but *G. elliptica* is the only one worth considering here. There are male and female forms of it, the most elegant being the pollen-bearing or male plant.

Genista.—In this numerous genus there are several beautiful garden shrubs, which are, however, more suitable for the rock garden than the shrubbery. Among these are *G. tinctoria*, *anglica*, *anxantica*, *sagittalis*, and *pilosa*, which for the most part are dwarf or prostrate shrubs, bearing yellow flowers. They are suitable for spots in the rock garden where they can be fully exposed and their shoots can ramble among and over boulders. In such positions their beauty is fully seen. The taller growing *Genistas* are few, but these are valuable. *G. elata* is one of the most noteworthy, and is not much known. It is a tall-growing, spreading bush, often 8 feet or 10 feet high. It is suitable for light soils, and in late summer is covered with a profusion of small pea-shaped flowers, which make the bushes glow with yellow, and thrives well as undergrowth to large trees if not too densely shaded, and is altogether a first-rate flowering shrub. The Etna broom (*G. ætensis*) is a slender, tall-growing shrub, from 3 feet to 12 feet high, and of most elegant growth. In August it is a mass of yellow bloom, which is then the more appreciated, as few other shrubs flower at that season. There are other *Genistas* to be seen in botanical collections, among them *G. ephedroides* and *monosperma*, but those described are the best for general culture. Being mostly natives of Europe they are quite hardy and suitable for almost all kinds of soil, though they prefer a warm, light one.

Gordonia (*Loblolly Bay*).—The two *Gordonias* in cultivation, *G. pubescens* and *G. lasianthus*, are very beautiful shrubs, but are far too rare in English gardens, owing probably to the difficulties attending their propagation. The genus is allied to the *camellia*, and the two species named are very old garden plants,

FORSYTHIA VIRIDISSIMA.

ALIMENTARY AQUATIC PLANTS.

By P. L. SIMMONDS, F.L.S.

IN the last number of the "Bulletin of the Paris Society of Acclimatization," 5th August, an article appears on this subject, which merits attention from the novelty of the information furnished, and while drawing one or two items therefrom, I may add some supplementary detail which will be interesting. It will come as a surprise to many that in Asia and in parts of North America thousands of people feed on the farinaceous seeds of certain water plants. I do not here allude to the enormous crops of cultivated rice in Asia, nor to the wild rice (*Zizania aquatica*) or *fluitans* of America, but to the various water lilies, the seeds of which are such a large source of subsistence to many. First we have the species of *Trapa*, known in India under the name of "Singhara." The plant is also cultivated on a large scale in the lakes and rivers of Southern China.

Fortune thus describes it: "Being detained for some time at Shanghai, I resolved to penetrate, if it were possible, into the district of Kwey-chow-foo. In ascending the river in a southwesterly direction, I soon arrived, after passing Kea-Hing-Fo, a city of 220,000 in-

Europe. Dried and reduced to flour, it makes a good gruel, and it may be mixed with flour for bread. Roasted or preserved in sugar or honey, it is a pleasant food. It is also excellent food for geese, ducks, and other birds of the poultry yard."

The species which is cultivated in Kashmir, according to Roxburgh and Sir J. D. Hooker, is believed to be *Trapa bispinosa*, although usually stated to be *T. natans* and *T. bicornis*. It is met with from Central and Southern Asia (where it is called *Singhara*) to Ceylon and Japan, and also reaches in the south of Africa to Zambesi. To this species probably belongs *T. cochinchinensis*, Lour., and *T. incisa*, Seib. *T. natans* is said to have furnished a large part of their food to the ancient Thracians, in the same manner as *T. bispinosa* does at the present day to the inhabitants of Kashmir and *T. bicornis* to the Chinese. It is mentioned by Dr. Royle that the former yielded as much as £12,000 a year of revenue to the government of Runjet Singh, the tax being levied upon from 96,000 to 128,000 ass loads from the great Lake of Ooller.

In Kashmir, after a severe famine, the governor of the district in which is situated the Woos Lake introduced the culture of the *Trapa*. This lake, which measures at least 5,000 acres, is so filled with this

THE SLIPPERY ELM OF CALIFORNIA (FREMONTIA CALIFORNICA).

introduced during the last century. *G. pubescens* is a shrub of camellia-like growth, 6 feet high, bearing in late summer beautiful flowers 3 in. across, pure white, with a center tuft of yellow stamens. *G. lasianthus* is taller and more robust in growth and has larger and more fragrant flowers than *G. pubescens*. Both are natives of the swamps near the coast of the Southern States of North America, therefore are not among the hardest of shrubs, but in our southern and coast counties they need no protection. Both species are obtainable in the best nurseries.

Grevillea.—These Australian shrubs are generally grown in the greenhouse, but there are a few quite hardy enough for wall culture. Among these are *G. sulphurea*, the hardest species in cultivation, and which flourishes freely against walls about London. Its flowers are pale yellow, of curious shape, as in all *Grevilleas* produced at no particular season, but continuously throughout the summer. *G. rosmarinifolia* is another hardy kind, having rosemary-like leaves and red flowers in clusters. The *Grevilleas*, like other half hardy shrubs, like a warm wall in a sheltered situation.

Grabowskia boerhaaviaefolia.—An ugly name for a not very beautiful shrub. It belongs to the potato family, and is hardy enough for the open air, though a native of Peru. The flowers are dull pale blue and not showy. It may be well to know the name, so as to avoid the plant.—*The Garden*.

habitants, at an immense pool, which I suppose communicates with the celebrated Lake Tai-ko. The water, not deep, was covered with *Trapa bicornis*, which the Chinese call ling, the bizarre fruit of which, resembling a bullock's head with two horns, is highly esteemed in China. I noticed three very distinct varieties, one of which bore fruit of a fine red color. Women and children in great numbers were paddling about in small boats of a circular form, like washing tubs, collecting the seeds. Nothing could be more curious than these singular boats, large enough to contain the person and the product collected, and pushed about among the plants without injuring them. The sight of this immense number of individuals floating about in their little tubs in this swamp was to me most diverting."

Another voyager, M. Marchal de Luneville, states: "The *Trapa bicornis* forms the food of the people when the rice crop is insufficient. The collection reminds me of the grape harvest in Europe. The 'ling' is sown at the close of autumn, in those ponds where the water is shallow and clear, and in localities exposed to the south. The Chinese affirm that this culture absorbs the putrid emanations which rise to the surface of the stagnant waters. If the harvest is abundant the seeds are given to poultry, which fatten readily on them, and their flesh acquires an exquisite flavor. This water chestnut, as it is termed, is considered refreshing and agreeable food in summer. In its green state it is sold in the markets of Peking as nuts are in

plant that navigation is impossible. The fruit is collected by entire boat loads, and the governor derives a large revenue from it. Many of these boats filled with seeds arrive daily at Srinagar.

The seeds of the *Trapa bispinosa* and *T. natans* contain a great quantity of fecula, and are eaten by the natives. In Gujerat they form an important article of food. During the Hooly festival a red dye is made from the fruit, mixed with a yellow dye from the flowers of the *Butea frondosa*. Colonel Sleeman has given the following interesting account of this plant in his "Travels in the Southwestern Provinces:" "Here, as in most other parts of India, the tanks get spoiled by the water chestnut (*Singhara*), which is everywhere as regularly planted and cultivated in fields under a large surface of water as wheat or barley is on the dry plains. It is cultivated by a class of men called Dheemurs, who are everywhere fishermen and palankin bearers, and they keep boats for the planting, weeding, and gathering of the *Singhara*. The holdings or tenements of each cultivator are marked out carefully on the surface of the water by long bamboos stuck up in it, and they pay so much the acre for the portion they till. The long straws of the plants reach up to the surface of the water, upon which float their green leaves, and their pure white flowers expand beautifully among them in the latter part of the afternoon. The nut grows under the water after the flowers decay, and is of a triangular shape, and covered with a tough brown

integument adhering strongly to the kernel, which is white, esculent, and of a fine cartilaginous texture. The people are very fond of these nuts, and they are carried often on bullocks' backs two or three hundred miles to market. They ripen in the latter end of the rains in September, and are eatable till the end of November. The rent paid for an ordinary tank by the cultivator is about 100 rupees (£10) a year. I have known 200 rupees to be paid for a very large one, and even 300, or £30 a year. But the mud increases so rapidly from the cultivation that it soon destroys all reservoirs in which it is permitted; and where it is thought desirable to keep up the tank for the sake of the water, it should be carefully prohibited."

In Kashmir, miles of the lakes and marshes are covered with it, and the fruit forms the staple food for some months in the year to a large number of people. It abounds in starch, resembles a chestnut in flavor, and is eaten either raw or cooked. Flour is made of it, which is eaten by Hindoos on fast days, also made into sweetmeats.

A variety of *T. natans*, to which the name of *T. ver-bunensis* has been given, is cultivated in the lakes of Majena and Varesa in Italy, especially in the Bay of Angera, Lake Majena, where the bottom is visible.

With the seeds, chaplets of beads are made, and sold in Rome, Varesa, and other places. Necklaces made of the nuts are also sold at Benares, and considered very sacred.

Capt. J. P. Pogson, of Simla, advocated, some years since, in the *Journal of Applied Science*, the more extended culture and utilization of this plant. "With the example of Kashmir before us, it seems very singular that the vaulted tanks, large lakes, and inland fresh water sea of the Madras Presidency, as well as the immense 'heels' of the North-Western Provinces and Oudh, are not, as a rule, turned to most profitable account by being placed under *Singhara* cultivation. The dried nuts will, I believe, keep for many years, and as arrowroot, or rather *Singhara* starch, will always sell in England, either as food or for manufacturing purposes. All old *Singhara* stock could be so converted and sold.

"Like the grain of wheat, the kernel of the *Singhara* nut is capable of sustaining life for an indefinite period, and is palatable, whether seasoned with salt and pepper, or made into porridge with sugar, ghoor, or jaggery. If the kernels are broken into small bits, they may then be ground into meal in a hand mill, and the produce kneaded up into dough, and made into small 'chupatties,' or cakes. If the kernels be soaked overnight in cold water, next morning a simple boiling converts them into food—steaming would do as well, perhaps better; but I have as yet only tried the soaked kernels in the boiled state. I have, years ago, eaten 'hulwa' made of *Singhara* meal, and it was more palatable than that made from fine wheat flour.

"The Madras Presidency possesses some magnificent ancient waterworks. The Viranum tank, with its area of 35 square miles and its embankment of 12 miles; Cauverypank tank, with its embankment of 4 miles, riveted along its entire length with stone; the Chembrumbankum tank, looking like a picturesque inland sea, are of unknown antiquity. The first of these artificial lakes equals 22,400 acres of surface, and the third being compared to an inland sea, may be ten times that size. It is an officially authenticated fact that in Kashmir 30,000 human beings are, for five months out of the year, fed and sustained on the *Singhara* nut, and if the picturesque inland sea under notice is at all deserving the name, its bed and water surface might be most profitably utilized by being put under *Singhara* cultivation. The tank of 35 square miles might become a first-class nursery for supplying seed nuts to Madras.

"The productiveness of the water nut, per acre, is at present unknown; but supposing the yield to be four quarters (480 lb. each) of nut kernels per acre, then the 22,400 acres would give 43,800,000 pounds of food, and at 60 lb. per adult per month, the above quantity would suffice to feed 716,800 human beings for one month, and 143,360 adults for five months. The cost of this large and perennial supply of food would be a mere trifle. There are 4,000 square yards in one acre, and allowing one seed nut to each yard, the price of the nuts and the railway freight may be easily calculated. The first year's harvest would more than cover all cost, and thereafter in perpetuity a harvest would result which would only have to bear the cost of watch, ward, and collection. The entire crop being state property, a very considerable revenue would be derived from the sale of the nuts, even if the kernels were sold at half the price of rice or other grain.

"In good seasons, the agricultural population would freely use this cheap and nourishing food, and sell and export rice crops, etc., and in bad seasons of famine the growing crop of water nuts would be a stand-by. In fact, their presence would go far to prevent the artificial production of local famine.

"The nuts, once sown, resow themselves, and in this way the square yard might soon be growing nine water plants or more. The inland sea, when covered with these nuts, would be a source of wealth to the state, and the public would be greatly benefited. As the annual extension of the cultivation, spontaneous and artificial, is a very simple affair, the Madras government would, in a few years, find themselves to be the proprietors of very valuable *Singhara* plantations."

Captain Pogson, writing from Simla, states: "The *Singhara* nut of India and Europe bears fruit annually from the old roots, being a perennial aquatic plant. If sown in water two feet deep, the nuts may be gathered by going in, wading about, and collecting them in a floating vessel, say a five-gallon cask. If in deeper water, any sort of raft, float, or canoe will have to be used, and the nuts picked off. In this country (India), several pickings take place during the season, and the last batch of nuts, *i. e.*, those that are of a large size and the kernel hard, are boiled and so eaten. Others are shelled and dried and made into meal, while others again are buried whole, to be used next season for seed. For example, the pool or depression which has borne a crop of nuts may dry up during the hot weather; when the rains commence the locality will become a pool *de novo*, and the stock of seed nuts are then dug up and sown twelve inches apart in the shallow water, putting each nut about two inches deep in the submerged soil, and this process is repeated daily as the waters rise. In due course the nuts will germinate, and yield that year's harvest. Of course, if the water did not dry up the old roots would remain alive, and in season send

up a fresh crop of stems, which would in due course bear fruit. Hence, if required to become a perennial crop, the nuts must be sown in the beds of shallow fresh water pools which never dry up."

The Pythagorean bean, the *Nelumbo nuciferum*, Gaertner; *Nelumbo speciosum*, Willdenow; and another species (*N. luteum*) have seeds of a particularly pleasant taste. The capsular fruit contains from twenty to forty of these seeds. The seed vessel is of a peculiarly beautiful form. The top, becoming detached when ripe, discloses a chamber with five partitions. The seeds were much used as food in ancient Egypt, but seem to be neglected now. These retain their vitality for several years. The tuberous roots of both species resemble the sweet potato (*Batatas edulis*), and are starchy. The root stocks when boiled are farinaceous and agreeable, and employed as food by the Osage and other Western Indians.

The seed vessel or receptacle of the fruit of the lotus (*N. speciosum*) is large, in the shape of an inverted cone, and has the nuts placed loose in apertures, or cells, on the surface; it has not inaptly been compared to the rose of a watering pot. The whole, in process of time, separates from the stalk, and, laden with ripe oval nuts, floats down the water. The nuts vegetating, it becomes a cornucopia of young sprouting plants, which at length break loose from their confinement, and take root in the mud. The lotus flower is highly venerated by the Hindoos, and is given as a valuable offering to the gods. The seeds, in India, are eaten raw when green, and roasted or boiled when ripe and hard. The root, which is two or three feet long, is eaten, boiled, as a vegetable.

The Klamath Indians of Northwest America live chiefly on the "tookow," or seeds of the yellow water lily (*Nuphar lutea*), which is the staple of their winter food. The capsules are broken, and the seeds separated from their husks.—*Jour. Soc. of Arts.*

THE REJUVENESCENCE OF OLD TREES.

THE fact that old and apparently decrepit deciduous trees can be rejuvenated by judicious pruning is not well understood in this country, where old trees which might perhaps be made to live a century or two are often allowed to perish unnecessarily. The death of a tree can generally be traced to a gradual failing of vigor, due to insufficient nourishment, or to internal decay, the result generally of neglect. The first indication of danger usually appears at the top, and when the upper branches of a tree begin to die, it is a sure indication that unless radical measures are taken to check the trouble, it can only live a comparatively short time. Vigor can be restored to a tree in this condition by shortening all its branches by one-third or one-half of their entire length. The only care needed in this operation is to cut back each main branch to a healthy lateral branch, which will serve to attract and elaborate, by means of its leaves, a sufficient flow of sap to insure the growth of the branch. This is essential in good pruning, and, if neglected, the end of the branch will die back to the first lateral branch or bud below the cut, leaving a point of danger to the tree. Care, too, must be taken to shorten the branches in such a way that the lowest will be the longest, that the greatest possible leaf surface may be exposed to the light. Fig. 1 will serve to show how an ancient oak should

FIG. 1

be pruned for the purpose of increasing its vigor.* The vigor of a tree depends upon the power of its leaves to elaborate plant food. The larger the leaf surface exposed to the light, the greater will be the vigor of the tree. The object of pruning, therefore, is to increase leaf surface. If half of a branch of a decrepit tree, bearing small and scattered leaves, is cut away, the leaves which will grow upon the half which is left will be so large that their total area will often be more than double the total area of the leaves upon the whole branch before it was cut. The truth of this statement can be easily verified by cutting down to the ground in the spring a feeble seedling oak, or indeed any young seedling tree, when a tall, vigorous shoot, twice the height and diameter, perhaps, of the slender stem it replaces, will appear at the end of a few months, and, although this shoot will only produce a few leaves, its greater vigor is due to the fact that a larger leaf surface is presented to the light by these few large leaves than by the more numerous smaller leaves of the original plant. The vigor, too, of a tree can be increased after it has been pruned by a good top dressing of well rotted manure or of fresh soil applied over its roots; and trees growing on banks can often be benefited by deepening the soil on the lower side. A large body of plant food can thus be supplied without burying any part of the trunk and without injury to the tree.

The internal decay by which so many old trees perish, through inability to resist the influence of storms, is caused by dead branches allowed to remain upon the

* We are indebted to the trustees of the Massachusetts Society for Promoting Agriculture for permission to reproduce these figures, which are extracted from Monsieur A. Des Car's work upon tree pruning, of which an English edition was published in 1881, by the Massachusetts Society, under the title of "A Treatise on Pruning Forest and Ornamental Trees," a work in which the whole theory of pruning is clearly explained and illustrated.

tree or from the stumps of branches left in pruning. It is an almost invariable custom in this country, when a branch is cut from the stem of a tree, to leave a stump a few inches long, as shown in Fig. 2. The end of this branch, as it has no lateral shoot to insure a flow of sap, is not healed over with a new formation of wood

FIG. 2.

and bark, and soon dies. Decay thus begins, as appears in Fig. 3, and this decay gradually extends into the interior of the trunk, as shown in Fig. 4, ruining the tree for any useful purpose, and so weakening the supporting power of the stem that a severe gale will prostrate it. This decay can be prevented by cutting off dead branches as fast as they appear, and by cutting living branches, when it is necessary for any reason to remove them, close to the trunk or close to a lateral branch. The secret of good pruning lies in cutting close, so that the wound may heal by the formation of a new growth over the cut surface. No matter how large it may be necessary to make the wound, no branch stump, large or small, should be left in pruning. A coating of coal tar applied to the wound as soon as made will serve to protect it from moisture, and will not interfere with the formation of a new layer of wood.

Pruning, so far as the trees are concerned, can be done at any time, except in very early spring, when they are gorged with sap and "bleed" more freely

FIG. 3.

than at other seasons of the year. The autumn, however, is found to be the best time for such work. There is more leisure now than earlier in the season, while the coating of ice which often, in this climate, covers the branches of trees in winter makes it difficult and dangerous to work among them.

Three men at least are needed to prune a large tree properly, and to manage the long, heavy ladders which this operation makes necessary. One man stands at a little distance from the tree and directs where the cuts shall be made; the second man uses the saw, which must be attached often to a long handle; while the third holds one end of a rope fastened to a belt on the man in the tree, and passed over a branch above his head as a precaution against a fall. Nearly all our forest trees bear severe pruning of this sort, and improve under it. Decrepit red, black, white and swamp oaks, black birches, beeches, hickories, and elms have been pruned in this way in the Arnold Arboretum, where many of the trees in the natural woods were perishing from pasturage and neglect. They were covered with dead branches, the foliage upon them was thin and poor, and their dying tops showed that

FIG. 4.

they had but a short time to live. It was important to preserve many of these old trees until a new growth of self-sown seedlings could be brought on to replace them and a covering to the forest floor grown. A portion of these old trees are pruned each year, and those which were operated upon first, or six or seven years ago, show, in their dense, dark colored foliage, compact habit and vigorous growth, how pruning can, without fresh soil and without the aid of manure, put new life into feeble and dying trees.

It often happens that when trees have grown together thickly, as in a forest, they are destitute of lower branches. When such trees are thinned, as often happens in the improvement of grounds, single specimens are left with long, straight stems, and without foliage except at the very top. Such trees, from the point of view of ornamental gardening, are ugly objects, and are, moreover, liable to blow down in the first gale.

But there is no deciduous tree, however tall and unsightly it may be, which cannot be gradually converted into a handsome, branching specimen, by the aid of a saw and a pot of coal tar.—*Garden and Forest.*