finger, which is slipped a little to one side. The tube is now passed alongside of the finger, exactly in the median line, till it reaches the tip of the finger. The handle is now sharply raised and the tube pressed home into the larynx. A gentle inflation from the bellows will cause the chest to rise and will be followed by expiration, if the tube is in the larynx. On the other hand, if it has passed down into the œsophagus, the chest will not rise, and in addition the air will be heard hissing in the throat. Occasionally the end of the tube gets blocked by the folds of the larynx. In these cases a little manipulation will generally clear it, or it may have to be withdrawn and again introduced. It is hardly necessary to say that these manipulations should be executed with gentleness and deliberation. The most common mistake is to see the operator frightened at a little delay in getting the tube in proper position and the inflow of air started. Seconds seem minutes in such cases, but it is very rare to see cyanosis develop which is not quickly cleared up when the bellows has been compressed once or twice.

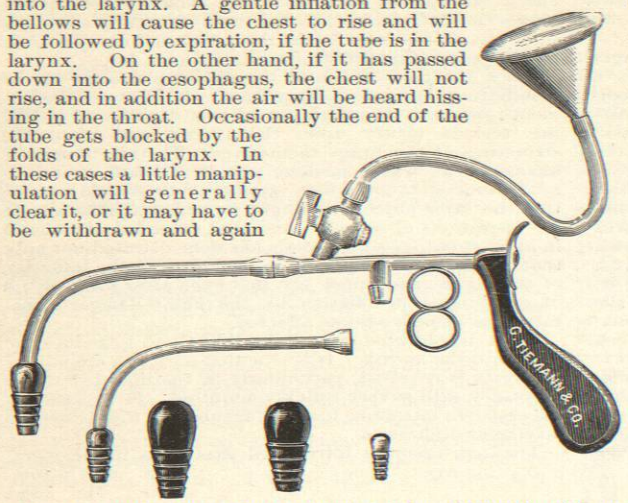

FIG. 2087.—Matas' Modification of O'Dwyer's Tube. (From his article on "Intralaryngeal Insufflation.")

The Fell-O'Dwyer apparatus is certainly the simplest and most efficient instrument so far invented for carrying on artificial or "forced" respiration. In 1897 Doyen ("Technique Chirurgicale") described an apparatus for insufflation, which he had devised for use in operations upon the thorax, to prevent the alarming symptoms of sudden pneumothorax. He was led to this invention by the experimental work of Tuffier and Hallion, Quenn and Longuet, who, recognizing the great danger from sudden pneumothorax, tried to find a way to prevent it. This they accomplished by insufflation, but they did not produce a suitable instrument. Doyen's apparatus is a credit to his inventive genius, but is manifestly inferior to the Fell-O'Dwyer apparatus.

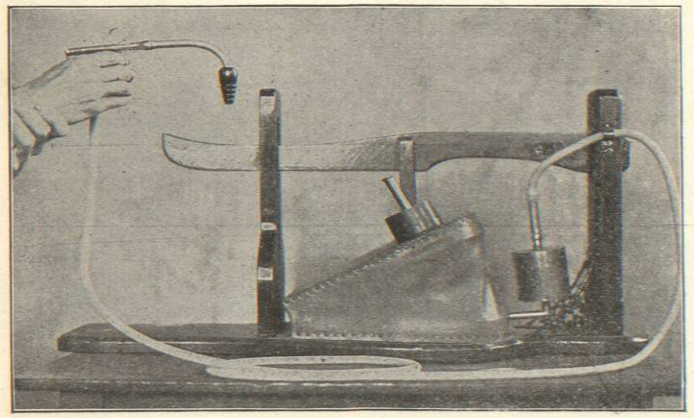

FIG. 2088.—Dr. J. D. Bloom's Modification of Fell-O'Dwyer's Apparatus as used in New Orleans Charity Hospital.

The latter is an admirably practical addition to our resources, and it is confidently recommended in the treatment of asphyxia in the following classes of cases:

1. In asphyxia neonatorum, by the use of Dr. J. D. Bloom's modification. The small size of the instrument permits its inclusion in any obstetrical bag. When its use is successful, the feeble and infrequent heart beat becomes more rapid and distinct. The skin loses its livid color and assumes the rosy hue of health, and even when no effort at independent respiration has been made by the infant the circulation appears to be perfectly normal. Generally a very short time elapses before the child can be left to carry on its respiration without assistance. I have myself now resuscitated too many asphyxiated infants with this instrument to feel any doubt of its superiority to any other method of meeting this condition.

2. In opium poisoning, with respiratory failure. This is the condition for which Fell originally recommended the method. Any one who has witnessed the transformation which occurs in the appearance of such a patient after the establishment of "forced respiration" with the Fell-O'Dwyer apparatus, and has compared its quiet efficiency with the strenuous and unsatisfactory effects of artificial respiration by Sylvester's and other methods, or with electrical stimulation of the respiratory function, will need no further argument to recommend it. Under its use the lividity of cyanosis is replaced by an unusually rosy color, the heart's action is improved, and, these two centres being kept going, the system has time to eliminate the poison. The use of the instrument is to be continued until, when the bellows is stopped, the patient breathes of his own accord at least twelve or fourteen times a minute and shows signs of being aroused from the narcotic stupor. We have frequently noticed that even after having regained consciousness these patients will lie quiet and permit the operator to carry on respiration for them. Sometimes after having regained the power to breathe for himself the patient will relapse and the tube will have to be again applied. At the Charity Hospital in New Orleans the apparatus has been used continuously for twelve or more hours, with ultimate success in saving the patient's life. It has undoubtedly saved cases which would have been fatal under other methods of treatment. It has markedly reduced the number of cases of post-narcotic pneumonia, which was formerly very frequent.

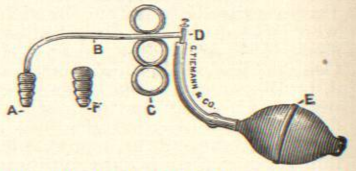

FIG. 2089.—Dr. J. D. Bloom's Adaptation of Fell-O'Dwyer's Apparatus for Use in Asphyxia Neonatorum. *A* and *F* are tips of different sizes; *D* is the ball valve to replace operator's thumb; *C*, metal rings into which the operator's fingers may be introduced; *E*, air bulb.

(3) In other cases of respiratory failure, as instanced by the following case: A young woman was brought into the Charity Hospital unconscious. She had been drinking long and heavily and appeared to be in a condition of alcoholic coma. No trace of opium could be found in either the stomach contents or the urine. The pulse was fairly good; respiration rapid and shallow. Suddenly the pulse became very feeble, the pupils became dilated and unequal, respiration practically ceased, and the skin quickly got blue. The pupils remained unequal for several hours afterward. Hypodermic stimulation and artificial respiration were at once resorted to, but she could not be made to breathe. Death seemed imminent, when the Fell-O'Dwyer apparatus was introduced. In a few moments the pulse had slightly improved, and under the influence of the regular respiratory movements the cyanosis disappeared. After three hours she was sent to bed breathing for herself, and on the next day she was partly conscious. Total suppression of urine, however, terminated her life in coma.

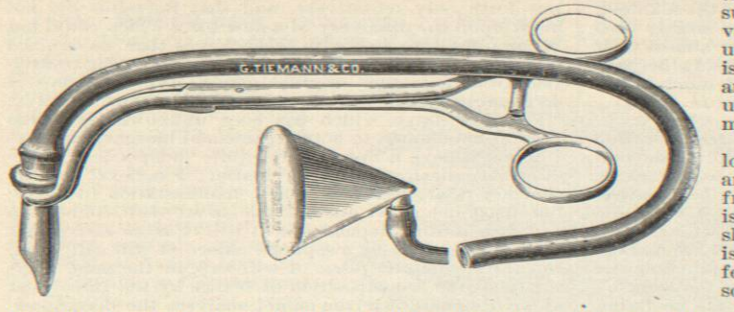

FIG. 2090.—Doyen's Intralaryngeal Tube and Rubber Connections, with Funnel Attached, for Laryngeal Tamponade and Chloroform Anæsthesia. The cut shows the special forceps used to introduce the tube. The intubating cannula may be used for direct air insufflation. (From Doyen's "Technique Chirurgicale," Fig. 43, p. 123.)

(4) In chloroform narcosis, when the respiration fails before the heart. Unfortunately, in most cases the heart fails along with the respiration, and then I believe nothing will save the patient.

(5) In the surgery of the mouth, to prevent the entrance of blood into the trachea and to secure free admission of air to the lungs, the anæsthetic being given through the tube; a very limited field of application, and one better met by preliminary tracheotomy.

(6) In thoracic surgery, when the pleura is widely opened and there is danger to life from the production of sudden pneumothorax, with collapse of the lung. As demonstrated by Parham at the Charity Hospital, in a case of sarcoma of the ribs, the frightful anxiety which attends this accident may be prevented by the use of the Fell-O'Dwyer apparatus, and the expansion of the lung quietly maintained while the organ is being secured to the chest wall by sutures.

There can be no doubt that the most brilliant future for this method of "forced respiration" lies in the field of thoracic surgery. Milton, of Cairo, has succeeded in doing some remarkable work upon the mediastinum with the assistance of insufflation, and Parham has, in this country, conclusively demonstrated its wonderful utility in forestalling the pneumothorax which has always been the bugbear of operative interference with the thoracic walls. *Erasmus D. Fenner.*

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FENNEL.—FŒNICULUM. The fruit of *Fœniculum. Fœniculum* (L.) Karst. ("*F. capillaceum* Gilibert," U. S. P.—fam. *Umbelliferæ*).

From a perennial or biennial herb with a tall, smooth, green, branching stem, and pinnate, skeleton-like leaves, the latter consisting of but little more than straggling, branching midribs and veins, arising from broad, concave, half-sheathing petioles. Umbels compound, naked, many-flowered.

Native of Southern Europe, Western and Southern Asia, etc.; it exists in several varieties, and has been long and extensively cultivated.

Of two separate or united carpels, each 0.5 to 1 cm. ($\frac{1}{5}$ to $\frac{3}{8}$ in.) long, about one-third as broad and one-sixth as thick, oblong or a little narrowed at the summit, more or less curved, bearing five very prominent and stout light-colored ribs upon the back, otherwise smooth, yellowish or brownish-green; pericarp containing an oil tube between each two ribs and two upon the flat side; odor pleasantly aromatic; taste sweet and pleasantly aromatic.

Sweet, or Roman fennel, with very large, long, light-colored, pale-greenish fruits, and a particularly pleasant odor and taste, from cultivated plants of southern Europe, is much the best. German, or Saxon, with shorter and proportionately thicker fruits, is cultivated in Germany. Wild, or bitter fennel, is from wild plants growing in the south of France.

Fennel contains about three and a half per cent. of an *essential oil* very much like that of anise, being composed of a large proportion of *anethol*, a smaller one of a hydrocarbon of the terpene series, etc.

Fennel is a mild aromatic of exactly the same medicinal qualities as anise. It is, however, less used in medicine than that, but is considerably consumed as a flavor in cordials, as a spice and in veterinary practice. It also enters, as a carminative, to prevent griping, into the compound infusion of senna, and its oil similarly into the compound spirit of juniper and the compound licorice powder. Both are often added to prescriptions, with this object. The dose of fennel is 0.5 to 2.0 gm. (gr. viij.–xxx.). *W. P. Bolles.*

FENNEL, OIL OF—a volatile oil distilled from the above—is thus described in the Pharmacopœia:

A colorless or pale yellowish liquid, having the characteristic, aromatic odor of fennel, and a sweetish, mild, and spicy taste.

Specific gravity: not less than 0.960 at 15° C. (59° F.).

Between 5° and 10° C. (41° and 50° F.) it usually solidifies to a crystalline mass, but occasionally it remains liquid at a considerably lower temperature.

Soluble in an equal volume of alcohol, the solution being neutral to litmus paper; also soluble in an equal volume of glacial acetic acid.

The oil is not colored by the addition of a drop of ferric chloride T. S. (absence of some foreign oils containing *phenols*, and of *carbolic acid*).

If the oil be dropped into water, without agitation, it should not produce a milky turbidity (absence of *alcohol*). It should contain about sixty per cent. of anethol. The relatively higher temperature at which crystals of this substance begin to separate indicates its percentage and of course determines its quality. Another substance present in it is *fenchone*, with pinene, phallandrene, etc. Its properties and uses are precisely like those of oil of anise, and the dose is ♏ i. to v. The official water (*Aqua Fœniculi*), having a strength of one-fifth of one per cent., is usually employed as a vehicle, but is carminative in doses of 8 to 30 c.c. (fl. ℥ $\frac{1}{4}$ to 1). *Henry H. Rusby.*

FENUGREEK.—FŒNUM GRÆCUM. The seeds of *Trigonella Fœnum-Græcum* L. (fam. *Leguminosæ*), a very ancient food and drug of India, produced upon a cultivated and wild erect, branching herb. The seeds are about one-eighth inch long and nearly as broad, and a little more than half as thick. They are irregularly rhomboidal, with rounded edges, and grooved diagonally, on both sides. They are of a peculiar brownish-yellow, sometimes grayish-yellow, smooth, peculiarly and not very pleasantly odorous, and of similar fatty and bitter taste. About one-fourth of their weight is gum, nearly as much albumin, and there is seven per cent. of ash, with six of a disagreeable smelling and tasting fatty oil and a little resin. There are small amounts of *choline* (see *Hemp, Indian*) and *trigonelline* ($C_7H_7NO_2 + H_2O$). They are largely eaten as an albuminous food and are also regarded as tonic (doubtless due to the bitter alkaloid) and carminative. They are also very largely used in the ground state for poultices. The absorbable properties of the alkaloid, so applied, are unknown. They are very largely used as food and medicine for cattle, and this is almost their exclusive use in this country. The very young herbage is similarly used as a sort of *medicinal food*, much as are dock leaves and dandelion leaves. *Henry H. Rusby.*

FERMENTATION. — Fermentation is derived from the Latin *fermentatio*, which has the force of the root found in the Latin verb *fervere*, to glow with heat, to seethe, to boil—a good idea of which may be obtained from the English cognate *fervent*. The word was used to describe such processes as take place in a beer-vat or a jar of working preserves—processes which are marked by an elevation of temperature and the production of a scum or froth. (For a historical résumé of the work by which such processes were shown to be due to living organisms, see article *Bacteria*, this HANDBOOK, vol. i., pp. 677-680.) Later, the word came to be used in a wider sense to include putrefactive changes in general, and its use finally was extended to take in the processes which are now best known by the name of zymolysis (see article *Enzymes*, this HANDBOOK, vol. iii., p. 840). Fermentation, therefore, in its fullest significance may be said to include, on the one hand, those processes brought about by the lower vegetable organisms (bacteria, yeasts, moulds, etc.), which increase in growth as they produce the physical and chemical changes observed in the medium in which they grow; and, on the other hand, the term is sometimes stretched to include zymolysis or the changes produced by enzymes, which enzymes neither increase nor grow less as the process is continued.

It is interesting to note that while in Germany the word *Fermentwirkung*, of Latin origin, is used to apply almost exclusively to zymolysis, in England and in America the word fermentation is used to apply to exactly the other half of the field, viz., to those changes which are produced by the lower vegetable organisms.

In this HANDBOOK "Fermentation" has been practically treated by the articles on *Bacteria* and on *Enzymes*. As these deal respectively with each half of the subject, it will not be entered into *in extenso* here. There are, however, three classic theories, inseparably connected with the subject of fermentation, which have not been discussed in the articles referred to and which will therefore be taken up now. These are:

(*a*) Berzelius' theory of *catalysis*.
(*b*) Liebig's theory of fermentation.
(*c*) Pasteur's theory of fermentation.

Berzelius' theory of catalysis, while not advanced exclusively as part of a study of fermentation, was promptly seized upon to explain the action of enzymes, and is still so quoted—though rarely—at the present day. Prior to Berzelius' classic paper on this subject, it had been observed that certain substances such as finely divided platinum would cause the union of such stable elements as hydrogen and oxygen with the evolution of sufficient heat to cause the platinum to glow. Similarly such platinum would cause the oxidation of alcohol (in the presence of water) to acetic acid, and yet the platinum did not appear (as far as was known at that time) to enter into the reaction—at least it was not used up. Platinum was found, furthermore, to decompose hydrogen peroxide, and, what to Berzelius was still more striking, a flake or two of fibrin would have the same effect, the amount of hydrogen peroxide decomposed being considerable, while the platinum or the fibrin was little or not at all affected and apparently did not enter into the reaction (compare with illustration of nitric oxide, article *Enzymes*, this HANDBOOK, vol. iii., p. 839). To account for such phenomena Berzelius advanced the theory that certain substances could act simply by their presence and produce profound reactions, in which, *as far as he could see*, they took no part. Later investigations have shown there is probably no case in which a body acts in this way without taking part in the reaction and many severe criticisms of the Berzelian theory have been made, but it should not be forgotten that the theory was put forth only tentatively, and that Berzelius did not insist upon the discovery of a new force which could not be brought into line with other forces then recognized as active. This is clearly shown by the following translation from Berzelius' original paper (*Ann. de chimie et de physique*, 1836, vol. lxi., p. 150), in which he says: "This new force, which has been unknown up to the present, is common to both organic and inorganic nature. I do not believe it to be a force quite independent of the electrochemical affinities of matter; I believe, on the contrary, that it is only a new manifestation of these; but inasmuch as we are not able to see their connection and their mutual dependence, it will be more convenient to designate them by a separate name. I will call, then, this force, *catalytic force*. I will call, in the same way, *catalysis*, the decomposition of bodies by the force, just as we designate, by [the name] analysis, the decomposition of bodies by chemical affinity." From a comparison of this theory with the action of enzymes it may readily be seen how it was called in to explain zymolysis, but it need scarcely be said that the simple employment of the new word catalysis did not, in the slightest degree, explain the nature of the process.

Liebig went a step farther than Berzelius in attempting to show how ferments acted. He applied his theory to both organized ferments and enzymes. According to Liebig enzymes were albuminous in nature and possessed intramolecular movements or vibrations, which they tended to transmit to certain other (fermentable) substances around them. These fermentable substances, when they took up the vibrations in question, were shaken to pieces, and the atoms of which they were formed entered into new combinations. In the same way he supposed that the protoplasm of yeast cells, being highly complex and tending to break down, would transmit vibrations to non-living matter near them and cause it to break down.

Pasteur entered the field with a new theory, viz., that yeast cells, bacteria, etc., as a result of needs of their own in their life process, took from substances in solution around them what they needed—usually oxygen—and by this means destroyed the fermentable substance as such. The atoms which remained after the extraction of what the yeast cell needed then formed new combinations in accordance with their chemical affinities. This has often been compared to the yeast cell pulling out what might be called the keystone of the arch (comparing the molecule to an arch); the other stones of the arch, so to speak, would fall together in groups corresponding to the chemical affinities they possessed.

For a number of years the scientific world was interested in the discussion which followed between Liebig and Pasteur, until finally, by brilliant researches of his own and of others, Pasteur succeeded in making his theory the favored one. Among the many researches which might be quoted here was one by Dumas, which might almost be said to have given the *coup de grace* to Liebig's theory. Dumas showed that a thin film of collodion, not more than 0.1 mm. (about $\frac{1}{250}$ in.) thick, would absolutely prevent the action of an actively fermenting solution being transmitted to a fermentable solution on the other side. If Liebig's vibration theory was true, this was not what would have been expected, while it harmonized thoroughly with Pasteur's theory that the yeast cell would have to come in absolute contact with the fermentable substance in order to pull out the parts which it needed.

The theory of Pasteur, more or less modified as to the importance of oxygen in the process, might be said to be the one most generally held in favor, even at the present day; but more recent researches indicate that a new theory radically different will, not unlikely, take its place. This new theory is that the vegetable organisms so long identi-

fied with fermentation, and believed to be the efficient cause of the same, really act a secondary part—that is, they produce enzymes, and the enzymes bring about the changes to which we give the name fermentation or putrefaction. (See article *Enzymes*.) *George T. Kemp.*

FERN, MAIDEN-HAIR. — ADIANTUM. (*Venus-Hair Fern.*) *Adiantum* is a large genus of ferns, several of whose species have been used in medicine, more especially the *A. Capillus-Veneris* L. of Europe and the *A. pedatum* L., growing throughout North America, except the far North and the Southwest, and abundant also in parts of Asia. The herb is the portion used. It has an aromatic-bitter taste, due to constituents which have not been studied. Its use is historical, it having been employed mainly in the treatment of catarrhal affections, especially of the respiratory tract. At the present time it is largely used in the manufacture of some patent medicines, but scarcely in any other way.
Henry H. Rusby.

FERN, MALE. — ASPIDIUM. FILIX-MAS. "The dried rhizome of *Dryopteris Filix-mas* Schott and of *Dryopteris marginalis* Asa Gray (nat. ord. *Filicas*)" (U. S. P.)

The first-named of these species is a large, robust, and handsome fern. It is one of the commonest in the cooler parts of Europe, and abundant also in the temperate parts of Asia, in the northern and southern extremes of Africa, and in both North and South America. It is not found in the Eastern United States, but occurs in British America and in the Western States. Its employment as a tænicidal agent is of great antiquity, as it is mentioned by some of the earliest writers upon medicine. The introduction of the "oleoresin" (ethereal extract) dates from the recommendation of an apothecary of Geneva named Peschier, in 1825 (Flückiger). The horizontal or decumbent rhizome is collected and either dried and marketed in its natural state, or (as now usual) after stripping it of its dense coat of leaf bases and chaffy scales, then constituting the "Peeled Fingers."

DESCRIPTION.—Before being peeled, 10 to 15 cm. (4 to 6 in.) long by 5 to 7 cm. (2 to 5 in.) thick, including the densely imbricated, dark brown, cylindraceous, slightly curved stipe-bases and the dense mass of brown, glossy, transparent, soft, chaffy scales; when peeled, 1 to 2 or 3 cm. ($\frac{2}{5}$ to about 1 in.) thick, slightly curved or claw-shaped, somewhat narrowed toward one end, bearing several coarse longitudinal ridges and grooves, pale-green when first peeled, becoming pale-brown, or when too long kept, rusty-brown, smoothish (or somewhat roughly scarred with remains of the stipe-bases); texture rather spongy, pale-green, with age becoming gradually brown from the outside inward, the *Filix-mas* showing about 10, the *marginalis* about 6, steles in a loose and interrupted circle. The marginal hairs of the stipe-scales of *Filix-mas* consist each of two parallel, slender cells, neither of them glandular; those of *marginalis* are almost identical in appearance, being directed slightly more toward the apex of the scale, and their lower cell often a little narrower. Upon the older scales they are nearly wanting. Male fern has a disagreeable odor and a bittersweet, acrid, astringent, and nauseous taste.

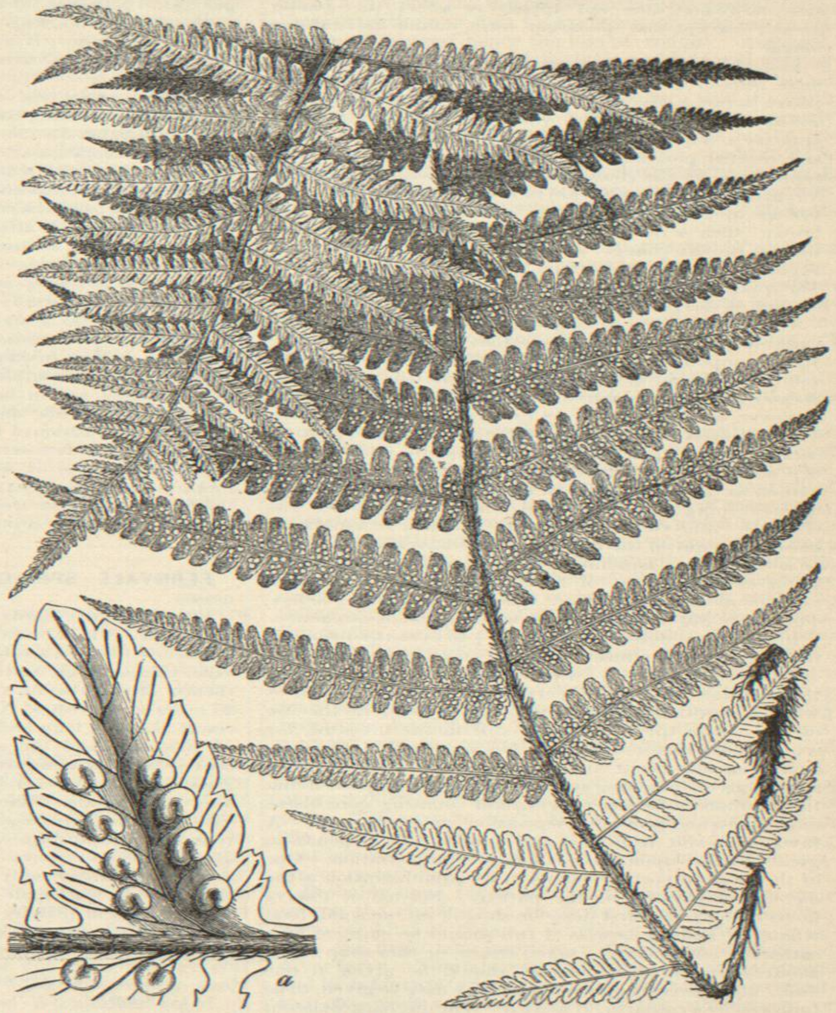

FIG. 2091.—Male Fern. Frond about one-third natural size; also a lobule (*a*) enlarged about four times, showing the round-reniform *indusia* covering the *sori*. (Luerssen.)

The chaff, together with the dead portions of the rhizome and stipes, should be removed, and only such portions used as have retained their green color. The powder should be freshly prepared and bright green.

Several, perhaps many, adulterants and substitutes have been and are sold. Some of these can be distinguished by their different numbers of steles, while the distinctions of others are microscopical and obscure. It is not indeed practicable, without a very elaborate description, to exclude all the possible adulterants. Some, not readily detected in the peeled drug, are so when the covering of stipes is present, a condition which is, for other important reasons, also to be preferred.

The second species occurs in Eastern and Northwestern North America. It is scarcely so large as the former.

Of late years, the market has afforded very much more male fern only a inch and a half in length by a quarter or a third of an inch thick, than of the larger sort. The size, however, does not appear to affect the quality greatly, except that the larger form retains its freshness longer.

Few drugs are more certain to prove effective than male fern of good quality and properly prepared, yet there are few whose preparations, as found in pharmacies, are more uncertain. The quality of the genuine drug appears to depend wholly upon its freshness and correct and careful preparation. The freshness is at once determinable by the color, and no pharmacist is excusable for accepting or using an inferior article. The outer surface at first loses its green, and assumes a very pale-brown, then a deep rusty-brown color. At the same time a similar change of color is occurring internally, beginning at the exterior and gradually working inward. The quality is in a general way proportional to the retention of the green color.

The composition of male fern is very complex and variable with the length of time that the drug is retained. Many compounds have been from time to time described and, being found to act more or less like the drug, have been credited as the active constituents. We are unable, however, to state positively to what the action is due. There appears to be little doubt that several of the constituents are active, upon both the system and the parasite. Filicic acid, which is certainly somewhat active, was long regarded as the chief tænicidal agent, but since it increases upon keeping the drug, while the latter becomes less effective, this view has become modified. Aspidin is more abundant in the fresh drug and has been proven to be active, as has aspidinin. With these substances occur six or seven per cent. of fixed oil, a variable amount of volatile oil and tannin, and various less known bodies. The 20% to 30% of *filicic anhydride* or *filicin* is not active.

In medicinal doses, 1 to 4 gm. (ʒ ¼ to i.) of the oleoresin, the preparation almost entirely employed, male fern ordinarily has a purely extraneous action, affecting only the parasite. But when very large doses are taken, or when absorption occurs, this being favored by the use of fats while the oleoresin is still in the intestine, for which reason castor oil is an ill-chosen adjuvant, poisonous symptoms may occur, and the results may be fatal. The symptoms of poisoning are those of great intestinal irritation and inflammation, purging and vomiting, convulsive movements and powerful depression, ending in coma. A favorable result from the use of male fern depends in great measure upon the method of administration. One of the most important points in its administration is the dietetic preparation of the patient. For ten or twelve hours before the first dose he should eat no solid food whatever, and the bowels if full should be emptied by a cathartic. Milk may be taken freely, or thin soup; then about 4 gm. of the oleoresin should be given at one dose; after several hours a second dose may be given, to be followed by a cathartic, if needed. The discharges should always be carefully examined for the head and upper portions of the worm. Unless these are passed the cure cannot be considered certain, and it may be found necessary to repeat the treatment. *Henry H. Rusby.*

FERN, SWEET.—This name has been applied to a number of plants; to some true ferns, because of their fragrance; and to some flowering plants with leaves resembling those of ferns, especially to the *Comptonia peregenia* (L.) Coulter (fam. *Myricaceæ*), also called Fern-Bush, Fern-Gale, or Sweet Bush. It is exceedingly abundant in rocky meadows, especially amidst blueberry bushes, in Northeastern North America. The leaves are peculiarly pinnatifid, with nearly semicircular segments alternating upon the two sides. They contain tannin, a small amount of an irritant glucoside, and a peculiar volatile oil, smelling like bay oil and somewhat like cinnamon. This oil has a specific gravity of 0.926 and solidifies at a freezing temperature.

The leaves are useful as a mild astringent of delightful fragrance, and are at the same time markedly stimulant, owing to the oil. The bark also contains tannin and is used as an astringent. The dose of the leaves is 1 to 2 gm. (gr. xv.–xxx.); of the bark, twice as much.

Myrrhis odorata Scop. (fam. *Umbelliferæ*) has also been called sweet fern. It is the sweet chervil of Europe and its root is used as a carminative. *Henry H. Rusby.*

FERNS.—(Nat. ord. *Filicineæ* or *Filices.*) This immense and interesting class of exquisitely beautiful plants has, unfortunately, but limited practical applications outside of decorative art. A few species yield extractible amounts of starch, while the rhizomes or young shoots of others are cooked and eaten. Dye-stuffs are yielded by a number, while several contain cumarin. There are many species which, although used to a large extent, and with good results, as domestic remedies, are not known to professional medicine. The commonest property, perhaps, is that of being anthelmintic, and many species of many genera, especially of *Pteris*, *Dryopteris* (incorrectly called "Aspidium"), and *Polypodium*, are so used. Many of these are poisonous, resembling in this respect the male fern. Next in importance are the astringent properties, due to tannin-like constituents, for which a very great number are in native use. In one or two cases, like that of *cibotium*, the hæmostatic effects are mechanical, after the fashion of lint. Many species are distinctly diuretic, and a few carminative, while a great number, like hart's-tongue or scolopendrium, are in use as pectorals. The gummy exudation from incisions in some of the South American tree ferns forms a most useful, permanent, and elastic protective covering to slight wounds.
Henry H. Rusby.

FERNVALE SPRINGS.—Williamson County, Tennessee.

Post-Office.—Fernvale Springs. Hotel and cottages.

Access.—Viâ Louisville and Nashville Railroad to Franklin; thence 13 miles west to springs. Or viâ Nashville, Chattanooga, and St. Louis Railroad to Bellview; thence 12 miles southwest to springs. The location is 25 miles southwest of Nashville. This pleasant summer resort has been long and favorably known to the citizens of Nashville and the surrounding country. It has recently been thoroughly renovated, and it is said that guests as far away as Texas are beginning to find their way to Fernvale. Many attractions are afforded to the visitor in the picturesque hilly and wooded districts surrounding the springs. The situation of the resort is about 1,400 feet above the sea-level. The springs here are six in number, only three of which are mineralized. An analysis was made in 1836 by G. Froost, analytical chemist, and in 1879 by Prof. W. T. Lupton, of the Vanderbilt University. The former analysis is antiquated and incomplete. Following is Lupton's analysis:

One United States Gallon Contains:

Solids.	Grains.
Potassium sulphate	1.14
Sodium sulphate	13.76
Sodium sulphite	8.30
Sodium chloride	8.85
Lithium carbonate	Trace.
Calcium sulphate	27.63
Calcium carbonate	7.04
Magnesium carbonate	6.52
Iron oxide and alumina	.55
Silica	.05
Total	73.84
Gas.	Cu. in.
Sulphureted hydrogen gas	14.21

This water is very clear and not unpleasant to the taste. It has proved to be efficacious in skin affections of the squamous variety and in disorders of the alimentary tract and kidneys. It is also used locally in the treatment of sore eyes, chafing of the skin, superficial ulcerations, etc. *James K. Crook.*

FERRIS HOT SPRINGS.—(Formerly Matthews), Gallatin County, Montana.

Post-Office.—Bozeman. Hotel. These springs are located on the east bank of the West Gallatin River, 7 miles west of Bozeman, from which place they are reached by coach. They were discovered over twenty years ago, but were not much improved until quite recently. The present proprietor has erected a handsome modern hotel, improved the natural charming surroundings, and placed the resort on a par with the most attractive in the West. The location of the hotel possesses unusual advantages. To the northeast and south a broad expanse of level country stretches out, dotted here and there with groves of cotton-wood and poplars, the intervening ground being occupied by fields of growing grain and verdant meadow lands. On the west the river sweeps along in magnificent curves, the line of tall trees conforming to the meanderings of the stream. Back of all, the grand old Rockies —snow-crowned, rock-ribbed, majestic—form an apparently unbroken guard to the enchanting scenes which lie in tranquil loveliness below. The location is 4,500 feet above the sea-level. Fish and game are found in great abundance and variety in the neighborhood. An analysis of the waters by Messrs. Riggs and Clark of the United States Geological Survey in 1885 resulted as follows:

One United States Gallon Contains:

Solids.	Grains.
Silica	4.61
Sodium silicate	6.40
Calcium carbonate	2.28
Magnesium carbonate	.21
Sodium carbonate	4.37
Potassium chloride	.78
Sodium chloride	4.12
Sodium sulphate	11.51
Loss	.06
Total	34.34

The analysis shows sufficient sulphate of soda to give the waters a laxative effect when taken in considerable quantities. They are recommended, both for internal use and for bathing, in the diseased conditions to which hot saline waters are applicable. *James K. Crook.*

FEVER. See *Calorimetry.*

FEVER, CLINICAL SIGNIFICANCE OF.—By fever we understand an abnormal elevation of the temperature of the body continued for a number of hours, or if not continuous, at least intermittently repeated, due to some infection or to some local inflammatory process, or to some unexplained disturbed state of the nervous system.

No symptom of disease was more carefully studied by the ancients than the temperature, and from the time of Hippocrates to the eighteenth century it was estimated by the rate of the pulse. Early in the eighteenth century Boerhaave began to use the thermometer in fever cases, but the thermometer did not come into general clinical use until Gavarret, in 1839, and twenty years later Zimmermann, Traube, and Wunderlich urged its advantages.

During the next twenty-five years the prognostic value of the height of the temperature became more and more over-estimated, but during the last fifteen years its prognostic importance has become much better understood, and to-day its greatest significance lies in its diagnostic advantages as a day-to-day indicator of the progress of the disease.

To understand well the pathology of fever, it is necessary to remember the normal mechanism of animal heat. The sole cause of this heat is a process of combustion of food substances by the oxygen absorbed. About four-fifths of the total body heat is produced in the skeletal muscles through an oxidation whereby oxygen is absorbed and carbonic acid given off, though the processes passed through are probably much more complex than mere oxidation. The other one-fifth of the animal heat is furnished by the secreting glands and the alimentary canal during digestion, and the liver, the largest gland of the body, contains the warmest blood. The internal temperature will be higher during the digestion of a meal than before.

During active fevers glandular activity and digestion are at a low ebb, and almost the entire heat production in these conditions is due to oxidation or changes in the muscular system; hence the loss of weight. Any muscular or mental activity or the taking of food will slightly raise the temperature, but external surroundings do not much affect the temperature of adults. But the adult during convalescence from a severe sickness is easily made colder or warmer by sudden changes in the external air or by any internal disturbance, the heat-regulating apparatus having become temporarily impaired. The babe, also, has its temperature easily raised or lowered by external or internal conditions because its heat-regulating apparatus is undeveloped.

Strychnine, caffeine, cocaine, and atropine all raise the temperature by increasing muscular and cerebral activity, the latter by reducing heat loss by preventing perspiration. Alcohol, nicotine, and morphine diminish temperature, the first two by relaxing the blood-vessels and increasing perspiration, and the latter by preventing all glandular and muscular activity.

Clinically, then, with high fever we should stimulate with alcohol, but with depression we should stimulate with strychnine.

A word as to the physiology of heat regulation. The equilibrium of the body temperature must be governed by the relation of the heat loss to the heat production, and as the one increases, so must the other, and all of this mechanism must be under the control of some finely adjusted nerve governor. The theories which have been offered in explanation of this are very various; they range from Macalister's three centres, namely, a thermogenic or heat-producing centre, a thermolytic or heat-dispersing centre, and a thermotaxic or heat-controlling centre, to Schaefer and Moore's belief that the vaso-motor mechanism in the medulla oblongata is probably the regulator of the relations of heat loss to heat production. Ott's cortical heat centre and Reichert's corpus striatum centre have not been proved, no structural difference having been discovered before and after the heat-regulating power has developed. But this power appears to be associated with the control over the skeletal muscles and blood-vessels.

As to the pathology of fever, its cause must be an over-production of heat, or a diminished loss of heat, or both. This may be due to anything that interferes with the vaso-motor regulating apparatus, or to anything that increases chemical activity, be it glandular, muscular, or metabolic.

Probably most fevers are due to poisoning from some source, the character of the fever, of course, depending upon the kind of poison. Anything that irritates or excites the brain may interfere with heat regulation and cause fever. This is especially noticeable in convalescents and in infants in whom too much excitement, over-eating, etc., cause a return of fever in the convalescent, or a febricula in the infant.

The purest kind of nervous pyrexia is seen in hysterical fever. This may be caused by hyperfunctional activity of some of the control centres, or we may have such a nervous shutting up of the peripheral blood-vessels as greatly to diminish the heat loss. Also the unceasing muscular activity present in some hysterical explosions, either as muscular or as simple fibrillar contractions, increases the heat production without adequate increase of heat loss.

A malarial paroxysm is perhaps the best type of immediate stoppage of heat loss and the consequent enormous sudden rise of the temperature. As the infected red blood corpuscles burst from the pressure of the matured plasmodia the first impression on the nervous system is to cause a sudden irritation of the vaso-motor centres and the resultant contraction of the peripheral vessels, and the symptom is a chill more or less severe. The internal temperature, perhaps partly from the toxin, perhaps largely from the obstructed heat loss, rises rapidly and often to a great height, which is sustained until the now superheated skin and over-stimulated sweat glands begin to pour out a profuse perspiration and heat loss first exceeds and then equals heat production, and the normal equilibrium is once more established. A period without fever, the intermittent stage, then follows, its length depending upon the type of plasmodium with which we are dealing.

In the same individual may be found mixed varieties of malarial parasites, maturing at different and at irregular times, and one set so overlapping the other that we have the so-called remittent fever—a malarial fever with remissions but without any marked intermissions. A frequent use of the thermometer, however, will generally show some short period of intermittency.

Our best type of a continued fever, of course, is typhoid. This fever undoubtedly becomes in time a mixed affair. Very soon in the course of this fever, unless laxatives and bowel antiseptics are freely given, fermentation and decomposition occur in the intestines, and we have an increased temperature due to the absorption of toxins from these processes, and the infection is then double.

This same double infection occurs in diphtheria, when added to the mild fever caused by the diphtheria bacillus we have fever from the absorption of the putrefactive products from decomposition of the diphtheritic membrane. The same is true of scarlet fever with decomposing membranous exudation on the tonsils.

In acute colds, follicular tonsillitis, measles, and chickenpox the fever is short-lived unless some complication occurs. The specific germs may so shock the nervous system as to produce the premonitory chill, and this in turn will be followed by a fever which, however, soon terminates unless some focus of pus formation develops, or the secretions undergo putrefaction, or the fæces become impacted.

The hectic fever of chronic tuberculosis is a pus fever, that is, a streptococcus fever, and is not caused by the tubercle bacillus.

Of all irregular and intangible fevers la grippe heads the list. The germs of this disease can cause a typical chill which is followed by a high fever that lasts two or three days and is followed by more or less nervous depression and by catarrhal symptoms; but the vaso-motor system is profoundly affected, often for a long time, and irregular chills, shiverings, hot flashes, and even hemorrhages from the mucous membranes may occur. In no fever is the insomnia so noticeable as in influenza, undoubtedly due to the inability of the blood-vessels of the abdomen properly to dilate and thus relieve the cerebral congestion and produce sleep—in other words, a general vaso-motor ataxia is present.

Fevers are classified as: (1) Continued, (2) remittent, and (3) intermittent, according to the character of the temperature range.

A continued fever is one in which there is but slight deviation in the temperature line. A remittent fever is distinguished by intense paroxysms. In the intermittent type we have paroxysms of fever with absolute intermissions, or periods of apyrexia.

Fevers are also sometimes classed as dynamic or sthenic, and as adynamic or asthenic, in accordance with the tone of the heart and nervous system.

Sthenic fever is characterized by a hard, full pulse, a flushed face, and often active delirium. The crisis in these cases is generally positive and short.

In an asthenic fever the pulse is from the beginning feeble and compressible, the skin is pale and often moist, the respiration troubled, and if there is delirium it is of the low muttering type, and the patient seems to die rather from exhaustion than from the lethal power of the disease.

To study the range of temperature carefully in a given case of fever the thermometer should be used at perfectly regular intervals.

Fevers are often divided into four stages: First, a period of incubation extending from a few hours to a week; second, the stage of invasion; third, the fastigium, or stage of greatest power of the disease; fourth, the stage of declination or defervescence.

The stage of invasion may be ushered in by a chill or by shiverings, and in the case of children often by convulsions, or by vomiting, or by both. The surface of the body, especially the extremities, tip of nose, etc., is cold for a short period, this stage being soon followed by myalgias, constipation, loss of appetite, thirst, and a more or less heavily coated tongue. The stage following is one in which the temperature and pulse become higher and higher. This stage terminates either by crisis or lysis. In crisis the temperature falls in the course of from twenty-four to thirty-six hours to the normal, and the other symptoms undergo a similar decline. Such a sudden decline of the fever may be attended by shock; hence this period is one of considerable danger. At this time we may expect hemorrhages, diarrhœa, profuse perspiration, weak heart, and collapse. The course of a lobar pneumonia furnishes the best example of a fever ending by crisis.

When the declination is by lysis, several days are generally occupied in the process, the morning remissions becoming more pronounced from day to day and the evening rise being less than that of the day before. This is typical of the declination of typhoid fever.

A sudden fall of temperature at an unexpected time in the disease shows that something serious is taking place, and is almost always a bad omen. A sudden rise, on the other hand, generally shows that some complication has occurred, and the case must then be carefully studied.

Before we consider the necessity of treating a fever, —that is, of simply lowering the temperature of the patient's body,—we should analyze its cause and should carefully weigh the danger, if any, which threatens the individual. In the first place, it is a question whether the fever does not represent nature's method of combating the harmful influence of the toxic products of the disease germs. On the other hand, however, there must be taken into consideration the question of how much fever the human body can safely bear. It is permissible to state that the system can sustain for a short time a temperature of 105°, or even 106° F., without danger or damage, while a long-continued temperature of 101° F. or over seriously threatens the integrity of the heart, muscles, and nervous system. With a short-lived fever, as of a malarial paroxysm, or the grippe, or a cold, if the fever is high it may cause some symptoms that are very uncomfortable and may call for some treatment, but the temperature as such requires no treatment.

The symptoms of high fever are myalgia, especially backache, generally localized in the lumbar region, headache, rapid heart action, and quickened respiration. Delirium may or may not occur, according as the patient is or is not susceptibile to irritation from cerebral congestion. The tongue is dry, and the mouth and lips are parched, not only from the fever, but from the mouth-breathing that is present if the lungs are much congested by a disturbed circulation. The surface vessels are more or less contracted as shown by the dry skin and the tendency to hemorrhages manifested by the mucous membrane. The internal organs, especially the liver and spleen, generally become congested. The liver thus becomes impaired in its power to produce materials protective against the toxins, and hence is unable either to render the poisons of the specific germs innocuous or to neutralize the effects of the toxins which are absorbed from the intestines.

Furthermore, owing to its congested state, the liver will secrete a diminished amount of bile, and thus there will be established a tendency to constipation and to fermentation in the intestinal canal. These changes, coupled with those which follow the diminished production of hydro-

chloric acid in the stomach, may lead to vomiting and to intermittent diarrhœa.

Aside from the fact that it easily becomes congested we cannot state what effects are produced in the spleen by fever.

From what has already been stated it is apparent that no serious harm can come to the organism provided the fever be short-lived. Hyperæmias give place to normal vascular conditions, toxins are eliminated, and all that we need do is to hasten nature's cure by increasing the loss of heat through the employment of any measures which tend to relax the peripheral blood-vessels and to cause perspiration. It is also possible that, in the effort to secure this result, we may derive some aid from the administration of a cathartic or from cold applications to the head.

If, on the other hand, the fever is a continued one, or even continuous for a few days, then we must analyze the condition. If we decide that this amount of fever is due to the specific germ and its associated local inflammatory conditions, our duty is to keep the patient as quiet as possible. The importance of this becomes apparent when we consider that every excitement causes restlessness, and this in turn means muscle movements through which heat production is increased. Hence it will frequently be necessary to give hypnotics. The bowels should be daily moved, not only for the relief of the liver, but to prevent fermentation, decomposition, and the absorption of all of the products of bowel infection. A carefully regulated ingestion of iced or cold water also tends to diminish the temperature, but if the latter still keeps too high we can, in short fevers, reduce it by means of the coal-tar products, cautiously administered in appropriate doses, or, in long-continued fevers, by cold applications.

If the body-temperature is so high as to be dangerous to life, even though brief in duration, as occurs in insolation, no treatment is as successful as immersion in cold water made gradually colder by ice. If the heart can withstand the previous high temperature, under this treatment the vaso-motor system recovers and heat control is re-established.

If after careful survey of the case we decide that the fever is in excess of that due to the disease *per se*, we must search for the additional cause, and with each disease we know where to seek its local manifestations. In the varied local inflammations such an abnormally high body-temperature generally indicates the formation of pus, as in appendicitis, pleuritis, synovitis, or otitis media. In typhoid fever and dysentery it means ulcerations with decomposing membrane and sloughing, and the absorption of toxins and pus products. In tuberculosis it means some closed up or incompletely evacuated pus cavity,—*i.e.*, streptococcus fever. In diphtheria, in follicular tonsillitis, and in scarlet fever it means a putrid exudation, a decomposing membrane, and a poorly cleansed throat.

While it is good treatment to keep the bowels free from fermentation and putrefaction in all short-lived fevers, it is absolutely essential in typhoid fever, and any treatment that gives free daily movements of the bowels in this disease will favorably modify the course of the fever. In typhoid fever constipation keeps the partially digested milk or other nutriment long in the intestines, and the mucous deposits and ulcerative sloughs long remaining *in situ* become most productive culture grounds for all sorts of bacilli and cocci, and the colon bacillus is often stimulated to migrate. Also fermentation increases, gas is formed, and tympanites, with the danger of perforation and hemorrhage from distention, readily occurs. We then have secondary infection with high fever and cerebral toxæmia.

If every local inflammation that develops in the course of any fever is kept as clean as possible, if the skin is kept in good condition by hot or cold sponging as the case may require, if plenty of water is given to drink, and if the bowels are kept nicely opened, there will be very little call for the use c. so-called antipyretics, and the non-use of such drugs will allow a more careful study of the temperature curve, and therefore a better understanding of the case.

Oliver T. Osborne.

FIBRINOUS BRONCHITIS.—(Synonyms: Croupous, exudative, plastic, pseudo-membranous, bronchitis; Ger., *Bronchialcroup, croupöse Bronchitis*; Fr., *Bronchite pseudo-membraneuse.*)

Definition.—An acute or chronic inflammatory affection of the bronchial mucous membrane characterized by the deposit of plastic matter which becomes detached and is expectorated in the form of moulds or casts of a more or less extensive portion of the bronchial tree.

Classification.—A distinction must be made between true fibrinous bronchitis, a comparatively rare disease, and those conditions in which the expectoration of similar moulds results from (1) an accumulation of clotted blood in the bronchi, as in hæmoptysis, (2) the extension of a plastic formation from the upper respiratory passages, as in diphtheria, or (3) the upward extension of the fibrinous exudate in acute pneumonia. The term bronchial polypus was applied to all these conditions, as well as to the disease under consideration, by many of the earlier writers from Galen [1] down to Laënnec [2] and Cheyne [3]; many indeed regarded the casts as pieces of flesh. Cheyne was one of the first to make a distinction between casts of hemorrhagic origin, mere coagula of blood "moulded into shape by the bronchial vessels," and those due to an inflammatory process.

Strümpell [4] classifies the disease into a true, essential form, or that which attacks persons who were previously healthy, and a secondary, symptomatic form, which occurs in those who have already suffered from some other disease, especially chronic pulmonary affections. An acute and a chronic form are recognized, but, although they differ very obviously, it is not always possible to assign a present case to one or the other class until its full clinical history has been revealed.

Etiology.—No specific etiological factor has been determined. It is quite probable that the exciting cause is not the same in all instances, so various are the conditions under which the disease occurs. It is encountered at all times of life from infancy to old age, but seldom before the tenth or after the fortieth year. Hayn [5] records a case with autopsy in a new-born child, and W. R. Brown [6] saw it in a man of seventy-four years, with recovery. The essential form is not frequent in childhood, many reported cases having been merely complications of diphtheria. Morrill [7] states that of seventy-six cases only eleven occurred in children of twelve years or under. It is about twice as frequent in men as in women, but attacks male and female alike in childhood. More cases have been observed in England, Germany, and Switzerland than in France, Italy, or the United States, and in the late springtime than at any other season (April and May—Beschorner; May and June—Eichhorst). More than one member of the same family has been attacked—Watson's two cases were in brothers,[8]—and Pichini [9] observed three simultaneous cases; but neither hereditary nor endemic influences have been demonstrated. Personal idiosyncrasy is probably a more important factor (Mason [10]). Robust individuals are sometimes attacked, but more frequently those who have been debilitated by some previous illness such as typhoid fever, pneumonia, measles, scarlatina, or other acute infection. The disease has occurred during pregnancy and in the course of typhoid fever, and the menstrual periods have apparently borne some etiological relation to it in some cases. The recurrences in Schnitzler's case of twenty-four years' duration occurred regularly for several years at the menstrual periods, but continued long after the menopause. Its association with such cutaneous affections as impetigo, herpes, and pemphigus has been repeatedly observed. Most of the subjects have been anæmic, and many have been the victims of syphilis, tuberculosis, rickets, or alcoholism. Six of Model's seven cases were tuberculous.[11] Its association with other diseases has no doubt been merely accidental in many in-