AINSLEE'S MAGAZINE

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Vol. VIII JANUARY 1902 No. 6

PRICE, 10 CENTS A NUMBER; $1.00 A YEAR.

THE NEW KNOWLEDGE OF WEEDS

USES OF THE SO-CALLED PESTS OF THE SOIL

BY THEODORE DREISER

VAST sums of money and an army of men are being employed by the government to locate, understand and put to their proper uses the weeds of the country. From every town and hamlet and country wayside this great government gathers reports concerning these vegetable outlaws. The impudent dock that surreptitiously slips his seed on to the coat of a passerby in Nebraska is recorded in the annals of the Agricultural Department, and the line of the dock's progress is marked on the maps which show the areas of distribution in the United States. It is now known what and where the weeds are, and a constant surveillance is kept over them. Those that threaten to become pests are headed off by all the forces of government. It is a fact that an order to kill some lone specimen of a pernicious Canada thistle has been sent by telegraph from Washington.

There is, however, little need of encouraging the destruction of weeds. The thing important now is to utilize those that have been found indispensable. There are weeds that are soil renewers, weeds that are food for man and beast, and weeds without which thousands of acres of our most fertile lands would be wastes to-day. These weeds the government is endeavoring to preserve. It is surprising in the light of these discoveries to consider man's attitude toward weeds in general. That he should have sworn at them, sought measures of extermination, plowed them toilsomely under year after year, and yet himself remained really handicapped in the battle for subsistence because he lacked the aid which one or more of these would have readily given him seems incongruous. One kind if properly used would have supplied deficient soil with potash, another would have brought it the needed lime, a third the nitrogen or phosphorus, taking it out of the atmosphere and depositing it where his crops of cereals and vegetables would readily draw upon it and wax strong. In one he could have found a better food for his cattle than he ever had before, in another a hardy worker capable of thriving with scarcely any rain and yet making returns in food or fertilizer far beyond the petty achievements of the most pampered and cultivated of domestic plants. The outlaws of husbandry have for ages held the secret of binding the sands of the sea so as to fix the shore; of digging deeper than any plow and searching for the minerals which make deficient land arable, and of drawing upon the atmosphere and taking from it the valuable chemicals which no farmer is rich enough to buy in sufficient quantities to make his poor holding profitable. These bandits of the garden have turned out for the most part to be saviors and man's best friends, and so clear have their distinguished merits become that scientists are even apologizing for the need of calling any of the remaining, and as yet little understood vegetation, *weeds*. So we have all unused plants now divided into poisonous and non-poisonous, with the reservation that all may be and probably are extremely useful. If poisonous, the new attitude is to find out why. Where the poison comes from—out of the air or the earth? How is it distilled? What is its nature? Whether it is a known or unknown poison? What its effect may be on one and every other object, particularly upon life and growth? These and others are the questions scientists seek to answer by investigating the weeds.

The result is a new world of information of immediate or ultimate usefulness. So far the investigations have served to show that we are in our infancy as regards a proper knowledge of food. The available supply has already been increased a thousand-fold. The possibilities of increasing the strength of the soil have never been so numerous. The time is already in sight when the ability to examine a stretch of land and prescribe the proper weed to nourish and cure it will be realized. The time also is not far distant when the poisonous weed will have been mastered and applied, and the most useless weed put in its place and made to do serviceable work.

Already from the kingdom of weeds has come the host now recognized as serviceable grasses. We have sixty native species of clover, seventy blue grasses, twenty-five grammas and curly mesquite grasses, all wild and all abundant. They have flourished on the great plains, and though not understood have produced more beef and mutton than all the cultivated hay grasses put together. The cattle of the ranches have been wiser in their selection of them for food than men. Besides, there are ninety lupines, twenty wild beans, forty vetches, forty beggar weeds, twenty kinds of wild rye, thirty kinds of brome grasses, and meadow, pasture, woodland and swamp grasses without number. Each of these has always been considered a weed and a nuisance, and yet each is especially adapted to a soil or climate and to some particular use. There is a wild millet, common to the South Atlantic coast, which grows from six to ten feet high, and is a splendid cattle food. There is a wild brome grass now approved of which was never thought to have any value until one almost identically like it was imported from Russia as a cattle food. There are wild perennial beans in the southwestern mountains of the United States which grow luxuriantly with only twenty inches of rainfall annually, and yet many of them far surpass in productiveness and forage value those which have come to us from foreign lands and require good soil and a normal rainfall. There are free seeding wheat grasses in the Northwest still generally looked upon as weeds, which equal the best of our hay grasses. In the mountain parks the government agents have found a wild green turf which rivals in fineness and beauty the best artificial lawns.

This order of grasses is in part claiming commercial attention. Already some are used as fibre in the manufacture of twine or paper. Some are used in making hats and many other articles of woven work. They are planted to subdue or bind the drifting sand of the seashore, to hold the soil of railway embankments, and to prevent the washing out of dikes and levees. Others are used to aid in reclaiming fields denuded of their soil by rain. It has been shown by the government that through their growth and decay the fertile prairie loams have been formed. They were and still are the forerunners which nature sends to cover the bare surfaces and to lessen the sterilizing effect of heat and drought. Not all have value as food for either man or beast, but it has been found that all of the number described serve some purpose in the economy of nature, and they are not yet completely understood.

The weeds of the cities and villages which are best known to us all have unquestionably the worst reputation and are looked upon as the most useless and harmful. They are some twenty-five in all—the good classed with the poisonous, and all misunderstood and considered evil. In New York, Philadelphia and Washington the residents see vacant lots growing with wild onion in winter, dandelion and bulbous buttercup in spring, then wild carrot, prickly lettuce and sweet clover, and after them the horseweed, ragweed, cocklebur, Mexican tea, slender pigweed and jimsonweed of the late summer and autumn. Chicory, horse-nettle, burdock and gum-succory are in abundant evidence throughout the season.

Some of the most prominent weeds of Boston are burdock, rough pigweed, chicory and fall dandelion. In Chicago rough pigweed, tall ragweed and cocklebur are abundant, while there are hundreds of acres within the city limits covered almost completely with Canada thistle and Russian thistle. In Denver false ragweed, squirreltail grass and Russian thistle are among the most noticeable weeds, and in San José, California, the vacant lots are chiefly occupied by wild licorice, spiny cocklebur, wild heliotrope, milk thistle and tarweeds. In Atlanta, Augusta, Auburn, Mobile, New Orleans and most other cities of the Gulf States tarweed is looked upon as the pest of early summer and sneezeweed of the late summer and autumn; the latter is a yellow flowered composite, which has been introduced during the past fifty years from west of the Mississippi.

It is known now that the presence of these weeds, collectively and uncared for, is not all bad. When young and growing, besides giving a more sightly appearance to utterly vacant ground, they purify the air, and herein lies the chief benefit conferred by their presence in cities. Numerous fires in dwellings, factories and locomotives, and the breathing of the people continually rob the air of its oxygen and charge it with carbonic acid gas. Growing plants of whatsoever kind, and weeds in particular, reverse this condition by drawing off into themselves the carbonic acid gas, and often other injurious gases, and giving out oxygen in return. So a vacant lot covered with healthy growing weeds is much better for the public

health, and certainly is more pleasing to the eye than the bare ground.

They have another effect not so good. When they stop growing they cease purifying the air, although it is not certain, as some suppose, that they rob it of its oxygen. They harbor injurious insects and fungus and bacterial diseases, which later they communicate to cultivated plants. When they become rank and begin to decay they shade the soil from the purifying and drying effects of the sun and wind, and, it is thought, keep it damp and sour—a fit breeding place for malaria. The ragweeds produce a pollen which is extremely irritating to persons afflicted with asthma or hay fever. The mayweed, tarweed and stinkweed produce disagreeable odors. The wild garlic is eaten by the cows, which gives the city residents reason to complain of the bitter flavor of garlic in the milk delivered them. Henbane or deadly nightshade, jimson weed and purple thorn are deadly poison and give cause for more opposition to weeds in cities.

Notwithstanding all this, the charge is not against the individual weeds, but their collective neglect and misuse. They are not understood. Every one knows that dandelion is an excellent pot-herb when taken by itself and cultivated. It is not so generally known that this is true of chicory, milkweed and pigweed, although the government is now calling attention to their value as food. Prickly lettuce, while not thoroughly understood, is known to be liked by sheep and is therefore thought to have some quality which will eventually make it useful. The same is exactly true of the wild carrot. The other weeds—wild onion, horseweed, ragweed, cocklebur, jimson weed, burdock, tarweed and sneezeweed—have done the service to humanity of exciting interest in the weed question. Their size and strength, the manner in which they multiply and the use which they make of what they find in the soil and atmosphere has stirred up investigation of a most profitable order. Part of the knowledge acquired has been how to kill them cheaply and effectively where they are a nuisance, but this knowledge is not now considered so important. Later a study was made of their growth and distribution until the whole vast scientific knowledge of how so-called weeds grow, multiply and distribute themselves was gathered. The investigation as to what it is that these weeds take from the soil and the air is under way, and the investigation will not end until it is known what they do and what is their place in nature. In 1898 an interesting pamphlet covering the character of thirty poisonous plants and the cure for injury by them was issued by the government. Since then several poisonous plants have been especially investigated by individual scientists. One of these, the common poison ivy, has been thoroughly analyzed by Dr. Franc Pfaff of the Harvard University Medical School. He discovered that the poison in the ivy which does the damage is a non-volatile oil to which he has given the name of the plant. It is an oil that has not hitherto been known to science, and is found in all parts of the plant, even in the wood. Why it should poison the skin when touched is not yet known, but the fact that it will poison only the spot which it touches and will not spread has been found out. Dr. Pfaff also discovered that it is readily removed by alcohol, and that old poisons by this plant are readily cured by two or three applications of a mixture of equal parts of alcohol and sugar of lead.

As much is now being done for corncockle, jimson weed, sneezeweed and others, remedies for which are already known, although the character of the poison is not.

Out of this branch of weed-study is certain to come remarkable information, for the poisonous plants are the most strangely constituted and given to astounding variations. For instance, the common poke berry presents a spectacle of contradictory qualities. Birds eat the berries which to men are poisonous. Cattle may eat the leaves when green and fresh, but if, perchance, they should eat a wilted leaf it would poison them. The roots are deadly poison, yet the shoots which grow up six inches high in the spring are an excellent food for man—the rival of asparagus and equally healthful. Science has at last paused to inquire why this should be so, and some day the chemical action which can make a deadly poison by wilting a leaf when the fresh one is harmless will be discovered.

Similarly it has been observed of American false hellebore or itchweed that the seeds are poisonous to chickens, and that the leaves and roots are poisonous to men and horses, but that sheep and elk, which chew the cud, seem to relish the plant. In all, the poison, when in the system, acts alike, paralzying the heart and spinal cord. The poisonous element of corncockle has not yet been explained, but its curious action has already been observed. When ex-

tracted it mixes freely with water, froths like soap and, though odorless, will, when inhaled, produce violent sneezing. Caper spurge, the common gopher plant or spring wort, is curious in that the mere handling of it will poison to the extent of producing pimples and often gangrene. It is a thing that cattle can eat without harm, and goats eat freely, but the milk of the latter will then be deadly poison. In men a moderate dose will produce a general collapse and death in a few hours. The poison of the sneezeweed develops mostly in the showy yellow flowers, and is violent. The young plants are comparatively harmless, and even in the mature ones the poison varies greatly —some having scarcely any at all.

In the case of this plant and the woolly and stemless loco weeds some effort has been made to find out where they get their deadly poisons. That of the loco weeds is a most subtle thing. The poison of the woolly loco produces strange hallucinations in its victims. It effects the eyesight and silently reaches one after another of the vital functions, killing the victim in two years' time.

Some animals after eating it refuse every other kind of food and seek only this. They endure a lingering period of emaciation, characterized by sunken eyeballs, lusterless hair and feeble movements, and eventually die of starvation. So mystic an element gathered from the earth and the air naturally causes wonder and the desire to know what such things may be and why they are.

Weed investigation has also resulted in a great addition to the known foods for cattle, and the discovery of a number of plants that will fertilize the soil. During this century and within recent years a score or more of valuable leguminous plants have been discovered in what were considered weeds, and hardly a year passes that new ones are not added to the list. They are plants which make food for cattle and which, when planted in poor soil, improve it by taking from the atmosphere and the deep subsoil things which the surface soil needs.

The manner in which they are known to improve poor soil forms a remarkable scientific discovery. Their roots extend into the stiffer and more compact subsoil, where no ordinary plant can reach, and after loosening and opening it up so that air and water can have action upon it, suck up from below great quantities of potash salts and phosphoric acid. When these weeds are plowed under or die, these salts and acids are left near the surface where they can be utilized by the cereals and root crops which live upon them. For instance, wheat and potatoes flourish well where these weeds have gone before and done the work of getting the necessary food for them from the subsoil and the air.

Much land is of no value until these weeds come in and make it so. This is particularly true of sandy soils and reclaimed marsh lands, which are deficient in potash, a thing necessary in all farming land. On these the deeper rooted legumes, such as gorse, broom, alfalfa, lupines, sulla and the perennial beans are of great value. Their roots not only reach down very deep and bring up potash from the subsoil in the manner described, but their leaves take great quantities of nitrogen from the air. Now, when a soil is rich in potash and nitrogen it is good soil, and as these plants die and leave their gathered potash and nitrogen on the surface, the sandy and marshy soils become good land. All the farmer has to do is plow these rotting weeds under and he has land on which he can raise cereals, root crop and tobacco—that hardiest, most wearing plant upon soil.

The government has induced farmers to try the Florida beggar weed. One experimenter reported that by planting it in his field and plowing under the annual crops for two successive years, the soil had been completely changed in texture and color. Another farmer discovered that a crop of beggar weed turned under, will, when decomposed, retain near the surface in ready reach of the roots of succeeding crops not only all the nitrogen that it took out of the atmosphere, but also whatever fertilizers were subsequently applied. A third reported that all his field produced more luxurious crops after having been given over one season to a rank growth of this weed.

To find out how much chemical value this weed really takes from the air and the subsoil, the government planted a sandy field (bare of any of the qualities on which ordinary cereals and vegetables can thrive) with beggar weed, and when the crop was at its height harvested it, root and all. The crop was then reduced to ashes and the result analzyed. It was found that every ton of beggar weed ashes contained 508 pounds of lime, 230 pounds of phosphoric acid, and 482 pounds of potash. Twenty to twenty-five tons of beggar weed hay were required to make one ton of ashes, but every acre yielded four tons of beggar weed. It was figured out that at a four ton yield per acre, which is an average, one acre of beggar weed would yield 150 pounds of nitrogen, worth fifteen cents a pound, or $22.50 worth of nitrogen, and potash and phosphoric acid worth $5.25, making a total of $27.75 worth of fertilizing chemicals taken from an acre of soil worth nothing at all.

As good a report can be made of red clover, alfalfa, cowpeas, the soy bean, crimson clover, Dakota vetch, Texas pea, the Stolley vetch and others, though some, as, for instance, the Texas pea are being allowed to die out. Crimson clover, particularly, is an excellent soil feeder, but will not do well north of a line drawn through New Jersey, East Tennessee and Central Texas, for it cannot withstand severe winters. It requires, also, a great deal of moisture, and so is better adapted to the needs of the Southern farmers. It has been proved an excellent preparatory crop for Indian corn, being sowed in the corn rows in late summer and turned under in time for the spring planting. It may be used in the same way for cotton or tobacco.

Incidentally, the habits of growth and distribution which characterize weeds have been thoroughly studied and a splendid picture of the intricate working of nature in these things has been evolved. There are maps in the Agricultural Department showing the present distribution in the United States of the Canada thistle, Russian thistle, nut grass, wild carrot, prickly lettuce and a score more, which show at a glance just where these weeds are to be found and the extent of their range. There are separate documents and papers for each one of over three hundred weeds, giving their life history, merits, demerits and present location and distribution.

What has been discovered about the migration of weeds shows how wonderfully life prevails even in the face of great hardship. It has been found that a weed no less than a man struggles to live and to propagate its kind, and that it will make thorough use of the poorest opportunity. Wind, water, the tides, the migration of birds, the moving of cattle, all furnish the average weed an opportunity to distribute its seed into new regions. Those now common to the United States have for the most part migrated from Europe and Asia. Of a list of 200 so-called injurious weeds, published in 1895, it was found that 108 were of foreign origin, while ninety-two were native. Of the former, twelve or fifteen had migrated only a short time before from Central and South America.

How they migrate has been accurately shown in the case of every kind of weed extant in the United States. Some travel exceeding slow by means of runners or slender radiating branches, which reach out anywhere from ten inches to ten feet along the ground and produce plantlets at the ends, which take root and grow. Others progress by spreading underground, working too deep to be disturbed either by grazing animals or mowing machines. Still others, finding the battle for life difficult, develop strange qualities. Professor A. N. Prentiss, of Cornell University, has demonstrated by experiment that a Canada thistle root, cut into pieces one-fourth of an inch long, can produce shoots from nearly every piece. So when the share of the plow digs down to cut and tear this inhabitant from its home it more often aids in its further distribution.

One of the most interesting yet least known methods by which plants travel short distances is by throwing their seeds. When the pods of the common tare are mature they dry in such a manner as to produce a strong oblique tension on the two sides of the pod. These finally split apart and curl spirally, with such a sudden movement upward as to hurl the peas several feet. Many others progress in the same way, the common spurge and wood sorrel in particular.

Many weed seeds have special adaptives that enable them to take advantage of the wind or to float lightly on water. Dandelion, prickly lettuce, Canada thistle, horseweed, milkweed and many others equip their seeds with some feathery or winglike apparatus that enables them to sail. Ordinarily the distance this equipment can carry is two miles, but a high wind or hurricane would bear them ten or fifteen. Yet with two exceptions, the most rapidly migrating weeds have not traveled in this way. Frozen ground or snow is another great aid to the hardy migrating weed because seeds are blown along for great distances. Buttonweed, giant ragweed and barnyard grass all progress in this way, because their seeds are produced late in the season, and many of them are held with such tenacity that they are dislodged only by the strongest winds, when the conditions are favorable for distant journeys. By that time the ground is usually frozen or covered with snow, and the seeds skip merrily along before every stray gust. This method of seed dispersion is now known to account in part for the general presence of ragweed, mayweed and

others along our country roads. It also shows that weeds are distributed much more rapidly over fields left bare during the winter than over those covered with some crop that will catch the rolling seeds. Professor Balley, of the Fargo (N. D.) Agricultural College, found by experiment that wheat grains drifted over snow on a level field at the rate of 500 feet a minute, with the wind blowing twenty-five miles an hour. Lighter or angular grains were found to drift more rapidly.

Some weeds migrate by tumbling, the whole plant, seed and all, withering into a sort of ball and rolling before the wind. Such are best developed in the prairie region, where there is little to impede their progress, and where there are strong winds to drive them, but they are found also in the Eastern states, where they may be seen in ditches, gullies and fence corners, swept bare of their seeds before the winter is out.

Some weeds depend for their widest distribution upon the hooked character of their seeds, which stick to the hide of cattle or the clothing of men. They have been known to travel hundreds of miles this way, and the ground about the great stock yards in Chicago and other cities is rich in weeds not common to that territory. Migrating birds sweep seeds through space for thousands of miles, and it is thought that some of the weed importations from Central and South America have come this way.

Railways are highways no less for the progressive weed than for man. Seeds drop from cars and from the clothes of passengers all along the line. The most prolific weeds, particularly the Russian thistle, have been introduced at widely separated points throughout the United States almost simultaneously by this means. They come in straw used for packing, and in grain not perfectly cleaned. The country towns that receive the freight are breeding places and the men who handle it are carriers. The weeds get everywhere, because the seeds survive long and are equipped to cling and travel. By centuries of struggle they have acquired the ability to adapt themselves to almost any quality of soil or to any kind of atmosphere. They earn their right to live by the most hardy efforts. No plant of culture could ever endure the knocks which they receive and survive. Heat, cold, drouth, frost, soggy rains, unnatural soils, all afflict the traveling seed by turns. Yet it will face the situation, dig deep, reach high, even change its diet and its very nature before it will give up the struggle. That it should be of some use is a long-delayed but just conclusion of science. The outlaw of the fruitful fields is to-day most often the helper and savior of the arid way. Equiped with a powerful constitution and giant energy, the worst of the weeds may readily become the best of the plants.