strong infusion, taken warm, and in a large quantity, provokes vomiting; in consequence of which it is used in this manner in order to assist the action of emetics. It is also administered with advantage as an anthelmintic. The pulverized flowers are an excellent mild tonic to both horses and cattle; and are peculiarly suitable either during the presence of low fever, or in other cases in which stronger tonics might have too powerful an action.—Wild chamomile, *Matricaria chamomilla*, is a very common, annual, white-flowered, pinnate and linear leaved weed of the road sides, waste grounds, and freshly turned spots of Britain. It was formerly of great repute as a remedy for uterine diseases; and after having gone almost quite out of use, it has recently come again into great request in connexion with homœopathy.

CHAMPACA,—botanically *Michelia champaca*. A beautiful, tropical, evergreen timber-tree, of the magnolia tribe. It is a native of India, and was introduced to Britain in 1779. Its stem usually grows to the height of about 20 feet. Its timber is employed by the Hindoos in making drums. The pulverized bark of its root is used to excite the flow of the menses. Its flower has a golden colour, eminent beauty, and so powerful an odour that bees will not alight upon it; and it is held in high estimation by the Hindoos, and dedicated to Krishna.

CHANGE OF CROPS. See Rotation.

CHANGE OF SEED. See Seed.

CHARD. See Beet and Cardoon.

CHARCOAL. A well-known black substance, which possesses many singular chemical properties, the details of which are given under the article Carbon. In the present article we shall confine ourselves to the modes of preparation employed in Britain and in France, and to its economical uses.

Charcoal which is employed as fuel, is obtained generally from wood of different kinds; the most dense and hard being preferred. The white and resinous woods are commonly rejected. Large timber is seldom employed for this purpose, both because it is too expensive, and because it does not yield charcoal equal in quality to that procured from coppice wood. Pieces of three or four inches thick must be cloven into four pieces. It is an object of some moment to ascertain the most productive wood in the preparation of charcoal; and although accurate results are not to be expected on the great scale, yet experiments made by Mr. Mushet afford very good general proportions, which may be the rule by which the products may be estimated.

The following table exhibits very satisfactorily the results of these experiments.

100 parts of			Colour.
Lignum vitæ afforded	26·8	charcoal,	greyish.
Mahogany - -	25·4	—	brown.
Laburnum - -	24·5	—	velvet black.
Chestnut - -	23·2	—	glossy black.
Oak - - -	22·6	charcoal,	black.
American black beech	21·4	—	fine black.
Holly - -	19·9	—	dull black.
Sycamore - -	19·7	—	fine black.
Walnut - -	20·6	—	dull black.
Beech - -	19·9	—	dull black.
American maple	19·9	—	dull black.
Norway pine -	19·2	—	shining black.
Elm - - -	19·5	—	fine black.
Sallow - -	18·4	—	velvet black.
Ash - - -	17·9	—	shining black.
Birch - -	17·4	—	velvet black.
Scottish pine -	16·4	—	brownish.

In Scotland very large quantities of charcoal are prepared for the iron works, in the following way:—A platform, having a diameter of from twenty to thirty feet, is formed on the ground, by laying strata of earth upon it, and giving it a slightly convex surface. On the centre of this circular area, a circle of sticks are so placed as to cross each other a little below the top, and thus to form a cavity resembling an inverted cone, around which successive concentric layers of truncheons, having a diameter of from one to ten inches, are placed; care being taken, that the truncheons in the same circle are of the same size, and as few interstices as possible left. The exterior circle is composed entirely of brushwood.

When the platform is nearly covered, a coating of turf is laid on the pile, the grassy side being next to the wood; dry earth is then heaped up around the lower part, and well rammed down, so as to exclude all air. The pile is then lighted, by placing a few inflamed chips of wood in the interior cavity; and when these are consumed, others are added during the first three or four days. When the upper part of the pile is completely inflamed, a row of holes, each of which has a diameter of two inches, is made around it at a few inches below the top, and the opening at that part is closed up. The flame then gradually descends to the circle of holes, and its arrival there is announced by a very perceptible diminution of smoke and vapour. Another row of air holes is then made at a distance of six or eight inches below the first row, which are closed up; and the same operation is repeated until the flame has been conducted to the lowest part of the pile, which generally happens in about a fortnight; when the whole is carefully covered until the fire is extinguished. Such pieces as are not completely charred, are separated, and reserved as fuel for the next pile. The charcoal produced from the truncheons is laid aside for particular uses; and that obtained from the brushwood is sold, under the name of small coal, as fuel.

In France there is some difference in the mode of preparing the charcoal: it therefore is worth while to give an outline of the various processes there adopted. The wood is cut down in large faggots, and after having been well dried for some months, it is divided into brushwood, small and large faggots. The last are cut into truncheons of three or four feet in length. The turf is then taken off a square or circular space, having a diameter of about fifteen feet, and the earth beaten until the surface becomes dry and solid. A stake is next fixed in the middle of the area, and some brushwood laid on the surface as a foundation for the remainder. A stratum of truncheons is then laid on the brushwood, and the same alternatives are repeated, until the pile is completed to the height of about six feet in the form of a truncated cone or pyramid. As soon as this is done, the whole surface of the pile is covered to the thickness of about two inches with dry earth, over which sods are very compactly laid, except at the base, where considerable spaces are left between them. The central stake is now withdrawn, and the cavity is filled with chips, which are lighted at the top; the whole of the chips become inflamed, and, after a considerable quantity of smoke has been poured out, a light flame rushes from the chimney in the centre of the pile; the aperture of which is immediately closed by laying a piece of turf over it. During the next ten or twelve hours, considerable attention is necessary to prevent any mischief resulting from the sudden disengagement, and consequent combustion of carburetted hydrogen, which take place during that period of the manufacture. The explosion is announced by a rumbling noise, and seldom does any other injury than that of throwing off some portion of the covering, and through the opening thus formed flame and smoke issue. It is necessary to close up all such openings with a few spadefuls of dry earth. When the smoke decreases, and the explosions have entirely ceased, the interstices between the sods at the lower part of the pile must be closed. At this stage little attention is required, the combustion gradually extends to the surface, and in about thirty or thirty-four hours after the process commenced the whole pile becomes a glowing mass. The wood is thoroughly charred, the whole is covered with dry earth, and in four or five days it may be taken down. The particular stage at which it is proper to do so, is determined by making a small opening into the pile: if no flame appears, it is fit to be taken down; if it bursts forth, the aperture must be again closed, and allowed to remain so for another day.

Great nicety is requisite in the preparation of charcoal for the manufacture of gunpowder and other delicate chemical processes. And the manufacturers select the stems of the willow, alder, dogwood, and some others, which they prepare with peculiar care. In most of the large manufactories, the charcoal is distilled from iron vessels; by which means it is obtained in a state of considerable purity, and the other products are saved. As all charcoal contains minute portions of earthy and metallic substances, lamp black is commonly used in nice chemical experiments. Lamp black is obtained by the turpentine manufacturers, from the combustion of the refuse of their operations in furnaces appropriated to that purpose. The smoke deposits itself on the sacking which is hung up; it is swept off, and sold for common use, without further preparation. The lamp black in this state contains some oil, which is separated by being heated to redness in a close vessel.

The chief consumption of charcoal is as fuel. It is also employed as a tooth powder, and to purify tainted meat. No mode of preparation for the first of these objects is at all necessary; and for the two last, it must merely be reduced to a fine powder. It forms a part of all reducing fluxes. It is an indispensable constituent of gunpowder. It is the basis of most black paints and varnishes. It is used to polish brass and copper, and is an excellent clarifier. It is used, in farriery, in combination with linseed meal, as an antiseptic cataplasm for cracked heels and foul and fetid ulcers.

Powdered charcoal must be heated to redness in a covered crucible, with an opening in the middle of the cover, and kept in that state till no flame issues out; it must be then withdrawn, allowed to cool, and then put into close vessels and kept for use. Whenever either wine, vinegar, or any other fluid is to be clarified, it is simply to be mixed with the liquor; a froth appears at the surface, and after infiltration it is pure and colourless.

Charcoal has of late years become known as a valuable general manure, and as a powerful means of securing and accelerating the propagation of tender garden plants by means of slips and cuttings. In an Italian cyclopædia of agriculture, the Biblioteca Agraria, edited by Professor Joseph Moretti and Carlo Chiolini, it is said: "From numerous experiments made by the Abbé G. Piccone, charcoal is considered as an efficacious manure. It consists principally of oxide of carbon, the primary element of vegetable productions, and is, therefore, undoubtedly calculated to be employed for the purpose specified. According to the above author, every sort of charcoal, whether of oak, chestnut, or of any other sort of wood, the refuse of the charcoal, the small particles, or still better the dust, can be used as manure for every species of plant and in every soil. The charcoal of close-grained wood, therefore, should be the richer in nutritious particles, as it contains less ashes and earth. The effect is more speedy and vigorous according to the fineness of the pulverization of the charcoal; if it is coarse the effect is weaker but more durable. When the charcoal is intended to manure a field for several years, or the roots of vines and fruit trees, it is not necessary to pulverize it very fine. It is sufficient in such cases to triturate it so that the largest pieces may not exceed the size of a vetch. The means used for triturating the charcoal are, the olive-presses, mallets, and large pestles of iron or heavy wood, suspended from a beam of wood like that of turners' and many other machines. The dust which is produced during trituration is easily laid by sprinkling it with water. When the pulverized charcoal is to be used in flower-pots, in furrows, in seed-pans, or in seed-beds, it is sprinkled on the surface and incorporated with the spade or with the watering-pot. This may also be done after the plants have germinated, and are 2 or 3 inches high, according to the nature of the species. In sown fields the same method is followed in applying it as with manure. Therefore, in treating ground burnt up by the sun, according to the opinion of the Abbé Piccone, it is laid on the ground towards spring, when French beans are to be sown, to preserve them from drought; to these succeed common beans, and afterwards wheat or any other grain without manure. In soils less arid, the rotation is begun with potatoes, hemp, buckwheat, and wheat. In every case the seed should be used sparingly. On artificial meadows charcoal dust is sprinkled in spring on the surface, as is practised with chalk and lands containing saltpetre. As to the quantity, the Abbé Piccone computes about an equal weight between charcoal and woollen rags, skins, and even scrapings of bones: a rubbo (about 18 lb. avoirdupois) of charcoal to two of new urine; three of night-soil well digested; four of fresh, and six of common manure. After this, he advises, for olive-grounds, vineyards, orange-gardens, or orchards, to allow an interval of four years for the first time, five for the second, and six for the third, and so on between every manuring, taking care always to increase the quantity according to the growth of the trees."

About six or seven years ago, M. Lucas, a very talented assistant in the botanic garden of Munich, accidentally discovered that some hothouse plants, whose roots found access to charcoal ashes, displayed an extraordinary vigour of growth; and he and other distinguished cultivators afterwards made several series of careful and multitudinous experiments, the results of which appeared to show that charcoal roots cuttings and slips of some plants which can with difficulty, if at all, be rooted by any other known means,—that it facilitates the rooting of cuttings and slips of many plants which are usually rooted in ordinary soils,—that it exerts a healing or restorative power upon many sickly plants,—and that, in a state of mixation with the several kinds of ordinary soil, it acts as an excellent general manure, and can be made greatly conducive to the most common purposes of both field and garden cultivation. Dr. A. Buchner, Sen., writing in the 'Garten Zeitung,' makes pointed reference to these "numerous experiments and observations," pronounces them to be "very important contributions, not only to vegetable physiology and dietetics, but also to the founding of a vegetable therapeutic system," and makes a very clear scientific statement, though necessarily but a theoretic one, of the manner in which he supposes the charcoal to produce its beneficial effects. The following is the most important portion of his statement:—

"1. *Absorption of Light, and Generation of Heat.*—It is well known that bodies receive the light of the sun the more perfectly, the darker, duller, and looser they are, and that the consequent development of heat is in proportion to this absorption of light; hence, a black light soil is, under the same circumstances and relations, much more favourable to vegetation than a light-coloured, grey, heavy earth. Heavy clayey soil, with a deficiency of humus, is less suitable to vegetation, inasmuch as it soon loses its porosity through rain and snow, and assumes a smooth surface, by which it is prevented from absorbing air and light, and generating heat. Hence agriculturists justly name these clayey soils, which are deficient in humus, cold soils. As charcoal dust is one of the darkest, dullest, and most porous of bodies, it must, on account of its peculiar capacity of receiving the sun's light and changing it into heat, be particularly favourable to vegetable life.

"2. *Absorption of Atmospherical Air.*—Among all porous bodies that have the capacity of absorbing gases and vapours, charcoal has been proved by numerous experiments to hold the first rank. If, therefore, clayey soil, deficient in humus, is in general less suitable to the growth of plants than rich loose garden mould, the reason lies, not only in the latter receiving more light and creating warmth, but also in its more readily condensing, by its greater porosity, the constituent parts of the atmospheric air, and consequently supplying oxygen, nitrogen, and carbonic acid gas for the nourishment of the spongioles. We come here to a very important point, the nourishment of plants, which I cannot slightly pass over in elucidating the theory of the effects of charcoal in this respect. Modern vegetable physiologists are, for the most part, of opinion, that plants can receive no solid nourishment from the earth; that is, that every thing that they can assimilate must be in a liquid and gaseous or vapoury state. If we, therefore, meet with siliceous earth, chalk, magnesia, oxide of iron, in short, such substances in plants as could only be received from the soil, we may always consider it certain that these sorts of matter can only be absorbed by the roots in proportion as they are in a fluid or dissolved state in the soil. These sorts of matter, and particularly the different organic salts which we find in the ashes of vegetables, are not actually to be considered sources of nourishment, but stimulants to assist in digesting, as salt and spice are to the higher animals and man; we also not unfrequently observe, that a superfluity or mixture of certain inorganic substances in the soil, prejudicial to certain families and species of plants, is the cause of disease when this inorganized matter is in a dissolved state, and capable of being absorbed by them.—If we analyze the nourishment of plants, we shall find it is only the constituent parts of air, water, and charcoal. The experiments of Boussingault on the origin of nitrogen in organic bodies show, 1st, that no plant exists without a proportion of nitrogen; and 2d, that, while men and animals receive the portion of nitrogen of their bodies not from the air by breathing, but from food by assimilation, plants on the contrary draw their supply of nitrogen, not from manure or humus, but from the air. We come now to a very important point in the nourishment of plants, to which M. Payen has particularly called our attention in two treatises read before the Academy of Sciences at Paris, on the 8th and 14th of October, 1839: viz., that charcoal operates as a condenser, under the influence of water, on the constituent parts of the air, in the same manner as spongy platina on the elements of detonating gas; so that nitrogen and oxygen are dissolved, and, mixing with water, are absorbed by the spongioles, and carried to the cambium for assimilation. This property of condensing the air, and making it fit to be received by plants, does not exclusively belong to charcoal, for it is also more or less perceptible in other sorts of earth, chiefly in porous and pulverized bodies. We know that water, even when not distributed through charcoal or earth, absorbs some air, which becomes a watery fluid, and by heating is again expelled in the form of gas: but charcoal-powder appears to possess this power in the highest degree; consequently, besides light and heat, is capable of carrying to the roots both air and water, i. e., nitrogen, hydrogen, and oxygen, in the greatest abundance.

"3. *Decomposition of the Charcoal, and Formation of a nourishing Substance for Plants.*—It is well known that manure, as such, does not nourish plants, and that, on the contrary, when it touches the roots it causes disease. We know that it is the constituent parts of the humus, i. e., the matter produced by decay, which nourish plants. This apparently takes place because the humus, with the co-operation of air and water, is continually forming oxide of charcoal, or carbonate and nitrogen, which, together with the saline particles, is absorbed and assimilated by the roots. For a long time it was generally believed that charcoal, as an inanimate body incapable of decay, contributed in no degree to the nourishment of plants, and that charcoal-dust could only serve at most to make the earth looser and warmer. But M. Lucas found, from his experiments, that the charcoal in which plants grow by degrees undergoes decomposition, and at last becomes a sort of humus. This obviously takes place merely because the charcoal dust acts as humus, and, with the co-operation of water and air, continually gives out to the plants oxide of charcoal, or carbonate, together with the saline particles which are in the charcoal, and remain in the ashes after burning. But, to prove this, some chemical experiments were necessary.

"4. *Antiseptic Power of Charcoal.*—In judging of the effects of charcoal on vegetation, its antiseptic properties are of great importance, for it has very little power of retaining water, and the little it retains is partly absorbed by the roots and partly evaporated. This property deserves the greatest attention of gardeners, in respect to recovering the health of plants the roots of which have become injured by being in a clayey soil, and too freely watered, or after continued rain, or being in contact with manure not sufficiently decomposed. They should be immediately transplanted into charcoal powder, as the most effectual method of cure."

Liebig, though not offering any lengthened explanation, but speaking as if the point were more a matter of long-established notoriety, than of recent experiment and theory, gives his powerful testimony in the same direction as Buchner, and says, "Charcoal, in a state of powder, must be considered as a very powerful means of promoting the growth of plants on heavy soils, and particularly on such as consist of argillaceous earth." Two sets of interesting and successful experiments were recently made upon the growing of turnips with charcoal manure,—the one with common wood charcoal, by the Earl of Essex,—the other with peat charcoal by W. Upleby; and both are recorded in the volume of the Royal Agricultural Society's Journal for 1845.—*Philosophical Magazine*, vol. iii.—*Annales de Chimie*, vols. xxxi, xxxii, xxxvi, xlii.—*Nicholson's Journal*, vol. iv.—*Loudon's Gardener's Magazine*, vols. xvii. and xix.—*Journal of the Royal Agricultural Society*, vol. v.—*Marshall's County Reports*.—*Liebig's Chemistry of Agriculture.*

CHARGE. A thick adhesive plaster, applied warm to a weak or diseased part of a cow or a horse, and taking so firm a hold of the hair and the skin as to remain for a very long time closely attached. Charges are far less frequently used in modern than in former veterinary practice; yet, in the case of several kinds of weakness and disease, they might still, with eminent advantage, be uniformly employed. In any case, a charge may protect from cold, and serve as a bandage; in rheumatism, it not only protects from cold, and supports the limb, but gently stimulates with its resin; and in windgalls, old lamenesses, and other complaints which require to be blistered or fired, it follows up the action of the chief remedy by serving as a continued bandage. A mixture of resin or burgundy pitch with wax or oil serves for any ordinary charge, but ought to be applied in a half-melted condition, and covered with flocks or short tow as it cools; and, when a locally strengthening influence is desired, armenian bole, litharge, crocus metallorum, or any similar substance may be added.

CHARLES' SCEPTRE. See PEDICULARIS.

CHARLOCK. Several yellow-flowered weeds, which infest corn-fields, and belong to the cruciferous tribe of plants. The chief is the corn charlock mustard, *Sinapis arvensis*. This is an