a higher blood pressure and a more uniform flow through the capillaries. Venous congestion is relieved and the nutrition of the various organs, including the heart, is improved. At the same time the relaxation in diastole is usually lessened so that the heart assumes more nearly its normal form. It is especially in dilatation in cases of valvular disease that digitalis is used; in such cases in addition to the above action the drug causes a contraction of the ring of muscle surrounding the diseased valve, and this tends to limit the regurgitation. As a result of the increased work of the heart and its better nutrition the condition of the muscular tissue is improved to such an extent that after a time the drug can often be dispensed with for longer or shorter periods.

The question is often debated whether digitalis should be used in aortic insufficiency; the theoretical objection has been made that the prolonged diastole might allow time for sufficient blood to regurgitate to lead to syncope. Physicians seem to hold now that digitalis is just as serviceable in the dilatation accompanying aortic insufficiency as in other cases, provided it is given with care. A little experiment of Dreser's (*Archiv für exper. Path. und Pharmakol.*, xxiv., p. 238, 1888) may be mentioned in this connection. The valves of the ventricle of a frog's heart were destroyed, the ventricle was tied to a perfusion cannula on one limb of which was an outflow tube. This arrangement represented roughly the condition in aortic insufficiency; the pressure of the liquid in the upright tube represented the aortic pressure, while the side tube, from which the blood was collected, represented the peripheral circulation. Blood was led to the heart and the amount expelled from the side tube measured. Digitalis (or helleborein) was now added to the blood; the heart was slowed so that there was a greater opportunity for the blood to drain back through the broken valves into the ventricle, and if the above theory were correct the outflow from the side tube (*i.e.*, the peripheral circulation) should be diminished. Dreser found, on the contrary, the outflow to be uniformly much increased; the increased output of the ventricle and the prolonged systole had more than counteracted the effect of the prolonged diastole. This little experiment is of interest as it shows that the only experimental evidence we have agrees with the clinical evidence that digitalis is useful in aortic insufficiency.

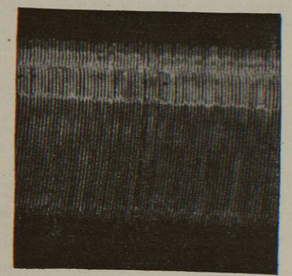

FIG. 1144.

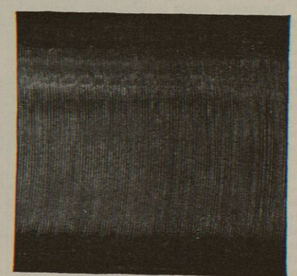

FIG. 1145.

FIGS. 1144 AND 1145.—Tracing of the Ventricle of the Dog's Heart; 1144, Normal; 1145, After Caffeine. The lever moves upward during systole, downward during diastole. The only alteration caused by caffeine is acceleration. The slightly larger excursion in diastole in 1145 is mechanical. (Contrast tracings under digitalis: Figs. 1141 and 1142.) (From Cushny.)

Members of the digitalis series are used for other purposes than as cardiac tonics, although the heart action probably plays a more important part here than is always recognized. Thus the good results following the use of squills as an expectorant are almost certainly due in part to an improvement of the pulmonary circulation. Several of the series are used extensively as diuretics; the fact that as a rule they produce marked diuresis only when there is a diseased condition of the heart points to the effect upon the kidney being secondary to changes in the circulation. On the other hand some of these drugs produce diuresis in normal rabbits, and occasionally in healthy dogs and man, when there is no evidence that the renal circulation is altered; this indicates that some of the series, especially squills and digitalis, have a direct action upon the renal epithelium, but comparatively little satisfactory work has been done upon this subject. There can be little doubt that the extraordinary diuresis produced by digitalis in cases of cardiac dropsy is due largely to an improvement in the renal circulation; the blood is removed from the veins and collected into the arteries, the congestion of the kidney relieved and a more uniform and active circulation established—a condition favorable for the secretion of the urine.

Sparteine, the alkaloid of broom (Cytisus scoparius), has been included by some in the class of cardiac stimulants. It has been said to have an action similar to that of digitalis; recent work (Cushny and Matthews, *Archiv für exper. Path. und Pharmakol.*, xxxv., p. 129, 1895) has shown this resemblance to be entirely superficial and that the drugs have little in common. Broom is used to some extent as a diuretic in cardiac diseases; it is also said to make the heart beat more regularly.

Cactus grandiflorus (cereus) has been warmly recommended by some clinicians as a cardiac stimulant. Very little is known about the chemistry of this drug or its physiological action; there is certainly no evidence that it belongs to the digitalis series, as has been claimed by some. It is said to accelerate the heart and to cause a rise of blood pressure; the latter seems to be due in part to a stimulation of the vaso-motor centre. It is sometimes combined with digitalis, but is said to be especially useful in certain cases in which digitalis is contraindicated. It is said to be valuable in cardiac weakness due to tea, coffee, alcohol, tobacco, etc.

Caffeine.—Caffeine has a very characteristic action upon cardiac muscle which makes it a cardiac stimulant of great value in some cases; it has also a stimulating action upon the vaso-motor and other medullary centres. The changes in the cardiac muscle have been most carefully studied in the frog's heart. When blood containing minute quantities of caffeine is perfused through a frog's heart placed in a William's heart apparatus, the rate of the heart is slightly accelerated and the amount of blood expelled at each beat slightly increased, but the most marked change is an increase in the force of the beat (Dreser, *Archiv für exper. Path. und Pharmakol.*, xxiv., p. 233, 1888). The heart is able to contract against a much greater aortic pressure than normally—that is, the "absolute power" of the cardiac muscle is increased. Dreser compares this action of caffeine to an increase in the cross section of the muscle fibres while their length remains the same. Caffeine has thus an action entirely different from that of digitalis; the effect of the latter is the same as lengthening the muscle fibres while the cross area remains the same; the extent of the contraction under digitalis is increased, while the absolute force is scarcely altered.

After larger quantities of the drug the heart becomes slower and its volume smaller; then the apex ceases to relax with the rest of the ventricle, but remains white and contracted, and eventually the whole heart passes into a

condition of rigor. In all these respects the action of caffeine upon the cardiac muscle is very similar to the remarkable effects the drug is known to have upon ordinary skeletal muscle.

Upon the mammalian heart the chief effect of caffeine which has been described is an acceleration of the rate: this acceleration occurs when the heart is entirely isolated from the central nervous system (Bock, *Archiv für exper. Path. und Pharmakol.*, xliii., p. 367, 1900), and must therefore be attributed to a stimulation of the cardiac muscle. No observations seem to have been made upon the effect of caffeine on the absolute power of the mammalian heart; that the extent of the contractions, and so the pulse volume, is not increased is shown by the accompanying myocardiograms (Figs. 1144 and 1145).

When caffeine is administered to a normal animal the effects upon the heart are somewhat obscured by the simultaneous action upon certain nerve centres. As a rule the heart is accelerated, but at times it is slightly slowed by a stimulation of the centre of the cardio-inhibitory nerves. On the other hand, stimulation of the vagi is usually less effective in slowing the heart after caffeine owing to the increased irritability of the cardiac muscle. That the cardiac acceleration is not due to a paralysis of the terminations of the vagi is shown by the fact that it occurs after these have been paralyzed by atropine; the acceleration must be attributed to a direct stimulation of the heart muscle. After larger doses the heart becomes weak, irregular, and arhythmic, resembling the condition seen in digitalis poisoning. The vaso-constrictor centre is stimulated by caffeine: this and the increased output of the heart due to the acceleration cause a rise of blood pressure. The most marked effects upon the circulation are seen in animals in which this has been depressed by such a drug as alcohol. Thus Binz found that the blood pressure of a dog deeply under the influence of alcohol rose from 84 to 120 mm. in ten minutes after the subcutaneous injection of caffeine; the pulse rate was doubled. The respiration was also greatly improved.

Administered to a healthy man a moderate dose of caffeine causes the pulse to become full and hard; it is also moderately accelerated. Occasionally there is a slowing due to stimulation of the vagi.

Theobromine has an action upon the heart very similar to that of caffeine; the peripheral vessels are not constricted, however, and so the rise of blood pressure is much less marked.

The great diuretic power of caffeine has been attributed to the changes in the circulation, and it is probable that these do exert a favorable influence when the blood pressure is very low. Under ordinary circumstances, however, the constriction of the blood-vessels antagonizes the diuretic action, and the latter can often be obtained only when the caffeine is combined with such drugs as chloral hydrate or paraldehyde which dilate the vessels. It is now generally held that caffeine and theobromine produce diuresis by a direct action upon the renal epithelium, and entirely independent of their action upon the circulation.

The experiments upon animals indicate the class of cases in which caffeine might be expected to give good results in therapeutics. It is chiefly in cases in which the heart is simply weak and in which there is no dilatation that caffeine is indicated; it causes the output of the heart to be increased and the blood pressure to rise. It is especially useful in cases of alcoholic and opium poisoning, for not only is the cardiac muscle stimulated in these, but the vaso-motor and respiratory centres are also thrown into increased activity. Caffeine cannot be considered a substitute for digitalis, for it has almost no effect upon dilatation of the heart in valvular lesions; it is often used in such cases, either alone or combined with digitalis, but the beneficial results seem to be due much more to its diuretic than to its cardiac action.

Strychnine.—Strychnine has come into somewhat extensive use in recent years as a cardiac stimulant; the good results following its use are probably to be attributed to its action upon certain parts of the central nervous system (especially the vaso-motor centre) and the nutrition generally, rather than to any special action upon the heart. At the same time there is some evidence that the frog's heart is directly stimulated by small quantities of strychnine while larger amounts weaken and slow it. In the mammal strychnine causes a slight slowing of the heart due to stimulation of the vagus centre. If convulsions occur, the heart becomes accelerated just as it does in struggling from any cause. Few drugs have such a powerful action upon the vaso-constrictor centre as has strychnine. Whether convulsions occur or not the arterioles are constricted to an extreme degree and the blood pressure rises enormously. The irritability of the subsidiary vaso-motor centres in the spinal cord is increased, so that a reflex rise of blood pressure may follow stimulation of a sensory nerve after the influence of the chief vaso-constrictor centre has been removed by section of the cervical cord.

Strychnine, like iron, seems to be used rather as an adjuvant to digitalis in the treatment of heart diseases; at the same time it is frequently recommended in those cases in which digitalis is contraindicated. It is also used in cardiac failure during typhoid and other fevers, shock, etc.; in these cases the action is probably mainly upon the vaso-motor centre.

Reid Hunt.

CARDIOGRAPHY. See *Heart*.

CARLSBAD (Karlsbad) is one of the most important thermal stations of Europe; indeed, its reputation is world-wide. It is charmingly situated in the northwestern corner of Bohemia, some 70 miles from Prague, at an altitude of about 1,160 feet, lying in the narrow valley of the Tepel River among the pine- and fir-clad hills traversed by paths in all directions. There are many beautiful walks and drives in the woods covering the slopes of the valley, and attractive excursions in the environs. "The valley in which it lies is shielded from the south and east winds by the mountains, but is exposed to the winds from the north and west, and the climate is consequently somewhat trying and subject to sudden changes in temperature" (Stedman). The native population is about 12,000, and upward of 30,000 people visit the springs annually.

These thermal waters are said to have been discovered in 1347, by the Emperor Charles IV., while hunting, but Carlsbad was known as a health resort a century earlier (Baedeker). "The springs issue from apertures in the rocky shell upon which most of the town is built, and are sixteen in number, all similar in their ingredients, which are principally sulphate of sodium, carbonate of sodium, and common salt. They are chiefly taken internally. They vary in temperature, the hottest having the least amount of carbonic acid gas. Some of the principal springs are the following (with their temperatures, Fahrenheit scale):

"Sprudel, 162.5°—a steaming fountain leaping up at short intervals, and having a capacity of four hundred and fifty gallons per minute; Felsenquelle, 138°; Schlossbrunnen, 127°; Mühlbrunnen, 124.5°; Theresienbrunnen, 122°; Marktbrunnen, 118°. These waters are classed among the sulphated alkaline waters." The following is the composition of the Sprudel water, according to the analysis of Ragsky, as given by Stedman. "Each litre (1.76 pint) contains:

	Grams.	Grains.
Sulphate of sodium	2.372	= 35.58
Sulphate of calcium	.163	= 2.44
Chloride of sodium	1.030	= 15.45
Carbonate of sodium	1.361	= 20.41
Carbonate of calcium	.297	= 4.45
Carbonate of magnesium	.124	= 1.86
Carbonate of strontium	.0008	= .012
Protoxide of iron	.002	= .03
Protoxide of manganese	.0006	= .009
Fluoride of calcium	.003	= .045
Phosphate of calcium	.0002	= .003
Silica	.0072	= .108

Carbonic acid in one litre 210.59 c.c." (Stedman).

Although, as has been said, the waters are now used chiefly internally, there are seven bath houses with mineral, mud, vapor, hot air, and other baths, and with massage and Swedish movements. The Kaiserbad is said to be "one of the most magnificent bath houses of Europe." The conditions for which the internal use of Carlsbad water is beneficial are stated by Weber to be the following:

In the first place, affections of the liver, including catarrhal jaundice, frequent attacks of biliary colic, early stages of alcoholic cirrhosis, enlargement of the liver in great eaters, etc. Secondly, habitual constipation, hemorrhoidal conditions in robust persons, some cases of chronic gastric and intestinal catarrh with or without diarrhœa, some cases of dyspepsia, uric-acid diathesis, chronic glycosuria in fat people, and corpulence, which is often combined with a weak-acting heart. Enlargement of the spleen is also said to be benefited by these waters, as are also periodic, frequently recurring headaches connected with abdominal disorders. Disturbances of the female pelvic organs, chronic congestion and enlargement of the uterus, chronic affections of the conjunctiva and deeper structures of the eye, and chronic aural catarrh are all likely to be benefited or cured by the Carlsbad waters (Stedman).

During the summer the usual time for drinking the waters is from half-past five to half-past eight in the morning, an interval of about a quarter of an hour being allowed after each glass (ʒ vi.), and the dose being from two to six glassfuls.

In beginning a course of treatment the spa physician carefully considers each case, and regulates the habits and diet of the patient. Probably the regularity in daily life and diet has very much to do with the improvement of the patient. The average daily programme of the ordinary Kurgäste is outlined by Weber as follows:

"Rise early to drink the water, and in the intervals promenade to the sound of the music; walk to some café, and take breakfast at about 9 A.M., consisting of coffee or tea, rolls, and perhaps boiled eggs or ham. At about one o'clock the chief meal of the day is taken; coffee and tea at about 4 P.M., and a light supper in the evening." Those who have been ordered a course of baths mostly take them in the forenoon. There are a fine Curhaus and a good theatre; classical concerts are given regularly; there are covered walks; in brief, there is almost everything which will render the stay of the invalid agreeable and pleasant. There are also good educational facilities.

The season lasts from the middle of April to the end of September or October, although one can take the waters at any season of the year. Besides the amount of water drunk at Carlsbad, it is said that about 3,000,000 bottles and 110,000 pounds of the salt are exported annually.

An after-cure is always recommended subsequent to a course at Carlsbad. Instead of returning home immediately, and at once resuming his or her usual mode of life, the patient should abstain from active work, adopt a simple diet, and live outdoors as much as possible for some weeks.

Carlsbad is reached by various routes in about thirty-one hours (from London): by Cologne, Würzburg, and Nürnberg or Bamberg; by Paris, Stuttgart, and Nürnberg; or by Cologne, Leipsic, Dresden, and Kromotan.

For the major part of the above account of Carlsbad, the writer is indebted to "Spas and Mineral Waters of Europe" (by Hermann and F. Parkes Weber, London, 1896), to which the reader is referred for much valuable information upon this subject. *Edward O. Otis.*

CARMINE. See *Cochineal.*

CARGBA.—A name applied to the leaflets of several species of *Jacaranda* (fam. *Bignoniaceæ*), small trees of Brazil, especially of *J. procera* (Willd.) Spreng. and *J. Caroba* (Vell.) D. C. They contain resinous and slightly aromatic constituents, and the crystalline, apparently insective body *carobin*, but nothing to which any special medicinal properties can be assigned. The drug bears a high reputation and is largely used in Brazil as a remedy for syphilis and syphilitic disorders. This belief, which applies to so many plants of little or no activity, doubtless results from the indefinite ideas which prevail regarding syphilis, all sorts of venereal diseases being included under this name. The drug is generally given in the form of the fluid extract, in doses of 1 to 4 c.c. (ɱxv. to lx.).
Henry H. Rusby.

CAROTA.—*Carrot.* The root of *Daucus carota* L. (fam. *Umbelliferæ*). This plant is a native of Europe, but freely naturalized in the United States (wild carrot). The cultivated form is the common table carrot, grown everywhere. The fruits of wild carrot have been used as aromatic diuretics; the cultivated roots are made into pulp as poultices; but neither have any claim to medical notice. The coloring matter of carrot root is called *carotin*. The very small amount of volatile oil consists of pinene and probably cineol. *W. P. Bolles.*

CARTHAGENE BARK. See *Cinchona.*

CARTHAMUS. See *Safflower.*

CARTILAGE.—Under this name is classified one of the important members of the group of connective tissues; it is characterized not so much by the structure and arrangement of its cells, as by the peculiar nature of its basement substance. Cartilage occurs in three tolerably distinct forms, the differences of which depend largely upon peculiarities in the structure of the basement substance. These forms are called *hyaline cartilage*, *fibro-cartilage*, and *fibro-elastic cartilage.*

The most abundant and typical of these is *hyaline cartilage.* This, in the adult, is found covering the articular surfaces of bone, forming parts of the ribs and of the walls of the trachea and bronchi, and in less considerable masses in other parts of the body. Hyaline cartilage is translucent and of a bluish-white color, is firm in consistency, and elastic. Like other members of the connective-tissue group, it consists of cells and an intercellular or basement substance. The basement substance is for the most part quite homogeneous in the fresh condition, but it is occasionally very finely granular. By suitable treatment with chemical agents, it may be seen to contain, and almost to consist of, exceedingly minute and delicate fibrils, which under normal conditions are merged into a homogeneous mass. The basement substance is said by some observers to be penetrated by minute branching canals which communicate with one another and with the spaces in which the cells lie. Mucin and gelatin, and a rather indefinite substance called chondrin, have been obtained from the basement substance, but our knowledge of the chemical nature of these substances, and particularly of their existence in the cartilage in the natural condition before being exposed to chemical manipulation, is still too indefinite to enable us to speak very positively of its chemical constitution.

The cells of hyaline cartilage differ considerably in shape and arrangement in different cartilages and in different parts of the same cartilage, depending, apparently, to a considerable degree, upon the conditions of pressure to which they are subject, as well as upon the intimate constitution of the basement substance and the influences under which its development transpires. The cells, except near free surfaces or where cartilage and fibrous tissue join, are in general spheroidal, ovoidal, ellipsoidal, or somewhat flattened at the sides, and lie unevenly distributed in the basement substance. The cell body is finely granular, or in some animals contains delicate fibrils, and may enclose droplets of fat, and pigment particles, or may also contain glycogen. The nuclei—of which there may be one or more—are usually spheroidal, sharply outlined, and contain more or less well-marked networks of coarser and finer fibrils and nuclei, in which, during life, in some animals, slow oscillatory movements may be seen. The cartilage cells may lie

singly in the basement substance, but they are more frequently arranged in groups of two or four, or more, and the cells forming these groups are apt to be flattened on the sides which abut on one another. Under normal conditions the cartilage cells completely fill the spaces in the basement substance in which they lie. But on exposure to the air, to water, to electric shocks of moderate intensity, to a variety of chemical agents, and under certain pathological conditions, they separate from the walls of the spaces and shrink into irregular-shaped, coarsely granular masses, in which the nucleus may be partially or entirely concealed. This shrinkage may be only partial, some portion or points remaining adherent to the sides of the cavities, so that the shrunken cells may appear irregularly stellate or have festooned edges. In this shrunken condition we usually see the cells of cartilages which have been preserved in alcoholic fluids. In some parts of the articular, and also in the costal cartilages, the cells lie in large groups, or in longer or shorter rows. At the free surfaces of cartilage, or where it comes in contact with the perichondrium, the cartilage cells are usually flattened, and just beneath the perichondrium may merge imperceptibly into the ordinary flattened cells of the connective tissue. The basement substance immediately about the cartilage cells may be seen, under favorable conditions, to be more transparent than the rest, the more transparent zone being sometimes very thin and sometimes of considerable thickness. This portion of the basement substance is called the capsule, and is believed to be that part which was last formed around the cartilage cell. Somewhat similar appearances may be seen not only around single cells, but around all groups which have apparently been derived from some single cell originally occupying their position in the basement substance.

The basement substance of hyaline cartilage may, under a variety of conditions, become infiltrated with salts of lime, and thus assume to the naked eye a white, opaque appearance, and under the microscope appear crowded with larger and smaller distinct granules. Under pathological conditions the basement substance may become fibrillar as well as calcified. Cartilage is surrounded, except over the articular surfaces, by a vascular layer of fibrillar connective tissue called the *perichondrium.* The perichondrium contains a varying amount of elastic fibres. The fibrillated fibres of the perichondrium pass on into the hyaline basement substance of the cartilage, into which they become gradually merged. Although ves-

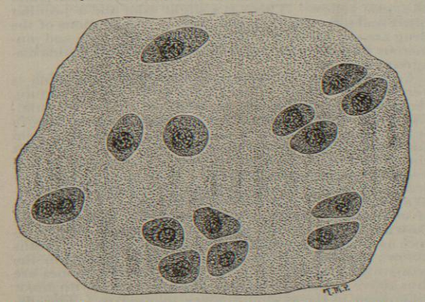

Fig. 1146.—Hyaline Cartilage from the Head of the Femur of Frog. (× 700 and reduced.)

sels from the perichondrium sometimes penetrate for a short distance into the cartilage tissue, the latter is, in general, non-vascular.

Development of Hyaline Cartilage.—At a very early period hyaline cartilage consists of a congeries of rounded cells closely packed together, with a small amount of intercellular substance around each cell. The intercellular substance gradually increases in amount, and the cells divide; new capsules, *i.e.*, new portions of intercellular substance, are formed around the new cells, while the old capsules are expanded and appear to coalesce with those of adjacent cell groups to form the homogeneous basement substance. In this way the cells become gradually separated from one another, but may still retain a grouping which indicates their primitive relations.

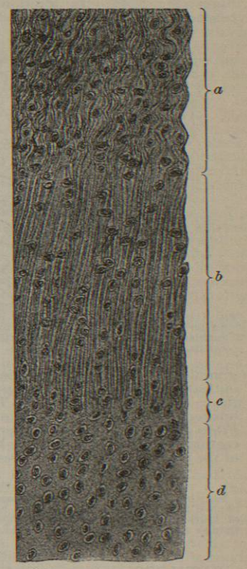

Fig. 1147.—White Fibro-Cartilage from the Ligamentum Teres at the Point where it is Inserted into the Head of Femur. × 650 diameters. (After Böhm and Davidoff.) *a*, Fibrous connective tissue; *b*, fibro-cartilage; *c*, point of insertion of the ligamentum teres; *d*, hyaline cartilage.

Schleicher has shown that in the division of cartilage cells, while the changes in the nucleus are in general those common to the indirect mode of cell division (see *Cell*), the separation of the body occurs, not by a gradually deepening constriction as in cells which are surrounded by a fluid or yielding material, but by the formation of a partition out of the intracellular filaments. This partition finally becomes continuous with the capsule around the new-formed cells, and thickens with their separation from one another. The exact way in which the capsules and intercellular substance originate, whether by a separation of a portion of the periphery of the cells, or whether it is simply formed under their influence, or entirely apart from them, is not certain.

Fibro-Cartilage.—This variety of cartilage is found in the interarticular cartilages of some of the joints, such as the knee and jaw, between the vertebræ, at the symphysis pubis, around the tendons of certain muscles, and at points where tendons are inserted into hyaline cartilage, as at the junction of the ligamentum teres with the head of the femur. The cells are similar to those of hyaline cartilage, but the basement substance is fibrillated, the fibrillæ being arranged in dense bundles or interlacing in all directions. The cells are frequently arranged in rows between the bundles of intercellular fibres (see Fig. 1147), and are less uniformly distributed than are the cells of hyaline cartilage. This form of cartilage frequently merges, in structure, on the one hand into fibrillar connective tissue, and on the other into hyaline cartilage.

Fibro-elastic Cartilage (yellow elastic or spongy cartilage).—This form of cartilage is not abundant in the body, being found in small masses in the external ear, Eustachian tube, epiglottis, and in some parts of the larynx. It is tough, opaque, and yellowish in appearance. The cells, which are irregularly distributed through the basement substance, are similar in appearance to those of hyaline cartilage. Around each cell is a narrow, strongly refractile, homogeneous zone of base-

ment substance—the capsule. Outside of the capsule the basement substance is more or less densely filled with coarser and finer anastomosing and interlacing elastic fibres (Fig. 1148). In addition to the elastic fibres the basement substance contains numerous large and small

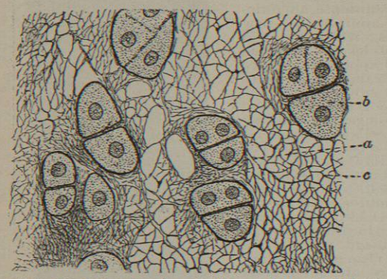

FIG. 1148.—Elastic Cartilage from the Human Ear. × 760 diameters. (After Böhm and Davidoff.) At *a*, in the immediate vicinity of the cartilage capsules, a network of elastic fibres with fine meshes: *b*, cartilage cell; *c*, elastic fibres.

granules, consisting of a material similar in chemical and optical properties to that composing the elastic fibres—the so-called elastic granules. These elastic granules are unevenly distributed through the basement substance. Fibro-elastic cartilage is developed from a hyaline form of cartilage by the formation, in the basement substance, of the characteristic elastic fibres and granules.

BIBLIOGRAPHY.

For the methods of studying cartilage, see Ranvier's Traité technique d'Histologie, p. 270 *et seq.* For literature, see Index Catalogue of Library of Surgeon-General's Office, U. S. Army, vol. ii.; also Quain's Anatomy, tenth edition, vol. i., part ii., p. 244.

T. Mitchell Prudden.

CARVACROL.—*Oxycymol. Cymophenol.* ($C_6H_3.CH_3.[CH_2.CH_3.CH_3]6H$). This is one of the active constituents of oils of thyme and summer savory, and occurs also in some other plants. It is a thickish volatile liquid, with a specific gravity of about .981. It has a characteristic odor. Like thymol, with which it is associated, it is strongly antiseptic. It is very closely related to carvol, having the same composition.

Henry H. Rusby.

CASANTHROL is a thick and gelatinous emulsion of neutral reaction, composed of casein ointment and ten per cent. of lithanthracic extract. The latter consists of those constituents of coal tar which are soluble in benzol and ether. Casanthrol is soluble in water and when applied to the skin dries like a coat of varnish. However, being pervious to water, it does not prevent, but rather, if anything, tends to increase, the perspiration. It is precipitated by mineral acids, acid salts, and calcium salts; no oil separates from it on warming, and it does not become rancid. Classing it among his water-soluble varnishes Unna considers it a valuable application in chronic eczema and other chronic conditions of the skin.

S. Beck uses it in eczema and prurigo with no unpleasant secondary effects. It is the strongest coal-tar preparation which can be employed in inflammatory conditions of the skin; and if desired it may be used as a vehicle for other drugs. *W. A. Bastedo.*

CASCARA AMARGA.—*Honduras Bark.* The bark of *Picræna Vellozii* Engl. or of a related species, or, according to some authors, of an undetermined species of *Tariri*, syn. *Picramnia* (fam. *Simarubaceæ*). This bark comes from Central America, and is a very highly esteemed vegetable bitter by those who are accustomed to it. There is, with its strongly bitter taste, a peculiar sweet and aromatic flavor not resembled by any other drug. It contains a small amount, about one-half per cent., of volatile oil and about three per cent. of the alkaloid *picramnine*. The latter has the peculiar sweet and bitter taste of the bark and is probably its principal active constituent. It, as well as its salts, is amorphous. It is a simple or slightly aromatic bitter of unusually pleasant flavor. Its use as an alterative in syphilis is common, but we have no evidence of any special properties in this direction. The dose is .3 to 1 gm. (gr. v.–xv.).

Henry H. Rusby.

CASCARA SAGRADA.—*Rhamnus Purshiana.* Chittem Bark; Sacred Bark. "The bark of *Rhamnus Purshiana* D C. (fam. *Rhamnaceæ*)" (U. S. P.). To this definition should be added "collected at least a year before being used." The genus Rhamnus and the nature of its species and their constituents have already been discussed under *Buckthorn*. The species here considered is a small tree growing very abundantly in our extreme Northwestern States and northward. It was introduced into the materia medica in 1878 and encountered a remarkable degree of prejudice and opposition, being practically boycotted by many of the most influential physicians. It, however, steadily increased in favor and is at present probably the most largely used in professional practice of any American drug. During its early history, the bark of a related species, *R. Californica* Esch., growing abundantly in central and southern California, was frequently substituted for it, but persistent exposure resulted in completely stopping the fraudulent practice, so that adulteration and substitution are now almost entirely unknown. The bark is taken off in quills, but these are afterward broken up to save space in transportation. These quilled pieces are of variable thickness, up to nearly one-quarter of an inch. The outer surface is rarely fissured, but is more or less warty, the warts being low and broad. The surface is originally of a peculiar red-purple or purple-brown, but becomes more or less covered with gray lichens. These may grow so as to form a uniform gray covering or a series of gray patches of variable size. Pieces taken from the base or junction with the root, are frequently thrown into transverse wrinkles or semi-folds. The inner surface when fresh is light-yellow, but exposure turns it gradually darker until after two or three years it may be nearly black. The fracture is sharp and of a pale yellow. There is a slight odor and a peculiar bitter and somewhat aromatic taste. Preparations of the drug are apt to have a very disagreeable taste and numerous formulæ have been devised for avoiding this disagreeable feature.

COMPOSITION.—The composition of cascara sagrada is very similar to that of buckthorn in its general nature, though certain differences are manifest. The frangulin-like body is not identical, and the percentage of *emodin* is much smaller. There is a much larger amount of resin and this is divisible into three distinct bodies. It is not clear to which of these differences the more regular and less griping characters are due. Throughout the recent active discussion of the presence of emodin, or emodin-like substances (*anthraquinones*) as active constituents of some of our most important cathartics, there has been shown a disposition to over-rate the effect of such presence as determining similarity of action. It by no means follows that other constituents are to be ignored in the laxative effects, merely because the anthraquinones are thus active; besides which, we have to reckon with minor differences in the anthraquinones themselves. The distinctly bitter properties of cascara sagrada make it more effective in stimulating appetite and digestion. Like buckthorn, it is much more useful when given in small doses, for some time, to overcome habitual constipation, than when used as a cathartic. It has been at various times claimed as a useful agent in the treatment of rheumatism, syphilis and similar diseases, and it is so by virtue of its depurative and eliminative properties, but not in any way

as a specific. The actual physiological action of cascara sagrada has never yet been worked out, but it is evident that it in some way profoundly modifies the secretory and excretory functions. The fluid extract alone is official. The dose as a cathartic, taken at night, is 2 to 4 c.c. (fl. ʒ ss. to i.). Those few who find their rest thus disturbed may take it in the morning, or may take a smaller dose. As an alterative or tonic laxative, the dose is 1 to 2 c.c. (ɱxv. to xxx.), preferably before meals. Licorice, alkalies, and carminative oils tend to disguise the bad taste.

None of the extracted so-called active constituents of the drug are worthy to be compared to its preparations.

Henry H. Rusby.

CASCARILLA.—"The bark of *Croton Eleuteria* Bennett (fam. *Euphorbiaceæ*)" (U. S. P.). This species of Croton is a large, widely branched shrub of the Bahama Islands.

Cascarilla was imported into Europe about the middle of the seventeenth century, when it was considered a variety of cinchona. It has undoubtedly formerly been the produce of several species of *Croton*, but at present comes exclusively from the one above named. It is in quills or curved pieces, about one-twelfth of an inch (2 mm.) thick, having a somewhat fissured, easily detached, brown, corky layer, more or less gray from a covering of lichens, and the inner surface smooth. It breaks with a short fracture, having a resinous and radially striate appearance. When burned, it emits a strong, aromatic odor. Its taste is warm and very bitter.

The active principles of this bark are *cascarillin*, a white crystalline, bitter substance, scarcely soluble in water, to which it owes its tonic properties, and an *essential oil*, which latter it contains to the extent of something more than one per cent. It also contains some *resin* and a little tannin.

The composition just given indicates the use and value of cascarilla. It is a bright, rather pleasant, aromatic, bitter tonic, with no special qualities other than its taste, to distinguish it in medicinal value from other spicy bitters. It is used occasionally in pastils, and is said to be put into tobacco on account of its fragrance when burning. Alcohol extracts its virtues to the best advantage. Dose, as a tonic, 1 or 2 gm. There is no official preparation.

The section *Eleuteria*, of the enormous genus *Croton*, contains thirty or more plants, a number of which have barks possessing properties similar to those of cascarilla.

W. P. Bolles.

CASEATION. See *Necrosis.*

CASEIN OINTMENT.—A thick, white emulsion, miscible with water and proposed by Unna as a vehicle for the application of drugs to the skin. Its formula is: Casein, 14; potassium and sodium hydroxides (1 to 4), .43; glycerin, 7; vaselin 21; salicylic acid or borax, 1; water, 56. As it dries it leaves a thin coating upon the skin. *W. A. Bastedo.*

CASEOIODIN.—A substance of the nature of thyreoiodin stated to have been used with good results in myxœdema. The œdema subsided, the hair and skin became soft, the intelligence clearer, and the phlegmatic condition gave place to one of average activity. It is prepared from periodo-casein, and is a white powder containing 8.7 per cent. of iodine. The dose is gr. ¼ once or twice a day, increased rapidly up to gr. i. a day. In overdose it is capable of producing flushing, rapid, weak heart, and prostration. *W. A. Bastedo.*

CASHEW (or *Caju*) **NUTS.** *Anacardium.* The ripened ovary, with contents, of *Anacardium occidentale* L. (fam. *Anacardiaceæ*), a large, widely sprawling shrub, or small tree, of tropical America, largely cultivated in all tropical countries for its fruit. The edible portion of this fruit consists of the fleshy enlarged pedicel, and is of the form and size of a medium pear, green or yellow with a red cheek. It is juicy to an extraordinary degree, and is consumed chiefly for its thirst-quenching properties. Unless thoroughly ripe, it is exceedingly astringent. When ripe, the juice is slightly sweetish and slightly acid. This fruit is also manufactured into a wine which is credited in Brazil with special properties as a hepatic stimulant. The ripened ovary, many times smaller than the fleshy portion, is partly hidden in the summit of the latter. It is kidney-shaped, about 3 cm. (1.25 in.) long, brownish-ash colored, and smooth externally. It contains a large, bland, oily, curved, edible embryo. The pericarp, which is 2 or 3 mm. (⅛ in.), thick, is of cavernous structure, and contains when dry a thick or solid, black, extractiform, resinous substance, of exceedingly irritant properties when applied to the skin. A bassorin-like gum exudes from the stem; an edible milky sap, which also is an indelible dye, flows from the trunk.

The resinous extract consists of *anacardic acid*, and a yellow or brown oily liquid, *cardol*. This is an intense and dangerous irritant, causing often severe inflammation of the skin and blisters, and even the fumes, when it is burned, are said to have the same properties. It was formerly used as an irritant, and is still so used to some extent in the West Indies. It has no medicinal value here, and is only to be known as a poison.

The East Indian *anacardium* is a smaller but similar product, from *Semecarpus anacardium* Linn. *fil.*, in the same order. A milder cardol, "*Cardol pruriens*," is obtained from its fruit, and has been used also as an irritant, and as a basis of indelible ink. It is entirely out of use on account of the danger attending it. Poison ivy, *Rhus toxicodendron* L., and poison sumach, *Rhus venenatum*, are in the same family, and, as well as some other species of *Rhus*, have a similar inflaming action upon the skin (see *Poisonous Plants*). *W. P. Bolles.*

CASSIA, PURGING; CASSIA FISTULA.—"The fruit of *Cassia Fistula* L. (fam. *Leguminosæ*)" (U. S. P). The British Pharmacopœia improves upon ours in its definition of this article, under the title *Cassiæ Pulpa*, as "The pulp obtained from the pods," this pulp being the only portion of the fruit used. The drug has been undoubtedly in use for five or six hundred years, but its name is much older, having been transferred to this substance from some variety of cinnamon to which it properly belonged. The tree is a native of tropical Asia, but is extensively cultivated for its beauty, both in the Old World and in the New. It is of medium size and produces long, drooping racemes of beautiful, showy, sweet-scented flowers.

The pods are nearly or quite straight, from 30 to 60 cm. long by about 2.25 cm. in diameter (12 to 24 in. by 1 in.), cylindrical, shortly stalked and blunt-pointed. The surface is dark purplish-brown, and although not very smooth it has a dull polish. The dorsal and ventral sutures are marked by broad, flat, longitudinally striated bands running the length of the pod. The position of the partitions is generally noticeable upon the surface by means of shallow, annular constrictions about 5 or 6 mm. (¼ to ½ in.) apart. The exocarp (shell) is hard and brittle when dry. The cavity is divided by transverse septa into from twenty-five to one hundred chambers, each containing one brown, shining, flattened seed and further filled with pulp. This last, when the pods are fresh, is soft and fills the entire space; as they dry it hardens into a thick, black, extract-like mass which eventually becomes hard and brittle and only covers the surfaces of the chambers, leaving the seed free and loose. When very dry, the quality is considered to be impaired. This pulp is removed for use by maceration. It has a sweetish, mawkish, mulberry-like taste and smell and is slightly laxative, but, at least in the dry state in which the fruits reach us, it has very little value. *Sugar, gum*, and other common vegetable substances are all that have been observed in it. Cassia Fistula is retained in the Pharmacopœia as a traditional ingredient of the Confection of Senna. In the south of Europe it is more used. Dose: of the pulp, from 4 to 12 gm. (ʒ i to iij.) as a laxative;

as a cathartic, two or three times as much. The official confection contains 10 per cent. each of senna and tamarind, 7 per cent. of prune, 12 per cent. of fig, 16 per cent. of cassia fistula, and one-half per cent. of oil of coriander, the rest sugar. The dose is 4 to 8 gm. (℥i to ij.). It is little used. *Henry H. Rusby.*

CASSIA.—Cassia Bark, Cassia Cinnamon, and Cassia Buds. See *Cinnamon.*

CASTALIAN MINERAL SPRINGS.—Inyo County, California. These springs are found near Owens Lake, and are thirteen in number, most of them being cold. One or two are sulphurous, and the others are alkaline and carbonated. The place is being developed as a resort. Some of the waters are also used commercially, and are recommended in cutaneous disease. The following analysis of one of the springs was made by Prof. Thomas Price, in 1880:

One United States Gallon Contains:

Solids.	Grains.
Sodium carbonate	1,724.11
Sodium sulphate	651.02
Sodium sulphate (?)	46.34
Sodium chloride	1,840.72
Potassium chloride	132.30
Lime	Trace.
Magnesia	Trace.
Silica	14.28
Boric acid	Trace.
Phosphoric acid	Trace.
Iodine	Trace.
Bromine	Trace.
Iron	Trace.
Organic matter	13.48
Total solids	4,422.25

Gases not determined.

This is an exceedingly dense alkaline-saline water and cannot be used medicinally without dilution. There are other springs close by which are not so heavily impregnated. *James K. Crook.*

CASTALIAN SPRINGS. Holmes County, Mississippi. Post-Office, Durant. Hotel. These springs are located three miles west of Durant, at the point of intersection of the Canton, Aberdeen and Nashville and the main line of the Illinois Central Railroad, and about 250 miles north of the Gulf Coast. There are from ten to twelve passenger trains arriving at and leaving Durant daily, all of which are met by the Castalian Springs stage line.

The country around the springs is generally rolling, with some high hills and beautiful valleys, making a charming combination. The location of the springs is about 300 feet above the sea level. Notwithstanding the great rainfall in this section, there is very little gloomy or cloudy weather. The clouds roll up quickly, discharge their contents and disperse, leaving Old Sol to resume his sway. The temperature about the springs ranges, on an average, from 35° F. in winter to 65° F. in summer. The greatest extremes ever noticed are 10° F. the lowest, to 90° F. the highest. The place is used as a resort both summer and winter. At present there are excellent accommodations for about 250 persons, but the resort is soon to be improved by the addition of a first-class new hotel with a capacity for 500 guests. The springs are situated in a pleasant little valley shaded by magnificent water-oaks, and surrounded by high hills with gradual slopes to the valley below. The hills are clad with evergreens of pine and some cedar. On the springs property which embraces some 360 acres, there are about fifty springs and wells, only two of which, however, have been analyzed or used for medicinal purposes. We have been able to secure these analyses, one of which is only a qualitative determination of the mineral ingredients, while the second is a quantitative one.

Spring No. 1.

(Examination by Prof. E. W. Hilgard, former State Geologist.)

One United States gallon contains 138.5 grains of solid matter, made up of the following ingredients in the order of their quantities:

Calcium sulphate.	Iron carbonate.
Aluminum sulphate.	Potassium sulphate.
Magnesium sulphate.	Sodium chloride.
Iron sulphate.	Silica.

Sulphureted hydrogen gas, strongly charged.
Carbonic acid gas, considerable quantities.

Professor Hilgard states that the waters may be classed as sulphureted-chalybeate. They possess the astringent qualities of alum water, while at the same time they have laxative properties from the presence of the sulphate of magnesium.

This spring yields about 600 gallons of water per hour, having a temperature of 56° F.

Spring No. 2.

(Prof. L. G. Patterson, present State Chemist, Analyst.)

One United States Gallon Contains:

Solids.	Grains.
Calcium sulphate	37.23
Magnesium sulphate	15.18
Sodium sulphate	8.68
Silica	7.35
Ferric and aluminum oxide	4.84
Sodium chloride	2.47
Potassium sulphate	1.29
Total	77.04

This spring flows about 300 gallons per hour. The water is used for bathing purposes, and is also sold by the barrel or case. It has long held a wide reputation in Mississippi for the treatment of the malarial cachexia and for liver, stomach, bowel, and skin affections.
James K. Crook.

CASTOR.—*Castoreum.* The dried preputial follicles with their contents, obtained from the Beaver, *Castor Fiber* Linn., and separated from the somewhat shorter and smaller oil sacs, which are frequently attached to them. The glands or reservoirs are usually connected in pairs by their excretory ducts, which open so near together as to be removed without dividing. They are oblong or pear-shaped, somewhat shrivelled, multilocular bags, of dark-brown color (when dry) and tenacious consistence. The castor itself is within these; it is an unctuous brown or reddish-brown substance of intense and disagreeable smell. It consists of volatile *oil, castorin,* a *resinoid substance,* a peculiar fat, and other proximate principles, but like musk and others of its class the chemical composition is not especially instructive as to its qualities. There are two varieties of Castor, the Siberian, from the Siberian beaver, whose "pods" are longer (6 to 12 cm. = 2½ to 5 in.) and larger, and whose contents are more fragrant; and the Canadian, from the American variety. The latter is naturally the most common here.

This substance has been long used as a stimulant and antispasmodic in hysterical and other nervous conditions, but is now nearly obsolete as a medicine. It is no longer official either in this country or in Great Britain. There is some call for it as a basis of perfumes. Dose from .5 to 2 gm. (gr. viij to xxx.). *W. P. Bolles.*

CASTOR OIL.—Oleum Ricini. "A fixed oil expressed from the seeds of *Ricinus communis* L. (fam. *Euphorbiaceæ*)" (U. S. P.). In temperate climates, this plant is an annual, often dying at the season's close without ripening its fruit; or, where the season is long enough, as in the Middle States, it bears abundantly the first year, and is killed by the approach of winter; but below the frost line, as in the extreme south of Europe, in

Africa, and India, it becomes a shrubby or tree-like perennial, sometimes attaining, in the tropics, a height of forty feet. In the United States it usually attains a height of from three to twelve feet, with a round, very smooth, purple and glaucous, hollow, branching stem,

Fig. 1149.—Castor-oil Plant. (Baillon.)

and large, peltate or subpeltate, five- to eleven-lobed leaves. The flowers are borne in large, falsely axillary, paniculately branched spikes. The fruit is a short, blunt, prickly tricoccus capsule, containing three pendulous seeds. Castor-oil seeds vary considerably in size and markings; they are generally from 1 to 2 cm. (about ½ in.) in length by about two-thirds as broad and half as thick, ovoid, blunt, and rounded at the ends. They are convex on the outer surface. The inner surface is usually flattened on each side of the middle by the pressure of the neighboring carpels, the two facets so formed uniting in a very blunt and rounded longitudinal angle. They have a good-sized caruncle at their upper end (or a scar if this has been broken off). The surface is very smooth and shining, usually of a gray color, marked with very pretty brown or blackish marblings. In color and markings, however, they may vary considerably. The nucleus consists of a soft, oily albumen, with a good-sized, straight, broad embryo in the middle. This plant is probably indigenous to India, but has been cultivated so long and extensively that its original habitat is difficult to determine. It has been completely naturalized, and grows with all the freedom of a native in other parts of Asia, as well as in many of the Mediterranean islands and coasts. It is cultivated extensively for its seeds in India, Southern Europe, and the Middle United States. It is a very variable species, and is divided into numerous varieties, mostly distinguished by the size, shape, and color of capsules or seeds.

Fig. 1150.—Seed of the Above. Two-thirds natural size.

The castor-oil plant was known to the ancient Egyptians and Greeks, and its oil was used for fuel, light, and medicine. It has even been suggested as the gourd that sheltered Jonah. After a long period of neglect, it was again brought into use, a hundred and twenty years ago, by Peter Canvane, a physician who had practised for many years in the West Indies, and who, in a treatise upon this oil, strongly recommended it as a gentle purgative (Pharmacographia).

The oil is separated from the seeds by the usual methods employed with fatty substances, viz., by boiling in water and skimming it off; by extracting it by means of some solvent like alcohol or ether; or by expression. The latter is the method employed in the United States. The seeds are carefully cleared from dust and fragments of the capsules, and then warmed, by which means the oil becomes more liquid. The mass is then subjected to strong pressure, and the expressed oil further purified either by standing and decantation or by boiling with water. The yield is about forty or fifty per cent. The purer the oil is, the less active and griping it is. If expressed cold from the peeled seeds, like the best Italian oils, it is very white and odorless, and almost tasteless.

The higher the temperature employed in the process, the greater is the tendency toward the freeing of the irritating and griping *ricinoleic acid.* The pulp left after expression contains a small amount of the albuminoid *ricin,* which is a powerful irritant and convulsive poison. This substance renders the action of the seeds so violent as to unfit them for use as a medicine, though the practice prevails in some countries of triturating one or two with a dose of the oil, to render the latter more effective.

Description.—The following is the official description: A pale yellowish or almost colorless, transparent, viscid liquid, having a faint, mild odor, and a bland, afterward slightly acrid, and generally offensive taste.

Specific gravity: .950 to .970 at 15° C. (59° F.).

Soluble in an equal volume of alcohol, and, in all proportions, in absolute alcohol, or in glacial acetic acid; also soluble, at 15° C. (59° F.), in three times its volume of a mixture of 19 volumes of alcohol and 1 volume of water (absence of more than about 5 per cent. of *most other fixed oils*).

With an equal volume of benzin, it forms, at 15° C. (59° F.), a turbid mixture, but at 17° C. (62.6° F.) it yields a clear solution.

When exposed to the air in a thin layer, it slowly dries to a varnish-like film.

When cooled to 0° C. (32° F.) it becomes turbid, with the separation of crystalline flakes, and at about −18° C. (−0.4° F.) it congeals to a yellowish mass.

If 3 c.c. of the oil be shaken for a few minutes with 3 c.c. of carbon disulphide and 1 c.c. of sulphuric acid, the mixture should not acquire a blackish-brown color (absence of *many foreign oils*).

Castor oil consists almost wholly of a compound of *ricinoleic acid* ($C_{17}H_{32}[OH]COOH$) which is irritant and purgative when set free by saponification in the intestine.

Castor oil is a cathartic of very reliable character, more uniform and painless in its action, and more susceptible of gradation, than almost any other. The full dose clears the bowels with great certainty, producing numerous and copious discharges of their contents, with but little irritation of their surfaces; indeed, when these are inflamed it appears to have a decidedly healing or soothing effect upon them. On these accounts, when the desire is simply to relieve the entire intestinal tract, either from the accumulated fæces or from the irritating secretions of dysentery or enteritis, castor oil is the safest and surest means at the command of the physician. For attacks, also, of acute indigestion, and for the constipation following childbirth, it has long been almost universally used. It is not a hydragogue, nor is it very well adapted for continuous use in habitual constipation, although for "weak" and sensitive conditions of the bowels, when they are easily disturbed, now a little constipated, now a little loose, with frequent slight colics and flatulent tenderness, small daily doses of this medicine may be useful. Daily doses of ♏xx. to xl., before breakfast, are recommended by high authority for overcoming chronic constipation. It is one of the ingredients of flexible collodion (*Collodium flexile,* U. S. P.), to which it gives softness and flexibility.

Administration.—There is scarcely a medicine in use which is generally taken with so much repugnance as this. When it can be taken clear this is the best way, or it may be mixed with syrup or glycerin, or floated upon the surface of some aromatic water, or in the froth of soda-water containing some aromatic syrup; or a regular