1 mm. in diameter. The granules are often conglomerated into irregular masses. The bouillon is never clouded if the growth is not contaminated.

Microscopical examination of the growth in the culture shows longer and shorter rods and threads, the last mentioned sometimes branching. The organism stains irregularly, and often shows rounded or club-shaped swelling or other irregularities in shape, especially at its extremities. It does not altogether preserve its filamentous character in the cover-glass preparations from the cultures. This is probably due to the fact that the filaments are broken up in the manipulation. An additional peculiarity of this organism is the presence of deeply staining rounded or oval bodies in the rods and threads. These are of about the same diameter as the rod, and are frequently distributed along the length of the rod or filament at variable intervals. Their nature and function are not understood.

Animal inoculations with actinomyces at the hands of various investigators have not led to conclusive results. Max Wolff and James Israel (*loc. cit.*) in 1891 published the most interesting work that has ever been done on this subject, but their results lack confirmation.

The exact position of the organism in the botanical world is still a matter of discussion, as is also the name of the group of micro-organisms to which it belongs. On account of its branching it is to be regarded as belonging to a more highly developed group than the bacteria, while it is not so highly developed as to be classed with the moulds or hyphomycetes. The tendency at the present time is to call it and similar branching organisms "streptothrices." Of such organisms a small number have been more or less satisfactorily described, some of which have been met with in inflammatory processes. The precise relationship of these to actinomyces bovis is not very clear at the present time.

The most frequent seat of primary actinomycosis in man is the tissues about the buccal cavity and the neck. Primary actinomycosis of these parts forms more than half of all the recorded cases. Next in frequency is primary actinomycosis of the digestive tract and of the lungs. Primary actinomycosis of the outer skin, exclusive of the skin of the face and neck, is less frequent. Ruhräh (*Annals of Surgery*, October, November, December, 1899, vol. xxx., Nos. 4, 5, 6), who has collected all the reported cases that he could find in the literature, gives the following figures: Total number of cases, 1,094, including certain cases probably counted more than once. In these the disease affected the head and neck in 56 per cent., the digestive tract in 20 per cent., the lungs in 15 per cent., and the skin in 2 per cent; 6 per cent. are classified as doubtful. Various cases have also been recorded of actinomycosis of various organs, including the brain, without any demonstrable primary lesion in the situations above mentioned.

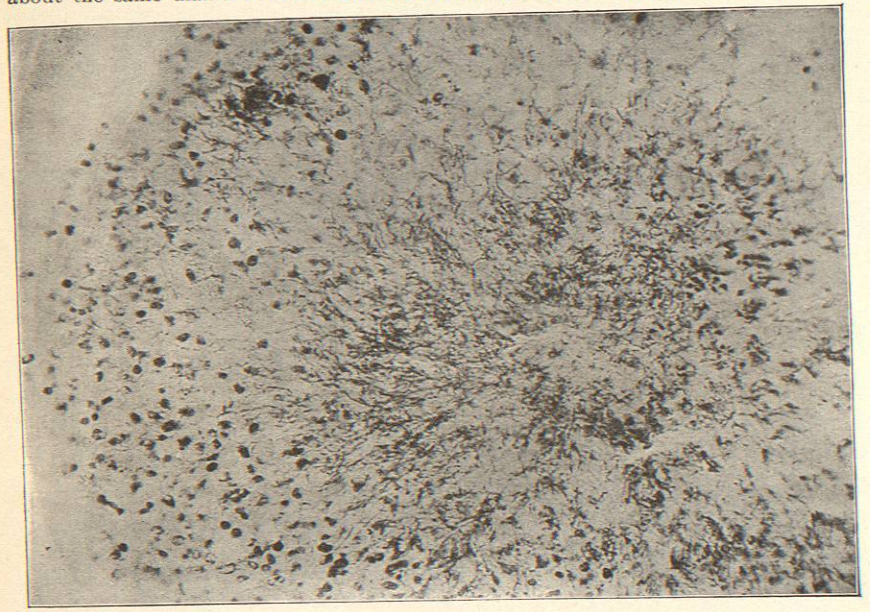

FIG. 32.—A Colony of Actinomyces in a Section of the Same Lesion as in Fig. 29. This is a colony composed of filaments and hyaline substance. There are no "clubs." × 500.

The infecting organism is probably frequently carried into the tissues along with foreign bodies, especially such as occur in food material in the case of cattle. The not infrequent finding of such foreign bodies in or near the lesions of the disease, and the observations of the increase of the disease in herds of cattle when a change has been made in their food, as also the very frequent localization in the neighborhood of the mouth, pharynx, etc., support this idea. No one, however, has satisfactorily demonstrated the parasite outside of the lesions, and we know nothing definite concerning its habitat in the outer world. There is evidence that the infection may be transmitted from animals to man or from one individual to another.

Actinomycosis in man is distinguished from the disease in cattle not only by a less extensive new formation of connective tissue, but also by its greater tendency to the formation of fistulæ and sinuses, by which the disease may extend widely from one organ to another. Such sinuses may extend from the tissues about the mouth or pharyngeal cavities deeply into the thorax and along the spinal column (prevertebral phlegmon). In actinomycosis of the lungs fistulæ may perforate the chest wall or go through the diaphragm into the abdominal cavity. In actinomycosis of the intestines fistulæ may form which usually perforate the anterior abdominal wall; they may, however, extend through the lumbar region or into the rectum or bladder. The disease may also extend metastatically through invasion of the blood stream by the organism, and in this way various organs at a distance, such as the heart, brain, kidneys, etc., may become the seat of the disease. Only rarely does it spread by the way of the lymphatics. Secondary infections with pyogenetic cocci may occur.

The clinical course and prognosis of the disease depend upon its extent and localization, and upon the occurrence of secondary infections with the pyogenic cocci. The last mentioned is an unfavorable complication. In extensive involvement of internal organs there may be fever and marked disturbance of nutrition. In localizations about the buccal cavity and neck there is good evidence that many of these cases will heal by the simplest surgical treatment or even spontaneously. Probably many such cases go unrecognized. The bones of the jaw are rarely affected in man. The occurrence, in the soft parts

of the neck or cheek near the jaw, of hard swellings which have arisen painlessly and present a fluctuating or suppurating focus, should excite suspicion of actinomycosis.

Actinomycosis of the lungs in general resembles chronic pulmonary tuberculosis. The affection may last for months or years. It is characterized by cough, by much sputum, which is often fetid or bloody, and by marked pains in the breast and back. There are also irregular fever and progressive emaciation. Fistulæ perforating the chest wall and involving the sternum or ribs are not infrequent. In this the disease differs radically from tuberculosis of the lungs. The prognosis is generally bad. Remissions with appearances of healing occur. The process may be localized in any part of the lungs. It usually appears as small abscesses or broncho-pneumonic patches, from which cavities may be formed accompanied by new growth of connective tissue.

Actinomycosis of the intestines is characterized by extensive induration due to a marked development of peritoneal adhesions and to the extension of the process to the abdominal wall and neighboring organs. As before mentioned, the tendency to the formation of the fistulæ is marked. Metastatic involvement of the liver is not unusual. The prognosis must be regarded as unfavorable in general.

Actinomycosis of the skin, according to Leser (*Archiv f. klin. Chir.*, 1899, xxxix.), may appear as a circumscribed ulcerated lesion or as a nodular formation with central cicatrizations. The subcutaneous tissue may also be affected and a chronic phlegmonous condition be produced.

One of the forms of the disease known as "Madura foot" is very probably actinomycosis of the part. This is the so-called "white" or "ochroid" variety, in which the characteristic granules in the lesions are of this color. The "black" or "melanoid" variety of "Madura foot" is due to an altogether different vegetable parasite, which is a hyphomycete (Wright: Transactions of the Association of American Physicians, 1898, *Journal of Experimental Medicine*, vol. iii., 1898).

The diagnosis of actinomycosis is made by finding the characteristic granules or colonies of the organism in the lesions or in the discharges from the same. These in some instances may be so obscure as to escape observation with the naked eye. Microscopic examination is necessary to distinguish the colonies or granules from small pieces of necrotic tissue and masses of pus cells. The pus or suspected material should be spread on a piece of glass. In this way the granules will be more easily seen. In actinomycosis of the lungs the organism may be found in the sputa and in the discharges from fistulæ in the wall of the thorax. In the sputum the parasite is to be distinguished from the common leptothrix of the mouth by the fact that the filaments of the latter are larger, straighter, and thicker and do not branch as do the filaments of actinomycosis. The leptothrix filaments are also frequently adherent to epithelial cells.

The treatment of actinomycosis should be operative if the extent of the disease admits of it.

In internal treatment good results are said to have been obtained from the use of potassium iodide.

The photographs which accompany this article were made by Mr. L. S. Brown and the writer, in the Clinico-Pathological Laboratory of the Massachusetts General Hospital.

James H. Wright.

ACTIVE CONSTITUENTS OF PLANTS, CLASSIFICATION OF.—If this term were strictly interpreted, we should omit from consideration all but those constituents which produce positive physiological effects, other than nutritive, upon the animal system. As this treatment would exclude some substances having important medical and pharmaceutical relations, especially the latter, it is deemed better to consider briefly all plant constituents which affect the properties or uses of drugs or medicines.

Of the nutrients proper, the albuminoids may be dismissed as of neither medicinal nor pharmaceutical importance in the department of materia medica. The sugars, inulin, starch, and cellulose, as well as the more important plant acids, are considered in their respective alphabetical order. The other principles of interest to us may be conveniently divided into the inorganic and the organic. The inorganics from this source are not treated as of importance in the modern materia medica. The vegetable compounds of iron, being readily assimilated, are probably worthy of much more study and rational employment than has been the case heretofore. Sea weeds have long been a well-known source of iodine, and some vegetable drugs apparently owe their properties largely to this element. For the rest, the value of the inorganics in drugs depends chiefly upon the presence, especially in such fruits as prunes and tamarinds, of the well-known laxative salts, the properties of which do not differ from those of inorganic origin. It is possible to obtain important cutaneous stimulant effects from the use of many vegetable substances rich in needles of calcium oxalate, although the fact has never been duly appreciated.

The organic constituents which here require attention are the vegetable acids, gums, fixed oils, resins, volatile oils, amaroids, glucosides, alkaloids, and enzymes, together with such mixtures as oleoresins, gum-resins, and balsams.

Vegetable Acids.—The number of vegetable acids which have been extracted from plants is very great, though only a few are found widely distributed among different plants. In the plant they serve a variety of useful purposes. Some of them, at least, act as reserve foods, being manufactured during darkness and consumed in the light, while the reverse is true of starch. They combine with organic and inorganic bases, which are thus rendered soluble and transportable. They render many fruits more palatable, thus influencing dissemination, and, on the other hand and in other cases, by their irritating or antiseptic properties they protect the plant against its enemies. Those which are of a resinous nature are thus particularly useful in preventing fermentation and decay (see Resins). Another class form an essential element in the composition of fats and are known as fatty acids (see Fixed Oils). Some of the vegetable acids, as tannic, citric, benzoic, and hydrocyanic, are of direct use as medicinal agents, while others are of pharmaceutical interest, as influencing the extraction of the associated substances. It has been claimed in numerous instances that a basic organic substance is more efficient when administered in combination with its natural acid. Many of the natural compounds of these acids are with the inorganic constituents, and it is these salts which chiefly render some fruits and vegetables laxative. The antiseptic properties which render many acids of value to the plant are made to render a similar service to man.

The acid properties of the vegetable acids are much weaker than those of the inorganic acids, so that they yield up their bases to the latter. They are also less corrosive and irritating than the latter, and they cannot perform the same service in digestion. Taken continuously or in excess, they can impair digestion or cause gastritis, and they are supposed to favor a rheumatic diathesis. Their salts are commonly more soluble than those of the inorganic acids. Their incompatibilities are in general the same as those of the latter.

Gums are supposed to exist as waste substances in the plant. They usually form in successive layers upon the inside of the cell wall—the process known to botanists as "mucilaginous degeneration." While these statements are true of those gums which are collected as such for medical and pharmaceutical uses, another class, occurring in such drugs as althæa, apparently act as reserve foods. These are of interest as affecting pharmaceutically the preparations of drugs. The gums are insipid, insoluble in alcohol or ether, but soluble in water to form a mucilage or an adhesive jelly. They differ in their precipitation tests, but are mostly precipitated by lead acetate and by alcohol. Their presence in an alkaloidal solution will very often prevent the precipitation of the latter by tannin and by weak solutions of metallic salts. Chemically, the gums are compounds of special acids with potassium, calcium, and magnesium. Medicinally the gums are inert, but they serve to form a protective covering in many cases, thus guarding against irritation, as in corrosive poisoning. When used externally for this purpose, some antiseptic substance should be added. Mucilaginous substances are highly prized in the making of poultices, because of their marked power to retain heat and moisture. Here, also, it is desirable to add an antiseptic.

Pectose, the mucilage-like or gelatinous constituent of such fruits as apples and pears, and of such vegetables as turnips and beets, acts pharmaceutically like mucilage, being soluble in aqueous extracts, but precipitated upon the addition of alcohol.

The gelatinous principle of sea weeds shares the properties of gum and pectose, and exists in very large percentage.

Fixed oils, or *fats*, as those oils are called which are solid at ordinary temperatures, are compounds of special acids, known as fatty acids, with glycerin. From the names of these compounds those of the acids are derived, as oleic acid from "olein," stearic acid from "stearin," palmitic acid from "palmitin." Many fats are mixtures of such compounds. In the plant, fats are stored in parenchymatic tissue in the cell cavity. As they are reserve foods, of special use in the developing embryo, we find them specially characteristic of seeds, stored in both endosperm and embryo. They have a characteristically smooth feeling to the touch, are not volatile or inflammable, but combustible, insoluble in water, rarely soluble in alcohol, and then but partly so (see *Castor* and *Croton Oils*), but are soluble in volatile oils, ether, and chloroform. Heated with or kept mixed with alkalies, they are decomposed into their glycerin, which is left free, and their acid, which unites with the alkali to form soap, the process being known as "saponification." On exposure to the atmosphere, they undergo a peculiar decomposition known as rancidity, giving them a very disagreeable odor and taste. Physiologically, they are important nutrients, of exceptional value because of their ready absorbability through the skin, especially when rubbed upon it. They are not dialyzable, but by the aid of an albuminous substance and of gum they are resolved into an extremely finely divided state of suspension known as an "emulsion," and, more or less of this change taking place in the intestine, they can then become absorbed. They act as protectives, and, by their lubricating and softening power, as laxatives, whether taken internally or per rectum. It has been suggested that if taken in large quantities, the glycerin set free by their saponification in the duodenum acts as a laxative also.

They readily dissolve a great number of substances, and become thus of the greatest use pharmaceutically, as vehicles. This use is the more important because of their great absorbability, which favors the absorption of many dissolved medicinal substances used externally and internally. This property has to be considered in poisoning, as some poisonous substances not naturally absorbable from the intestine may be so under their influence. Fats are naturally destructive to insect life, apparently by clogging up their breathing apparatus. They therefore exert an important action as parasiticides and increase the activity of other agents of this class. For similar reasons, they are efficacious in destroying ascarides. The medicinal effect proper of fixed oils is very slight, if we except a few like castor and croton oils, which are apparently complex substances and contain an irritating element. The same is probably true of toxicodendrol, the poisonous fat of poison ivy and its relatives.

Resins.—These are in some respects like the fats, in others like the volatile oils. They are solid, non-volatile and non-inflammable, but fusible and combustible. They are insoluble in water, but most readily soluble in volatile oils; frequently also in alcohol, fixed oils, ether, and chloroform. They are acid in nature and are saponified by alkalies, giving us a series of resin soaps. Nitric acid converts them into a peculiar substance resembling tannin. They are apparently, at least for the most part, waste substances in the plant, which transports them through its tissues dissolved in volatile oils, as *liquid oleoresins*, in which form they are stored in special lacunæ, ducts, or tubes. They are of use to the plant by rendering its food storage parts antiseptic and disagreeable, or even dangerous, to animals eating them. Pharmaceutically, the resins are very troublesome, as they are dissolved in the alcohol in the extraction of many drugs, and are then most easily precipitated upon the addition of water, and often of acid substances. As to their medicinal properties and uses, the resins, by warming, become adhesive and have numerous and important uses depending upon this property. Those which are little irritating can be used as protectives, upon the evaporation of their solutions painted upon the surface. They are more or less antiseptic; less so than volatile oils. They are usually more or less irritant, many being thus available as counter-irritants. One class of them exhibit this irritating property especially in the intestine, and become purgative, some very powerfully so. Among these may be mentioned those of jalap, scammony, podophyllum, leptandra, iris, and euonymus. Preparations of such drugs should be thoroughly subdivided through an excipient, so that no large particle shall lodge in a pocket of intestine and produce undue irritation.

Gum-resins are merely mixtures of gum with resin, which adapts them very well to being used in the form of emulsions. Not only do the relative percentages of gum and resin vary widely in different gum-resins, but the percentage is quite variable in different lots of the same. The activity is, of course, proportional to the percentage of resin. Important gum-resins are myrrh, asafœtida, ammoniac, elemi, galbanum, and gamboge. They occur also in many drugs, such as sumbul, angelica, parsley, and lovage. Volatile oil is a very common constituent of gum-resins.

Volatile Oils.—For the sake of long custom and convenience, these are treated as a class of active constituents, although the idea is not a scientific one. They are in reality mixtures which are very indefinite in kind, as well as in degree. The name may without impropriety be extended to all volatile and aromatic constituents of plants. They consist mostly of one or more oxygenated compounds mixed with one or more hydrocarbons, usually terpenes. Of these, the former is commonly the active one. Since volatile oils are rather irregular in the relative amounts of the active and the inactive portions, and also highly subject to adulteration, which is very difficult of detection, the use of the active constituents, the purity of which is readily ascertained, is much preferable to that of the oil. Doubtless such use will extend as these facts become more generally appreciated, and this result will be hastened by a more common custom of regarding and speaking of these oils as indefinite and irregular mixtures, a custom which is carefully followed in this work. Their chief use to the plant is perhaps as solvents of other constituents. Their nutritive relations are not well known, and if they were, they could not be easily defined, owing to their variable chemical nature. Their fragrant properties are undoubtedly of value in indirect ways, such as attracting insects. Their antiseptic properties and the obnoxious character of many of them to some animals undoubtedly serve a protective purpose. They may be found in any part of the plant, perhaps most frequently in the seed. They may often be seen in the leaf, in the form of pellucid dots, when viewed against the light. Owing to their volatile nature, drugs which depend upon their presence are very liable to deteriorate on being kept, and unusual care has to be exercised in their preparation and preservation. On this account they are usually dried in the shade.

These substances leave no greasy stain on paper. They are light, volatile, aromatic, and inflammable. They dissolve in water sufficiently to render the latter aromatic and somewhat medicinal. They are readily soluble in alcohol, fixed oils, and glycerin, and act as solvents of resins, fats, and many medicinal substances. Aside from their medicinal properties, they have a wide use within

as well as outside the boundaries of pharmacy, in odorizing and flavoring. In their physiological and medicinal properties, volatile oils agree in some characters and vary greatly in others, so that they fall naturally into different therapeutical classes. Their local stimulant properties are very general. This makes them counter-irritant; some of them, like oil of turpentine, very powerfully so, especially when confined under an air-tight covering. Others which are strongly counter-irritant are those of mustard, amber, erigeron, cinnamon, cloves, and camphor. The irritating effect of some volatile oils is followed by a local anæsthesia, occasionally quite strong, as in the case of menthol and oil of cloves. In line with their counter-irritant action may be considered their stomachic and carminative properties, which are perhaps more general than any others. Here again certain oils, especially those of the families Umbelliferæ (anise, fennel, caraway, etc.) and Labiatæ (mint, thyme, pennyroyal, etc.), excel others. As to their gastric effects, it is to be noted that their presence with the digesting food mass tends to inhibit the process. This action also is greater in the case of certain oils, and is said to be quite wanting in that of oil of peppermint, which is thus an exceptionally valuable carminative. Aside from their intestinal effects in stimulating secretion and peristalsis, they exert a strong action in stimulating the sympathetic nerves, thus overcoming the excessive relaxation upon which various forms of serous diarrhœa depend in whole or in part. This action effects a final result similar to that of the true astringents, and makes a combination of volatile oils and astringents highly effective. Their carminative properties render them of great use in combining with griping purgatives. Their antiseptic properties are quite general and strong, though they vary greatly in degree in the different oils. They act not only as direct germicides, but they stimulate the cells themselves in their fight against the foreign organisms. In general, the oils of the family Myrtaceæ and many of those of the Lauraceæ are thus antiseptic, as are those of birch, wintergreen, sandal, copaiba, and thyme. Oil of cinnamon is probably the most powerfully antiseptic of any, eucalyptol, if pure, perhaps standing next. Volatile oils agree in their strongly diffusive properties, on account of which their systemic effects come on quickly. If the vapor is confined, they are quickly absorbed, even through the skin, as they are by inhalation. They then become systemic stimulants, though overdoses may act as depressing poisons. This stimulation makes them antispasmodic in many cases. Elimination begins as promptly as absorption, and their local effects are again seen at the point of excretion. They vary in their selection of the channel of excretion. Some, like eucalyptus, copaiba, and cubeba, have a tendency toward the respiratory mucous membrane and become important stimulating and antiseptic expectorants. Others, like sandal, copaiba, cubeba, birch, wintergreen, turpentine, juniper, savin, tansy, and buchu, have an affinity for the kidney, and become stimulating (to irritating) and antiseptic diuretics, some important antiblennorrhagics. A few, like oil of chenopodium, are powerfully anthelmintic. Those especially adapted to perfuming and flavoring may be named as orange, lemon, bergamot, rose, bay, bitter almond, citronella, lavender, nutmeg, and cinnamon.

Oleoresins, being resins dissolved in volatile oils, naturally combine their properties. They very often, however, contain a third substance in addition, and this may give to them specific properties distinct from those of either the oil or the resin, and in some cases exceedingly powerful. The most important oleoresins in use are those of the male fern, capsicum, ginger, copaiba, black pepper, cubeb, turpentine, and hops. Other important oleoresins contained in drugs but not commonly isolated for use are those of calamus, iris, inula, prickly ash, mezereum, and stillingia.

Balsams are liquid or solid oleoresins depending in part for their properties upon the contained benzoic or cinnamic acid, or both. Their properties are readily deduced from this composition. The principal ones are benzoin, dragons'-blood, tolu, and peru. Copaiba, though commonly so called, is in no sense a balsam.

Amaroids (their Latin names ending in "*inum*," their English in "*in*").—This term has been proposed for those bitter extractives of plants which, having a definite chemical composition, do not belong to any of the recognized classes of proximate principles. While not highly scientific, the term is often very convenient.

Glucosides (their Latin names ending in "*inum*," their English in "*in*").—These are compounds of glucose with some other substance, the latter class covering a wide range and occasionally containing nitrogen. They are especially numerous in the Liliaceæ, the Apocynaceæ, and some other families, but are very widely distributed elsewhere. They act as reserve foods to the plant, and are therefore more abundant in those parts which act as storage reservoirs, and at the close of the growing period. The bodies associated with the glucose are very frequently poisonous or obnoxious, subserving thus a protective function, while the glucoside in this way also acts as a protective of other parts or constituents. Owing to the readiness with which they are decomposed (in the plant by special enzymes), their nutritious portion is very readily available and at once assimilable. For the same reason they constitute very unstable medicinal agents and, like drugs containing them, require to be treated with very great care in pharmaceutical operations. They are mostly soluble in both water and alcohol. Some, like amygdalin, are inactive until such decomposition occurs, while others may be thus rendered inactive. Such decomposition is effected by the action of dilute acids, especially if heated, by hot water, and by the prolonged action of alkalies. They are mostly precipitated by tannin and lead acetate, and very frequently by mercuric chloride. They are usually very energetic physiological agents, but their actions are too diverse for generalization. It may be said, however, that they are as a class more disposed to act upon the circulation than in any other one direction. Several of the glucosides are widely distributed among different plants, and, exhibiting variations among themselves, may be regarded as forming sub-classes. Tannin or tannic acid (elsewhere considered) is technically a glucoside, but differs so much from the others that it is difficult to regard it as such. The *saponin* group (see *Saponin*) have also distinct and important properties. The chief interest in glucosides as a group centres in their incompatibilities, as indicated above. The principal glucosidal drugs are as follows:

Bitter almonds, Peach seeds, Wild cherry, Cherry laurel, Peach, plum, and cherry leaves, etc.,	Amygdalin.
Buckthorn, cascara sagrada, and other species of Rhamnus, Aloes, Rhubarb, Senna,	Emodin or relatives.
Apocynum—apocynin and apocynein.	
Convallaria—convallamarin and convallarin.	
Digitalis—digitalin and others.	
Dulcamara—dulcamarin.	
Phytolacca—phytolaccin.	
Piper—piperin.	
Soap bark, Soap root, Euonymus, Senega, Caulophyllum and others,	Saponin or a similar body.
Squill—scillin and others.	
Black mustard—sinigrin.	
White mustard—sinalbin.	
Strophanthus—strophanthin and strophanthidin.	

Alkaloids (their English names ending in *ine*, their Latin in *ina*, although it is now proposed to abolish this most convenient distinction and to spell them with a final *in*, a practice actually now in use to a great extent in Germany).—These are nitrogenized organic bases, occurring in plants (also in animals) usually, if not always, as waste products, and in combination with acids. Although commonly waste products from a nutritive standpoint, they perform the most useful purposes in the plant economy. Usually poisonous and intensely bitter, they often serve to protect those parts of the plant which are used for food storage from consumption by animals. They may occur in any part of the plant, but are most often found in the seeds, leaves, and bark of both stem and root. They are characteristically common in some families, like the Rubiacea, while from others, like the Compositæ, the largest of all families, they are nearly or quite absent. Alkaloids are usually crystallizable. Many were formerly known only in a liquid or amorphous state, but many of these, when thoroughly purified, have since been found crystallizable. Those which are not so, yet usually yield salts which are. Some alkaloids are volatile. Many alkaloids, while acting as proximate principles themselves, readily separate, either in the plant by natural processes or under laboratory treatment, into other alkaloids and some associated substance, so that series of them are formed. These are necessarily of unstable chemical composition. In some cases, an alkaloid will result from the decomposition of a glucoside, as solanidine from solanin. Alkaloids differ greatly in solubility, but the strong tendency is toward solubility in alcohol and insolubility in water, while of their salts the reverse is true. A few which vary markedly from this rule are enumerated below. These bodies show their basic nature by turning red litmus paper blue, but more especially by uniting with acids to form salts. They do this without displacing the hydrogen of the acid, as metals do. They vary greatly in the intensity of this affinity for acids, some, like caffeine, being very feebly basic. In some cases we are even uncertain whether they can properly be classed as alkaloids. Alkaloids are as a class probably the most active physiological constituents of plants. Their actions are so dissimilar that they cannot be at all generalized, except to say that by their almost invariably bitter taste they act, in the absence of other antagonistic properties, as bitter stomachics and tonics. In many cases two alkaloids, the one a derivative of the other, occur in the same plant, with antagonistic properties. Alkaloids converted into *methyl* compounds are thus usually antagonistic to those so yielding them.

It is of the utmost importance that the prescriber should keep in mind the incompatibilities of alkaloids. Some of these incompatibilities are innocent, or can even be utilized in important ways. Thus the addition of acids converts alkaloids into salts, which may then be dissolved in water, the physiological properties being usually unaltered. These salts differ greatly in solubility. In most cases acetates are the most soluble, hydrochlorides next, and sulphates the least. In other cases, a physical incompatibility exists, so that the alkaloid is precipitated. Owing to their energetic action such a result is exceedingly dangerous, the first portions of the medicine being ineffective, the last portions poisonous. In this connection it may be stated that all salts which will turn red litmus paper blue will precipitate aqueous or weak alcoholic solutions of alkaloidal salts. Such solutions are almost always precipitated by alkali hydrates, soluble salicylates, benzoates, iodides, and bromides, tannic acid, chlorides of mercury and of gold. The presence of mucilage or hydrated starch will sometimes prevent this precipitation, especially that by tannic acid. In other cases incompatibility involves the destruction of the alkaloid. Oxidizing agents will usually accomplish this result, except when they enter into a saline combination. This fact is utilized in some cases of antidotal treatment, as of morphine by potassium permanganate. Chloral hydrate is incompatible with many alkaloids, forming a soft or liquid mass. The solanaceous alkaloids, of which atropine is the type, as well as aconitine and coniine, are decomposed by alkalies. The strength of many drugs can be readily standardized by determining the average percentage of alkaloid contained.

The principal drugs which depend upon alkaloids for their activity are the following:

Aconite (aconitine).
Aspidosperma (aspidospermine, a mixture of six).
Belladonna (atropine).
Berberis (berberine).
Coffee (caffeine).
Cannabis indica (?).
Chelidonium (chelerythrine and chelidonine).
Cinchona (quinine, cinchonine, and cinchonidine, chiefly).
Coca (cocaine).
Colchicum (colchicine).
Conium (coniine).
Ergot (?).
Gelsemium (gelsemine and gelseminine).
Granatum (pelletierine).
Guarana (caffeine).
Humulus (trimethylamine, partly).
Hydrastis (berberine, hydrastine, and [artificial] hydrastinine).
Hyoscyamus (hyoscyamine and hyoscine).
Ipecac (emetine and cephaeline).
Lobelia (lobeline).
Menispermum (berberine and menispine).
Nux vomica (strychnine and brucine).
Opium (many, the principal being morphine, codeine, narcotine, narceine, and the artificial derivatives apomorphine, apocodeine, and heroine).
Physostigma (physostigmine or eserine).
Pilocarpus (pilocarpine and pilocarpidine).
Piper (piperidine, partly).
Sanguinaria (sanguinarine, chiefly).
Scoparius (sparteine, partly).
Spigelia (spigeline).
Staphisagria (four alkaloids, the properties not well differentiated).
Stramonium (daturine, a mixture).
Tobacco (nicotine).
Veratrum (veratrine, a mixture).

Important alkaloids which are soluble in water are coniine, codeine, caffeine, nicotine, atropine (nearly four grains to the ounce), pelletierine, lobeline (considerably).

Alkaloids which, with their salts, are little soluble in ordinary alkaloidal solvents are strychnine and sparteine.

Enzymes.—These are vegetable ferments, acting like the animal ferments, pepsin, trypsin, etc., in decomposing or digesting nutrients for the use of the plant. There are different classes of them, each acting upon a certain class of nutrients. The diastases acting on starch have become extensively utilized in medicine, but most enzymes have not. One class has for its function the decomposition of glucosides, another the digestion of amaroids, another acts upon certain gums. Unlike pepsin and others of its class, the vegetable enzymes can be extracted in a pure condition and their composition determined.

H. H. Rusby.

ACUPRESSURE.—A procedure devised by Sir J. Y. Simpson, of Edinburgh, in 1859, for arresting hemorrhage from a vessel by means of pressure made by a needle transfixed through the neighboring tissues. The flow of blood through an artery may be arrested in any one of three ways. The vessel may be simply compressed between the needle and some firm tissue, as a bone or the integument, as represented in Figs. 33 and 34. When the artery lies embedded in a soft tissue, as in a divided muscle, its occlusion may be accomplished by torsion. This is done by introducing the needle on one side of the vessel, and, when it has passed through a portion of the tissue, twisting it around the artery, and fixing its point in the tissue in a direction opposite to that in which it was first entered; or the artery need not be included in the bight of the needle, but the latter may be turned before reaching the vessel, the latter then being compressed by the elastic force of the twisted tissues acting upon the needle. A third method, applicable also in cases in which the vessel lies in a yielding tissue, consists in pressure between the needle and a slip-knot. The needle is passed beneath the artery, and a loop of fine wire is slipped over its point, the ends of the loop passing over the artery, and being fastened by two or three turns over the shaft of the needle (see Fig. 35). In the case of small vessels, the needles may be withdrawn at the expiration of twenty-four hours; but when large arterial trunks are occluded, the pressure should be maintained for forty-eight hours at least.

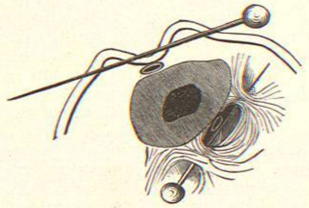

FIG. 33.

FIG. 34.

The advantages claimed for this method are: the ease and rapidity with which the needles may be applied, no delay being caused in the operation; the absence of danger from suppuration of the ends of the divided vessels; and non-interference with rapid closure of the wound, no inflammation being excited by the presence of the needles in the tissues for so short a period of time. These advantages, however, are less manifest at the present time, since the introduction and general employment of antiseptic ligatures, and it is not likely that the procedure will ever again enjoy the popularity which it at one time possessed.

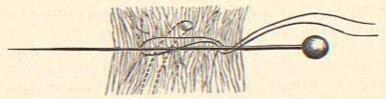

FIG. 35.

ACUPUNCTURE.—An operation which consists in the introduction of needles into the body, either as a means of giving exit to the fluid in œdematous tissues or for the relief of pain in neuralgia and muscular rheumatism. It is a method in great vogue in China, and is used by the physicians of that country not only to assuage pain, but to promote reparative action in ulcers and in the treatment of various other affections. It is said to have been introduced into Europe from China by the missionaries in the seventeenth century. The instrument employed is a round polished needle, having a cylindrical handle of sufficient size to permit of its being readily manipulated by the fingers. It is introduced into the tissues by a quick rotatory movement, and is then left *in situ* for a number of minutes, or even for an hour. Sometimes the insertion of a single needle is sufficient to relieve the pain, but ordinarily half a dozen or more are employed. This little procedure may be practised almost painlessly, and is sometimes wonderfully effective in controlling neuralgic and rheumatic muscular pains. It often fails, indeed, and it seems impossible to determine beforehand in what cases it will prove serviceable, but certainly no case of lumbago or sciatica should be abandoned until acupuncture, as well as the more ordinary remedies, has been tried. In anasarca, when the scrotum and lower extremities are distended with fluid, the patient may experience comfort from a few punctures with a three-cornered surgical needle. The operation should be practised with caution, however, as it is apt to excite an erysipelatous inflammation of the integument. In the treatment of paralysis insulated needles are sometimes used as a means of introducing the electric current into the deeper tissues. This procedure has received the name of *electropuncture*.

There is another form of acupuncture, called *Baunscheidtismus*, which at one time enjoyed a great popular reputation, and which even now is not very infrequently employed. It was devised by a German named Baunscheidt, who is said to have conceived the idea from observing that the irritation caused by the bites of insects afforded him considerable relief from the pain of an articular affection from which he was suffering. The instrument employed consists of a cylinder enclosing a button into which are inserted from twenty to thirty short needles. The open end of the cylinder is placed on the integument, and then by means of a handle the button with needles attached is drawn up into the cylinder compressing a spiral spring: when the handle is released the force of the spring impels the needles suddenly and sharply into the skin. The operation may rest here, or an irritating fluid, such as mustard water or cajeput oil, may be applied to the punctures. This is employed for the relief of neuralgia and muscular pains, and often proves of very great service.

There is still another form of acupuncture, if such it can be called, though it is more nearly related to hypodermic medication. It consists in the hypodermic injection of pure water, and has received the name of *aquapuncture*. Many superficial pains, even though quite severe, may be relieved by this simple procedure. That the relief thus obtained is not merely the effect of imagination, is evidenced by the fact that neuralgias of distant parts are not benefited by aqueous injections, but in order to be effectual the operation must be practised at a point as near as possible to the seat of pain. Aquapuncture is employed in various forms of neuralgia, in lumbago, and in painful functional affections of the abdominal viscera. Bartholow states that he has obtained excellent results from the injection of water into the substance of paralyzed and atrophied muscles. From 2 to 4 gm. (one-half to one drachm) of fluid may be used for each injection, and the operation may be repeated if no relief is experienced at the expiration of two or three minutes.

ADAMS COUNTY MINERAL SPRINGS.—Adams County, Ohio.

POST-OFFICE.—Mineral Springs.

ACCESS.—Via Cincinnati, Portsmouth and Virginia Railroad to Mineral Springs station, thence four miles by carriage to Spring hotel and cottages.

These springs are two in number and flow about sixty gallons of water hourly, having a temperature of 56° F. They issue from the base of a high hill and are surrounded by picturesque and charming scenery. According to a partial analysis by Prof. E. S. Wayne, the water is highly charged with gas and contains 205.35 grains of solid matter per United States gallon, composed as follows: Magnesium chloride, calcium chloride, calcium sulphate, calcium carbonate, sodium chloride, iron oxide, and iodine. The water may be classified as a saline calcic with ferruginous properties. The accommodations for visitors are now quite satisfactory, the hotel having been enlarged and a number of cottages added. The location affords a pleasant retreat for those who seek respite from the cares of business or need the refreshing influences of rural scenery and air. The water has long been resorted to by persons suffering from affections involving the stomach, bowels, and liver.

James K. Crook.

ADAMS SPRINGS.—Lake County, California.

LOCATION.—Eight miles south of Clear Creek and two miles from Cook's Valley.

ACCESS.—From San Francisco by rail via Oakland Pier, Vallejo, and Calistoga, thence by stage. Commodious quarters have been prepared for guests.

This resort lies among rolling hills which are thickly shrouded with verdant loveliness most of the year. The stage drive from Calistoga lies along a picturesque mountain road hedged in on either side by manzanita copses, scrub oaks, and, higher up, fragrant redwood trees. The elevation is 3,300 feet above the sea level. The following analysis by Dr. Winslow Anderson was made in 1888. One United States gallon contains:

Solids.	Grains.
Sodium chloride	4.64
Sodium bicarbonate	8.07
Sodium carbonate	50.70
Potassium salts	Traces.
Magnesium carbonate	97.90
Magnesium sulphate	Traces.
Calcium carbonate	27.95
Calcium sulphate	1.36