected as our prairie sod has protected the soil for thousands of years—not, of course, to the same degree.

3. That those lands cropped three times a year, under proper treatment, hold their beneficent powers better than those cropped but once.

Professor Voorhees' book, "Forage Crops," forms most hopeful reading.

But the soiling system of Germany or New Jersey, with its endless constant attention and manual labor, is hopelessly contrary to the genius of our agriculture, for it is as piecemeal as preparing the family meal three times a day.

Can we retain the essence of the system and make it chime harmoniously with our labor-saving, power tool-using habits?

To the man who runs and reads it is quite plain that the iron ore coming from the upper lakes is the basis of the steel to come, but to the man looking out of the car window it is not so plain that the vegetable growth he sees bears the same relation to the meat in the butcher's shop.

It will surprise most of you to hear that for more than twenty years the tonnage of meat yearly produced at our stock yards in Chicago has not increased.

The fact is that in the district tributary to Chicago the animal food produced does not support the stock, and more stock cannot be supported unless more vegetable food per acre is produced.

I will try to avoid technical details, but it is necessary now to bring out my claims with particularity. Let us examine a single crop somewhat closely—the oat crop.

In the United States the area devoted to oats almost equals that assigned to wheat. Both, of course, are far less than the corn acreage.

Our oats are planted in the spring. In late August or September, around Chicago, they are harvested. An average crop at average prices in a term of years yields less than $20.00 per acre; forty bushels of grain and something less than a ton of straw of uncertain value is the year's return.

Now, that same crop late in June, a month earlier, is at a stage known as "in the milk," and if the whole plant be taken will yield nearly two tons of dry matter which the chemist will report to be nearly equal in food value, pound for pound, to the grain itself; and, equally important, the plant in June is at the moment of maximum digestibility.

The crop when cut in September gives in the grain 130 pounds of protein, plus an uncertain quanity in the straw. The crop when cut in June yields 350 pounds of protein. In general, this crop, if cut and cured in the milk in June, is worth twice as much as the grain and its by-products cut in September.

But this is not all. Even in our short-growing season a crop taken by July 1st affords opportunity for another crop on the land that year. July, with its four inches of rain and warmth, is a favorable month indeed.

It is safe to say that two crops of grain hay may be had in Illinois which will support at least five times as many animals as the present oat culture will, provided the hay can be saved.

The question is at once raised, Why, since Illinois devotes several million acres to oats, this has not been done? The answer, of course, is that June and July are the periods of black clouds and storms from the Southwest, making success all too unlikely to take the chance. Not that farmers realize this; their procedure merely follows the composite experience of the locality.

This is equally true of all the grain crops, every one of which make a hay superior to the grass hays if cured at the proper stage.

What could be more illogical than our practice with the oat crop? At the end of June the grain is associated with just the right proportion of leaf and stalk to form a ration. It is allowed to waste its sweetness on the desert air—to turn the golden yellow poets love, which is the color and badge of loss. It is then harvested and threshed—finally to be mixed with another proportion of stalk and leaf acquired at another time and place to form a ration.

I hold no brief for the Quaker Oats, but do feel a sort of Scotch partisanship on this matter—which brings to mind Dr. Johnson's definition of oats in the first dictionary—"a food for horses in England, men in Scotland," upon which a Scot commented: "And, mon, where do ye find such horses and such men?"

Methinks I have extolled the possibilities with the grain crops. What shall be said when we pass to an audience with the king himself—alfalfa? Surely if the lion be the king of beasts, alfalfa is the beneficent king of animal food plants.

It can be successfully grown nearly everywhere within the United States. A good judge has stated it can be bountifully grown in England, where it is known as a curiosity. A ton of alfalfa hay has twice as much protein therein as a ton of bread. But it is a fatal quality to be so rich, for plants are hard to cure and save in proportion to their percentum of the precious nitrogenous compound —protein, the flesh-producing element.

The royal reputation of alfalfa has captured Illinois. It is successfully grown all over the state, but it is by no means successfully saved in this state or anywhere outside the arid regions of the West.

The stories of disappointment are so current from all sides that it seems to me, unless relief comes, men will not persist.

Yet the alfalfa culture has all the features of agriculture I would stimulate. There is a continuity to it with its three, four or five cuttings a year; it is a very beautiful crop—clean, protects the land and enriches it.

I have now stated the conclusions and discoveries developed in my quest to find why our tenants in Tennessee do not grow grain hay, the complete answer being, "They cannot cure it." Having

reached the state of mind disclosed, I decided, being fortunately placed, to undertake, as a labor of love for the most part, to investigate and perfect an apparatus for drying crops.

The boy whistling as he drives his team and mower across the fields little suspects that he is cutting mostly water—that in a full day he cuts forty tons of water.

This formed the unit for my proposed operation—an apparatus to cure the cuttings of one team—to evaporate forty tons of water in ten hours and produce a product of twenty tons of hay in the same time.

The best practice in artificial drying in the arts gives eight pounds of water evaporated by one pound of coal. At the best, then, my hay would be saddled with a charge equal to the cost of 500 pounds of coal for each ton of hay. Generally in the Middle West one can get seven pounds of coal for one cent, so I had to carry 70 cents right away for fuel.

But I did not need to first make a haystack; nor, second, to tear it apart and feed it piecemeal to a baler. I therefore saved perhaps twice as much as the fuel so far.

Without going too much in detail, it appeared that hay could be made artificially about as cheap as when naturally dried.

At this stage appeared a most interesting fact. Immediately life is killed in any plant, a race takes place between fermentation or decay on the one hand, and dessication or drying on the other. Under the normal and familiar process of curing, occupying twenty-four hours or more, fermentation makes such headway that it is rare to find a hay that has not lost 25 per cent of the protein it contained when a living plant.

Like most men who undertake what they regard as novel, I soon found it to be not new at all. Scientific men have been long acquainted with all I have stated.

I have knowledge of some half a dozen attempts to solve this problem. They all failed primarily for the reason that the apparatus cost more than the farm. Here we have another element. My

plant must not cost more than an average threshing outfit which may be used fifteen days in the year, say three or four thousand dollars.

Another great source of loss in normal hay making appeared. The most valuable parts of these plants are the new, delicate upper leaves. Now, these dry first under favorable conditions and spoil first under unfavorable conditions. Under the former, they become so brittle that a considerable percentage are detached and left in the field.

The tests of the Colorado Station show a minimum of loss of 30 per cent of the food values from this cause.

These two losses—that is, the chemical one due to incipient fermentation, plus the mechanical loss last described—mean that a crop of leguminous plants at least will make twice as much food in high quality hay when artificially cured as the very same crop will when naturally dried under favorable conditions, for in artificial drying all the manipulation takes place when it is green and tough.

Few engineers but would feel that the sum stated would not provide an apparatus to evaporate forty tons of water a day, equal to 300 horsepower in boilers alone.

For four years now I have wrestled with this problem, making a new plant each year based on the last year's disappointments, as is the way with such things. We start the coming season with fresh courage.

Our first plant was a simple stack of green material raised from the ground, sealed on the sides with steel plate, air-heated to 400 degrees—was blown with pressure upward. Some excellent hay was made with simple apparatus, but the result was capricious, as the air currents have an exasperating way of favoring certain zones and quite neglecting other zones.

I only mention this first apparatus to relate two discoveries. The first is the fact that hay may be ignited at quite low temperatures when subjected to prolonged exposure. Thus an hour's exposure at 250 degrees may ignite, whereas fifteen minutes' exposure at 400 degrees will not cause ignition.

The second discovery is a droll one. Late in the year it occurred to me to raise a question as to our procedure; apparently everyone approaches this problem with an obsession. We all have notions of clean, sweet, new hay. The mind rebels against bringing smoke or anything like smoke into contact with the material. One day it occurred to me to question this assumption. I reflected that ham, fish, etc., when smoked were appetizing; perhaps the animals had like tastes. So we obtained some green material, dosed it with smoke in drying, so as to be positively obnoxious. Behold! our animals preferred it to anything else. I have since found that in the north of Ireland and in the Tyrol it is the practice to smoke the hay for a cow with a new calf. This discovery was important. It showed us the way to a very simple procedure—an apparatus of capacity within the range of cost limit fixed.

The second year we boldly shifted to a plan of taking the hot gases from a coal-burning furnace, diluting them with normal air down to 400 degrees F., blowing this mixture through a traveling mattress of green material. In this way we operated during the year on oats, clover and millet, producing superb hay bright green in color, the clover blossoms remaining pink after curing. Our hay took about twenty-five minutes from the growing green stage to a bale of dried hay. We struggled much this season with fires, going eyebrowless part of the summer. Well I remember one very hot day spent on my back peering through a hurricane of hot air and ashes in the effort to discover the cause of mysterious fires. Such is the way of a man with a thing he has made; and we finally downed Mr. Conflagration—apparently so.

The winter following the three animals at my country place got nothing but this hay and never throve so well.

The following year the scene of operations was shifted to Mississippi. The same general form amplified was followed. We made excellent hay which would keep, something no one could generally do naturally in that region. Alfalfa was the material, but alfalfa is a more tender plant than we had before used, so back came the conflagration with its worries and its singed eyebrows.

As must be always expected, the most skeptic were the very

farmers we were aiming to benefit. They declared animals would not eat our hay. Some mules, doubtless overhearing the discussion settled it by breaking down the building and helping themselves

A good part of the States of Mississippi and Alabama i excellently suited to the growth of alfalfa. A large acreage now exists, yielding abundantly. The rainfall—50 to 55 inches—how ever, makes the situation worse than in Illinois. The unfortunat shipper only too often does not know whether his product wil arrive at destination fit for use or valueless.

The fourth year found us back in Illinois, but with the problen shifted. Difficulties directly involved in the drying are almost wholly passed, a fresh group arises pertaining to the gathering, hauling, an introducing the green material into the apparatus.

Every step must be effected by power tools. The picturesqu hay fork and its accompanying sweat and fatigue are impossibl in these days—all hand tools are and should be.

The line of tools available which are adapted to haymakin will not successfully deal with green material, which is three time as heavy, limber in lieu of stiff, and utterly perverse in its behavio

But these are details. Suffice to say that the end is reasonabl assured in the near future.

Now bear with me in a resume of what I have attempted t show my aims to be.

If we are to preserve that quality of citizenship which ha been the basis of American success, that mixture of good natur with energy and vision, we must preserve the elements upon whic it is based. That is, the clean-minded, vigorous, ambitious yout transplanted to the city.

Will we continue to raise that kind of raw material? I fea not, unless the idealism now surrounding rural life be changed. Fo one, I don't think it can be changed for the better unless there introduced more of the order, the organization, the effectiveness the comradeship, and the continuity of factory operation. And o these, continuity of operation must come first; will itself bring th others in train.

I have stated, for instance, that hay making in Illinois is crowded into a week or less in June.

I propose that hay be made continuously from the 20th of May until October. That this can be done, some fifteen years of practice of the soiling system at the New Jersey Station makes certain. Under such a plan, the mower and his team travel day after day, month after month; the haulers likewise, and so each man in his place. If this can be done, I know of no other manufacturing with such abundant prospect of profit.

We are slowly, unconsciously bleeding to death through the loss of organic matter and finely divided soil. Our practice aggravates this in an eminent degree. The culture of corn and cotton crops keeps the soil in a defenseless condition and are the very worst offenders. A form of culture must be found to retard this waste. The original condition of our prairies, with its mat of sod covering, formed an ideal agent for the creation, collection and retention of vegetable mould.

The American people fell heir to a great soil preserve, maintained as such by a million fierce Indians whose ethnic status fell far below that of permanent agriculture.

An agriculture binding the surface such as outlined will come nearest to an equivalent of the prairie sod; may at least so retard the drain that other creative agencies, frost, acids, earthworms, etc., may even hold the soil constant.

I have tried lately to get from experts some definite measure of the soil loss, but without success. That it exists alarmingly all agree. My own observation leads me to state that it will become a very serious matter within fifty years.

We must raise more animal food per acre or see meat prices climb more and more—not only such increase as will come through the intelligent use of fertilizers, but also utilizing our growing season to greater advantage. At present we hardly use the month of July except for growing corn. For the other crops the month is occupied in drying or curing, wasting the land's time. Inasmuch as July normally yields four inches of rainfall, manifestly it is valuable time poorly spent.

We must save the losses due to rain at harvest. Elsewhere I have placed this loss at a thousand million dollars a year. Having led your young minds to that point, gained your trust and confidence, I would now state that I believe it to be twice as much; but the actual losses are only part. A very large loss exists because crops are not even planted, fearing such a loss. For instance, one of the faculty at Wisconsin University writes me: "In this country devoted to dairying the coarse leguminous plants, as the cow-pea, are very desirable, and as a fact are easily grown—but it takes eight fine days running to cure it. As we don't get the eight fine days, we don't grow the crop extensively."

Such sins of omission bulk very large.

A close scrutiny of all these problems reveals that artificial curing holds the key to them all.

By means of it we can rob farming of its worst caprices. We can, by yoking it in double harness with the so-called soiling system, get a maximum product per acre. We can even change the crop's relation to locality, introducing some with success where they are now unknown.

We can save the great losses at harvest time.

We can save the land's time.

We can greatly restore the profit and pleasure in rural life.

Finally, most precious of all, we can in a measure save the very foundation of the national life—the rich lands of the Mississippi Valley.

(Paper read by Arthur J. Mason at the Chicago Literary Club March, 1917)