[Continued from SUPPLEMENT No. 1612, page 25829.]

HOW SEEDS ARE CARRIED.—II.*

II. SEEDS THAT TUMBLE AND FLOAT.

By CRAIG S. THOMS.

No doubt the wind is the most active agent in carrying the great majority of seeds. Often it helps in distributing those that have neither pappus nor wing.

DEPLETED SEED CLUSTERS OF RIVER RUSH, AND ENLARGEMENT OF SEEDS WITH THEIR "FLOATERS."

Indeed I have known flower seeds, after being, as was thought, safely planted in a garden, to be blown away with the surface soil in a strong gale, and to be lodged in the street. In dry seasons grain on sandy knolls is often blown some distance with the soil that covers it.

Seeds thus distributed, however, cannot be classed with those that fly, since they embrace seeds of every character, and are distributed by sheer force. A wind strong enough to carry sand and pile it into hills, will also carry seeds, picking them from the ground wherever it can get access to them, and carrying them for some distance. Even seeds that are too heavy to be lifted bodily by the wind are often rolled and tumbled along. In this rolling, tumbling, and drifting process the help which the snow renders can hardly be overestimated. A large number of plants hold their seeds during the early winter, and many retain part of them even until spring. In the fierce gales of winter these seeds are cast out upon the snow. If in December one shakes violently the podded stalks of beard-tongues, milk vetches, tall bellflowers, Indian mallows, cat-mints, and many other plants, many tiny seeds will be thrown out upon the snow. If the snow-crust be hard and the wind strong these seeds roll and tumble along on the smooth surface, and are carried far from the plant. If the snow be soft and light they are caught up when it drifts and are carried shorter or longer distances according to weight, size, shape.

In the same way many seeds having wings or pappus are carried much farther than would otherwise be the case. The three-winged dock seed, the small-pappused golden rod, the winged ashes and box elders, and the seeds of many pappiferous grasses, are found clinging all winter, being dislodged only by strong winds. Such winds, of course, bear the seeds a certain distance before they fall; but when they fall on a hard snow surface they are shoved and tumbled along to almost any distance, and when they are caught in drifting snow they are hurled along with it.

There are certain seeds, however, that, independently of snow, are scattered by rolling and tumbling. Prominent among these is the Russian thistle—the Tartar thistle of southern Russia. It was accidentally introduced into the United States, presumably by emigrants about 1885, and has already taken possession of thousands of acres in the Dakotas, Minnesota, and Wisconsin. It grows in flattish-round form with branches usually curving inwardly at the top. Its top-shaped seed capsules nestle in the axils of stiff, awl-shaped, spiny leaves, and are not easily dislodged. The numerous branches spread from a single small root immediately upon its emergence from the ground. In the autumn this small root breaks off just below the spreading branches, and the whole plant goes tumbling over the prairie mile after mile, scattering its seeds as it goes. In a strong wind hundreds of these plants tumbling at a distance, are sometimes mistaken for a herd of sheep on the run. Deep railroad cuts are filled with them, and much trouble is caused for the train crew. At times they bank themselves against barbed wire fences until the power of the wind upon them forces the staples from the posts, so that when the thistles have passed on the wires lie prone upon the ground.

Certain of the panicum grasses distribute their seeds in the same way. The brittle stalks break off just below the bushy heads, which then go tumbling over the fields scattering their small, shiny seeds. These grass heads may be seen cluttering large cocklebur plants which catch and hold them. They bank them-

selves against fences, catch upon tall weeds which border fields, and get tangled in brushwood on the edge of timber.

Certain inflated pods, like those of the rattlebox, while not light enough to be blown outright through the air, are sufficiently large and light when detached from the plant to be rolled along for some distance on the ground by a strong wind.

THE RUSSIAN THISTLE AND ENLARGEMENT OF BRANCH AND SEED VESSEL.

Various species of ground cherries have a large, inflated calyx which completely surrounds the fruit and forms a sort of balloon to help carry it. In mid-winter these plants are found usually with part of the fruit still clinging to the vine, and part broken off and

SEED CLUSTER OF GREAT BULRUSH, WITH ENLARGED SEEDS.

scattered about upon the ground. Balloon and fruit are firmly joined together, while the stem which holds them is easily broken. When detached these balloons are easily rolled along upon the ground by the wind whenever the conditions are favorable, and, since much of the fruit hangs during the greater part of the win-

DITCH STONECROP SEEDS, SHOWING SEEDS AND CAPSULE ENLARGED.

ter, many balloons with inclosed seed capsules fall upon the level and often hard snow, where they are tumbled along.

Like many other seeds, those of the ground cherry have a second way of being scattered. The seed pods

are very sticky, as are also the many seeds within them, so that they attach themselves to any animal that by treading or lying upon them bursts open the pods.

Practically all small seeds that are wingless and pappusless fall within a few yards of the plants which bear them. How the snow helps to carry them farther we have just seen; but running water is also an important factor in their distribution. Everywhere in the spring rivulets escape from thawing snow. They are not large, nor do they hasten until the joining together of many sufficiently increases the volume; but any one of them is quite sufficient to carry along seeds that lie in the snow or are scattered upon the frozen ground.

What spring season is without its pouring rains—rains which cover the soil with sheets of water, drenching it, and almost scrubbing it, as though in annual house cleaning? The rivers rise; the creeks trail broad skirts along their banks; every draw is flushed; innumerable tiny washouts line the sides of the hills; everywhere little pebbles lie bare with the soil washed from around them; practically the whole soil surface has been moved at least a little way; before the spring is passed another step has been taken in the long geological process that is gradually washing the hills into the valleys, and bringing the earth's surface to a common level. Meanwhile what has become of the seeds that are everywhere scattered upon the ground, most of them near the plants on which they grew? They have been washed everywhere, the distance depending always upon the volume of water, the suddenness of the downpour, the weight of the seeds, and the hilliness of the country.

Certain plants which grow in water have special devices for floating their fruit. The great bulrush has a small seed, flat on one side, and on the other convex, like the under side of a broad-keeled boat. Attached to one end, and extending the full length of the seed, are from four to six light bristles. They are not sufficient to carry the seed in the air like a pappus, but greatly assist its floating. In addition, the outer surface of the seed seems to be somewhat oily. Thus the seed is planned to enable it to float on the surface of pond or river. When thrown into a glass partly filled with water, the glass will stand much rough shaking before the seeds are submerged. When they are once under the surface, however, they sink straight to the bottom.

The river bulrush, a triangular rush, which many people regard as a kind of coarse swamp grass, has a seed of similar character, except that the boat is more sharply keeled, the three angles of the seed being about equal. The bristles serve not only in helping the seeds to float, but also as sails which are raised above the surface of the water to catch the wind.

A very different arrangement for floating is found in the water plantain. The delicate brown seed is packed snugly in the center of a flat, corky cushion which will float for days before sinking to the bottom. The flat seed pod is thin as a knife-blade on one side and quite thick on the other. This gives it the action of a flat-bottomed boat in gliding over the water, while the thick side catches the wind. Since any small, wet object attaches itself to another object, these seeds, like many others, are held up much longer than they of themselves would float, by sticking to floating vegetation. In case of a strong wind they are driven with the vegetation to which they cling, or if they become detached, since they sink very slowly, they are driven by the force of the waves. Even when the corky seed capsule is thoroughly saturated it is so balanced in its relation to the specific gravity of water that it will not sink nearly so far as the seeds of the rushes. This fact is significant when it is remembered that water plantain is usually found in shallow water, while rushes often grow in places where water is quite deep.

Certain plants which grow at the margins of bodies

SEEDS OF WATER PLANTAIN, SHOWING ENLARGEMENT OF SEEDS, SEED CAPSULES, AND SEED CLUSTER.

of water, of which the ditch stonecrop is a good example, have seeds almost as fine as powder, which float for a long time, a large proportion of them indefinitely. While part of these seeds sink until in shallow water they reach the ground, others would

*Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

seem to be floated to the water's edge, where, upon the receding of the water in late spring, they are left stranded and find rooting.

Although most people have picked water lilies, few, save duck hunters and botany students, invade their haunts when the large pods are fully developed. The general arrangement by which their seeds are scattered is much the same in all. The largest and most beautiful of the group is doubtless the American lotus (*Nelumbo lutea*). Its seed pod is a large, round boat which holds fifteen or twenty passengers, each one with a separate berth. The large pod when green holds its seeds carefully by a firm rim about the shoulders of each one. When ripe these pods are apt to break off and float away, carrying their precious passengers with them. Gradually the rim about each seed expands until the seeds drop out and find lodgment in the mucky soil, often six or eight feet below the surface.

An agent which does more service in scattering seeds than is usually supposed is the ice. Here and there along rivers and lake margins are to be found plants of many kinds, grasses, and rushes; also upon their banks are certain trees, bushes, and vines, all of which hold at least part of their seeds during most of the winter. It matters not of what sort the seed may be, if it falls upon the ice the wind will skid it along until it meets some obstruction, which is apt to be a further shore. I have found box elder seeds imbedded in the ice of a river far from their trees.

When the ice of rivers breaks up in the spring and is hurried away in the swollen stream, the rushes, grasses, and plants of many kinds which have been frozen in at the river margin, are carried away with it.

Nearly all the forces of nature seem to be in league to scatter seeds with utmost thoroughness. Wind and rain, snow and ice, lake, river, creek, brook, even to the tiniest rivulet, all have a part in the important, though largely unseen task.

(To be continued.)

CHINESE RHUBARB.*

By E. H. WILSON.

SOME difference of opinion exists as to the actual species yielding the Chinese rhubarb of commerce. In this article I shall endeavor to show that while it is possible two or more species may be involved, the bulk of the commercial drug is furnished by one species—viz., *Rheum officinale*, Baillon.

The chief source of the drug is the wild mountainous region of the Szechuan-Tibetan border, and the range of mountains extending from this border to the province of Hupeh, Central China. This range (Kiu-tiao-shan) separates the province of Szechuan from Kansu and Shensi, and forms the watershed of the Han and Yangtze rivers. A certain amount of the medicinal product is collected in Hupeh, and finds its way to Hankow, where it is classed with the Szechuan product. In the imperial maritime customs trade returns, the whole of the rhubarb exported from Hankow is given as Szechuan rhubarb, and there can be no question that the chief source of the drug is the mountains of Western, Northwestern and Northern Szechuan.

Dr. Henry, in 1888, was the first to discover wild specimens of the medicinal rhubarb in the mountains of Hupeh. The plant was found growing in the forests between 7,000 and 9,000 feet above the sea level. Henry forwarded specimens to Kew, where they were identified as *Rheum officinale*, Baillon. In 1900 I rediscovered the plant in Henry's region and sent seeds to this country. Plants were raised from my seeds, and on flowering and fruiting proved the Kew determination of Henry's specimens to be correct.

Hupei plant. Of this I am convinced not only from actual knowledge of the living plants in both districts, but also from comparison at Kew herbarium of the specimens I brought from both regions. My knowledge of the wild plant as it occurs in Szechuan-Tibetan

mum age, but this is probably not strictly adhered to. The forest product is not so highly esteemed as that found growing on the grass lands above tree limit.

"Ta huang" is the name by which the drug is known all over China.

THE SEED BALLOONS OF THE GROUND CHERRY. THE DIVIDED BALLOON AND SEED VESSEL ARE ENLARGED.

border extends from south of Taitien-lu to north of Sungpan, on the Kansu border. The plant occurs in the forests 8,000 feet above sea level, becoming more abundant and reaching its maximum between 11,000 and 12,000 feet. It extends up to 14,000 feet, the

THE INFLATED PODS OF THE RATTLE BOX.

highest altitude of any tall-growing herb in these regions.

Rheum officinale is a striking plant, with its large, handsome, dark-green leaves and tall, loose inflorescence of white flowers. 7 to 8 feet high. The fruits

The latter half of September and October is the season for digging the rhubarb, but the process is carried on until the snow finally renders it impossible. Occasionally a spring digging is resorted to. This takes place before the plants begin to make much growth.

Rheum officinale has a distinct stem, not very long, but thick, and this, I was informed, was considered better than the roots. It is severed from the roots, cleaned, the bark and crown removed, and then split transversely, or more commonly longitudinally, into pieces 4 to 6 inches long. Sometimes a hole is bored through the pieces and they are strung on a cord and dried under the eaves of the houses. The roots vary in size and are often very large—4 to 5 feet long and 3 to 4 inches in diameter is not unknown. These roots have all the weak laterals removed, and are cleaned, roughly trimmed, cut into lengths, and often divided longitudinally.

At Taitien-lu, where the climate is very moist, partly drying the freshly gathered roots over brushwood fires is often resorted to. The medicine-gatherers only trim and prepare the drug very roughly; it is in the shops and warehouses of the dealers at Chungpa, Mienchu, Kuan, Hsien, and Yachow that the drug is finally trimmed, sorted, and graded ready for export.

The Taitien-lu product is carried overland to Yachow, where it is put on rafts and brought to Kiating. At Kiating it is placed on boats and shipped to Chungking. The Chinese esteem the Taitien-lu drug the least valuable on account of the moist climate necessitating the application of much direct heat.

The climate around Sungpan is much drier than that of Taitien-lu, and the rhubarb is rarely subjected to direct heat of any kind. It is collected mainly by Sifans, and after trimming and preparing is stored beneath the rafters and eaves where it can get plenty of air until it is dry and ready for disposal.

The bulk of the Sungpan product and that of Northwestern Szechuan generally is carried overland to Chungpa and Mien-chu, and there put on boats and shipped to Chungking. A certain amount of rhubarb collected to the west and south of Sungpan passes down the Min Valley to Kuan Hsien and Ghentu. A considerable amount of rhubarb is collected by the tribesfolk inhabiting the nondescript country west of Wen-chuan and thence to Kuan Hsien, or by another route direct to Kuan Hsien. Much of the rhubarb brought to Kuan Hsien is sent direct to Chungking, but some is sent by way of the provincial capital, Chengtu.

In Chengtu the price of rhubarb in 1904 was taels 35.00 per picul (tael = about 3s. and picul = 133 1-3 pounds).

Rhubarb is occasionally cultivated in the mountains of Hupeh, and Western China, notably Mount Wa; but cultivation is not much practised, as the cultivated article is considered very inferior to the wildling. With the exception of "Huang-lien" (*Coptis chinensis*), "tan-kuei" (*Ligusticum Thomsonii*), and "aconite" (*Aconitum Wilsonii*), the Chinese hold the same opinion in regard to all their vegetable drugs.

While the bulk of the rhubarb exported from Szechuan passes through the port of Chungking, not all of it comes under the imperial maritime customs, with the result that the actual quantity exported cannot be traced. However, if the customs returns for the port of Ichang be taken, a fairly accurate estimate will be obtained, since at Ichang the native customs also come under the control of the imperial maritime customs. In 1904, according to the published returns, rhubarb to the extent of 11,218 piculs, valued at 473,415 Haikuan taels (H. tael equal 2s. 8d. approximately), passed through Ichang. All the Ichang exports pass through Hankow and are there transhipped. The export of rhubarb from Hankow in 1904 was: Hankow to Chinese ports, 865 piculs, value H. tals. 11,851; Hankow to Hongkong, 7,768 piculs, value H. tals. 419,472—a total of 8,633 piculs, valued at 431,323 H. tals. As mentioned previously, all rhubarb exported from Han-

THE TUMBLING HEAD OF THE PANICUM GRASSES, WITH ENLARGEMENT OF SEEDS AND SEED STEMS.

During 1903 and 1904 I was engaged in a botanical exploration of Western China, and came across the medicinal rhubarb in great quantities. It was always the same species, and undoubtedly the same as the

are salmon red, and even more conspicuous than the flowers.

The medicine gatherers of these regions root up only the oldest specimens, which from experience they readily recognize. Ten years is regarded as the mini-

* From the London Chemist and Druggist.